

# What Does a Public Option Do?

## Evidence from California

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### Abstract

Creating a public firm to compete with private firms is an increasingly debated intervention to address inefficiency in concentrated markets. I develop a mixed oligopoly model with alternative firm objectives and estimate it with consumer-level data from the California insurance exchange, where one-third of consumers have access to a public firm. In the best-fitting model, the public firm places more weight on consumer surplus than producer surplus. Adding a public firm decreases premiums, improves welfare in concentrated markets, and increases surplus the most for disadvantaged subpopulations. Enhancing subsidies for private plans, a leading alternative intervention, increases premiums and reduces welfare.

Keywords: Mixed oligopoly, adverse selection, health insurance.

JEL Codes: I11, I13, L51, L88, H51

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Governments often intervene in sectors such as agriculture, education, energy, and health care that are perceived to be socially consequential, but suffer from high prices and an underprovision of goods and services. Government interventions can take many forms. Nationalization of entire industries, such as the National Health Service in the U.K. or the proposed “Medicare-for-all” in the U.S., is the most extreme intervention. A less intrusive intervention is the provision of subsidies for purchasing goods and services from private firms, such as tax credits for electric vehicles, child care, and health insurance in the U.S. A third approach that has received increased attention is the introduction of a public firm that competes directly with private firms.

A market where at least one firm has an objective function that diverges from the objectives of the other firms is termed a mixed oligopoly (De Fraja and Delbono, 1990; Matsumura, 1998; Casadesus-Masanell and Ghemawat, 2006). De Fraja and Delbono (1990) review the theoretical literature where profit-maximizing firms compete with a public firm that maximizes some other objective, usually a weighted combination of consumer and producer surplus. Competition between public and private firms occurs in numerous industries. The United Parcel Service (UPS) and FedEx Corporation (FedEx) coexist with the U.S. Postal Service by offering faster and often more reliable shipping at a higher price point. Private teaching hospitals can compete with public hospitals by providing higher quality of care and offering more advanced treatments. Private schools coexist with public schools by promising more individual attention and a tailored education; the impact of voucher programs for private schools has been the subject of a well-developed literature (Abdulkadiroğlu et al., 2011; Chetty et al., 2014; Epple et al., 2017).

In this paper, I study the equilibrium and social welfare implications of creating a public firm that competes with private firms. Adding a public firm involves important welfare tradeoffs. Consumers may benefit from greater product variety and lower prices from increased competition. However, increased competition may lead some firms to suffer losses and exit the market. The public firm’s financial performance is also welfare-relevant. How these offsetting effects of adding a public firm ultimately impact social welfare depends on many factors, including the market’s existing level of competition, the public firm’s objective, consumer preferences for the public firm, and the policy environment. Adding a public firm is likely to have a larger impact in markets where existing competition is weak. A public firm with a more altruistic objective that diverges from profit maximization may also have a larger impact. However, these effects could be mitigated if consumers have strong brand preferences or consumer choices are “sticky.” Policies such as subsidization programs and regulation on products or prices could also dampen the impact of a public firm.

Because of these theoretical complexities, I develop a novel empirical framework for estimating a mixed oligopoly model. My framework allows for heterogeneity in consumer preferences for the

public firm's products and accommodates a wide range of public firm objectives, cost structures, and design features. I apply my empirical framework to U.S. health insurance markets, which often suffer from weak competition and high premiums that limit access to health insurance for millions of Americans. My model explicitly accounts for the principal health insurance market failures, including asymmetric information, firm market power, and consumer inertia. I also incorporate key health insurance policies such as regulation on price discrimination (known as community rating), the individual mandate for purchasing insurance, premium-linked subsidies, and risk adjustment.

I study the creation of a public firm in health insurance by exploiting consumer-level enrollment data from the Affordable Care Act (ACA) exchange in California. In this setting, residents in three California counties, accounting for approximately one-third of California exchange consumers, had access to a public firm run by their county governments. Heterogeneity in access to the public firm across neighboring county markets provides a source of plausibly exogenous variation for identifying consumer preferences for public firm plans. It also allows me to compare standard oligopoly markets with mixed oligopoly markets where the participating private firms are the same and government regulations are consistent across markets.

I combine my consumer-level enrollment data with data on plan costs from insurer rate filings to assess the fit of mixed oligopoly models with alternative specifications of the public firm's objective. In the best-fitting model, the public firm places 63% weight on consumer surplus and 37% weight on firm profit. Consumers are willing to pay an average of \$39 or 8.9% more in premiums for a private firm plan relative to a public firm plan, controlling for observables. Older and higher-income consumers have a much higher willingness-to-pay for a private plan, whereas Hispanic and African American consumers have a negative willingness-to-pay for a private plan and therefore prefer public plans, all else equal. Racial minority preferences for public firm plans could be the result of tailored provider networks or targeted community outreach efforts by the public firm. My findings suggest the public firm plays a key role in expanding insurance to disadvantaged subpopulations.

I use the best-fitting mixed oligopoly model to simulate the impact of introducing a public firm (with the same objective, cost structure, and product design as it currently exists in California) to five markets in California without a public firm. Two main results emerge: (1) adding a public firm *improves* social welfare in markets with limited competition, but *reduces* social welfare in markets with robust competition and (2) disadvantaged subpopulations benefit most from the addition of a public firm. First, the reduction in equilibrium premiums from adding a public firm depends on the existing level of competition. Average premiums fall by 21.2% in a rural market comprised of Monterey, Santa Cruz, and San Benito Counties where existing competition is weak, but by only 2.7% in urban San Diego County where competition is already strong. In Monterey, Santa Cruz, and

San Benito, annual per-capita social welfare increases by \$462 because the large premium decreases generate consumer surplus gains and savings in government subsidy spending that are sufficiently large to offset lower private firm earnings and public firm operating losses. Conversely, annual per-capita social welfare decreases by \$261 in San Diego because the modest premium declines generate consumer surplus gains and subsidy savings that are too small to offset lower private firm earnings and public firm operating losses. Second, adding a public firm increases African American enrollment by 10.5% and Hispanic enrollment by 10.6%. Annual per-capita consumer surplus increases \$250 for African American consumers and \$236 for Hispanic consumers. The larger surplus gains for these racial minority groups is the result of their preferences for public firm plans.

I apply my estimated empirical framework to evaluating proposals for a public option in health insurance. Discussion of adding a public firm in health insurance, often referred to as the “public option,” featured prominently in the original debate over the Affordable Care Act (ACA) and was resurrected during the 2020 presidential campaign by President Biden. Most recently, four separate bills for a public option were proposed during the 117<sup>th</sup> Congress. Colorado, Nevada, and Washington, have added or will add a version of a public option to their states’ ACA exchanges. Design of the public option, including how it sets premiums, negotiates with providers, and determines plan quality, varies widely across policy proposals. All public option proposals share the goals of reducing premiums and expanding access to health insurance by stimulating competition. I simulate several alternative designs of a public option to understand the economic tradeoffs and welfare implications of each design. I first consider adding a profit-maximizing private firm instead of an altruistic public firm. I find substantially smaller equilibrium premium reductions when adding a profit-maximizing private firm, resulting in less favorable shifts in welfare. Hence, the public firm’s altruistic objective plays a key role in determining its impact. Second, I consider adding a strong public firm that can negotiate “Medicare-like” reimbursement rates. I find significantly larger premium reductions, but welfare declines because consumer surplus gains are insufficient to offset earnings reductions and the costs of unreimbursed claims. The final design alternative investigates the degree to which inertia protects incumbent private firms from the public firm. I find inertia is a key source of firm market power that partially insulates private firms from entry of a public firm.

An alternative intervention to the public option is to provide enhanced subsidies for purchasing plans from private firms. The American Rescue Plan Act of 2021 (ARP) enhances premium subsidies available to ACA exchange consumers.<sup>1</sup> I use my model to simulate the impact of ARP subsidies. Although ARP subsidies reduce average subsidized premiums, average premiums before subsidies *increase* due to incomplete pass-through. Annual per-capita social welfare decreases be-

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<sup>1</sup>The ARP enhances subsidies for two years. The Inflation Reduction Act extends ARP subsidies through 2025.

cause the increases in consumer surplus and firm profit are insufficient to offset the government's higher subsidy spending. Adding a public option compares favorably with enhancing premium subsidies because the former policy increases supply, whereas the latter policy increases demand.

My work makes two methodological contributions to the literature. First, I develop a framework for estimating a mixed oligopoly model with alternative objectives. Previous work studies alternative regulator objectives ([Wolak, 1994](#); [Timmins, 2002](#); [Gagnepain and Ivaldi, 2002](#); [Abito, 2014](#); [Lim and Yurukoglu, 2018](#)) and nonprofit firm objectives, particularly in the hospital industry ([Newhouse, 1970](#); [Pauly and Redisch, 1973](#); [Steinberg, 1986](#); [Malani et al., 2003](#); [Lakdawalla and Philipson, 2006](#); [Gaynor et al., 2015](#); [Philipson and Posner, 2009](#); [Horwitz and Nichols, 2009](#); [Dranove et al., 2017](#); [Chang and Jacobson, 2017](#); [Capps et al., 2020](#)). I extend this work by estimating the non-profit-maximizing agent's objective in a mixed oligopoly setting. Second, my approach for counterfactual simulations overcomes a significant computational challenge in correctly endogenizing risk adjustment, improving upon the approaches in [Saltzman \(2021\)](#) and [Tebaldi \(2022\)](#).

I also make several empirical contributions. First, I provide novel evidence (to the best of my knowledge) that adding a public firm improves social welfare in rural markets with limited competition and provides the largest consumer surplus gains to disadvantaged subpopulations. Second, my model provides a comprehensive framework for studying how a broad range of proposed public option design features may affect its impact, unifying many of the potential impacts of a public option considered in previous theoretical ([Shepard et al., 2020](#); [Fiedler, 2020](#)) and microsimulation analyses ([Blumberg et al., 2019](#); [Liu et al., 2020](#)). Recent related work by [Craig \(2022\)](#) uses a model of demand and supply in an employer setting to simulate the impact of alternative public option designs. I extend his analysis by endogenizing both consumer preferences for the public firm and public firm objectives and using data on the experience of public firms in the ACA exchanges to estimate preferences and objectives. Third, I show adding a public firm compares favorably with enhancing premium subsidies because subsidies create inefficiencies identified in the previous literature ([Decarolis, 2015](#); [Decarolis et al., 2020](#); [Jaffe and Shepard, 2020](#); [Polyakova and Ryan, 2021](#)). Finally, I contribute to the literature studying the ACA exchanges ([Sen and DeLeire, 2018](#); [Domurat, 2018](#); [Diamond et al., 2021](#); [Drake, 2019](#); [Panhans, 2019](#); [Einav et al., 2019](#); [Polyakova and Ryan, 2021](#); [Tebaldi, 2022](#)) by highlighting the relationship between competition and welfare.

This paper is organized as follows. Section 1 estimates consumer preferences for the public firm. Section 2 evaluates alternative public firm objectives. Section 3 simulates the impact of adding a public firm. Section 4 analyzes design features of public option proposals. Section 5 concludes.

# 1 Consumer Preferences for the Public Firm

My goals in this section are to (1) identify which consumer types are most likely to choose the public firm and (2) distinguish whether choice of the public firm is attributable to observable plan characteristics, such as premiums and the provider network, or unobservable plan characteristics, such as stigma or customer service. The first subsection describes the data, the second subsection presents descriptive evidence, the third subsection develops a model, the fourth subsection discusses estimation, and the fifth subsection presents the results.

## 1.1 Data

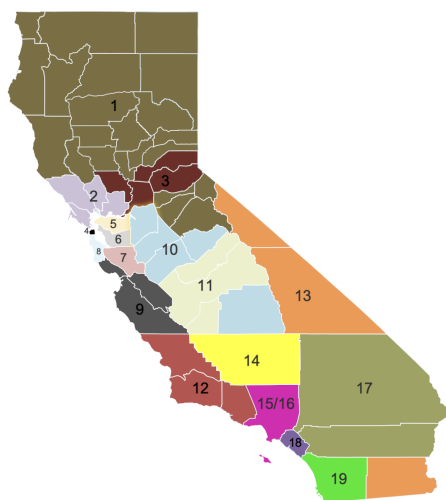
My demand-side data come from two primary sources: (1) California’s ACA exchange (called Covered California) and (2) the American Community Survey (ACS) ([Ruggles et al., 2022](#)). I obtain administrative data on consumer-level enrollment through a California Public Records Act (PRA) request. There are approximately 10 million records covering every exchange enrollee between 2014 and 2019 in my data. Enrollees in plans offered in the individual market but off the exchange (commonly referred to as “off-exchange plans”) are not included. The administrative data indicate each consumer’s chosen plan and key enrollee characteristics that enable me to define every household’s complete choice set and the household-specific premium for each plan in its choice set. I merge the enrollment data with plan provider network directories that were obtained through a second PRA request from Covered California. These directories list the national provider identifiers (NPIs) and hospitals that participate in each plan’s network.<sup>2</sup> To construct the outside option population (i.e., those forgoing insurance), I use consumer-level survey data on the uninsured from the ACS between 2014 and 2019. All household characteristic variables available in the Covered California data are also available in the ACS. I combine individuals from the Covered California administrative data with individuals from the ACS survey data to form the universe of consumers. ACS consumers are assigned weights equal to the representative sampling weights in the ACS, whereas Covered California consumers are assigned weights equal to 1.

Between 2014 and 2019, there was a public firm competing with private firms in 3 of the 19 markets or rating areas: Santa Clara (rating area 7), East Los Angeles (rating area 15), and West Los Angeles (rating area 16). Residents of Contra Costa (rating area 5) could also purchase plans from a public firm in 2014. Figure 1 shows the 19 rating areas in California and Table 1 indicates average annual enrollment and firm participation by market. Approximately one-third of Covered California enrollees reside in the rating areas with a public firm.

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<sup>2</sup>The provider networks for two insurers – Contra Costa and United – are not available in the directories.

Figure 1: California Rating Regions



Notes: Figure shows the partition of California's 58 counties into 19 rating areas ([Department of Managed Health Care, 2016](#)). Several rating areas (1, 10, and 13) are not contiguous and Los Angeles County is divided into two rating areas (15 and 16).

The public firms operating in Covered California are the Local Initiative Health Authority for Los Angeles County (L.A. Care), Valley Health Plan (Valley), and Contra Costa Health Plan (CCHP). Although independent, the three public insurers are fairly similar in their origins and business practices. All three public firms existed long before creation of the California exchange and exclusively sell HMO plans that target low-income and disadvantaged subpopulations. L.A. Care was established in 1997 and offers plans through Medicaid/CHIP, Medicare Advantage, and Covered California. L.A. Care's goal is to "provide access to quality health care for Los Angeles County's vulnerable and low-income communities and residents and to support the safety net required to achieve that purpose."<sup>3</sup> Owned and operated by the County of Santa Clara, Valley was established in 1985 and offers insurance through employer-sponsored insurance and Covered California. One of Valley's principal values is to "embrace a commitment to ensuring that our members are treated with dignity and respect, and the importance of insuring health equity in both treatment and outcomes."<sup>4</sup> Established in 1973, CCHP first offered coverage through Medicaid and then expanded to employer-sponsored insurance and Covered California. CCHP's mission is to "serve the low-income and vulnerable population through safety net providers." After participating in Covered California in 2014, CCHP exited due to new regulatory guidance from the Centers for Medicare and

<sup>3</sup><https://www.lacare.org/about-us/about-la-care/mission-vision-and-values>

<sup>4</sup><https://www.valleyhealthplan.org/about-us>

Medicaid Serves (CMS) that prevented it from offering competitive rates to its target population.<sup>5</sup>

Table 1: Firm Participation by Market

Rating Area	Counties	Average Annual Enrollment	Public Insurers Present	Regional Private Insurers Present
1	Northern Counties	60,722		United**
2	North Bay Area	60,604		Western
3	Greater Sacramento	90,433		Western
4	San Francisco	44,780		Chin. Comm., Oscar
5	Contra Costa	49,014	CCHP*	
6	Alameda	75,678		
7	Santa Clara	72,510	Valley	
8	San Mateo	29,760		Chin. Comm.
9	Monterey, Santa Cruz, San Benito	33,842		United**
10	Central Valley	77,550		
11	Fresno, Kings, Madera	36,801		United**
12	San Luis Obispo, Santa Barbara, Ventura	73,832		United**
13	Imperial, Inyo, Mono	12,211		Molina, United**
14	Kern	21,169		
15	East Los Angeles	200,788	LA Care	Molina, Oscar
16	West Los Angeles	243,186	LA Care	Molina, Oscar
17	Riverside, San Bernardino	142,412		Molina
18	Orange	157,319		Molina, Oscar
19	San Diego	140,872		Molina, Sharp

Notes: Table shows the firms that participated at any point between 2014 and 2019 in each of California's 19 rating areas. Four insurers – Anthem, Blue Shield, Health Net, and Kaiser – participated in nearly all rating areas in all years and are not shown in the table above. The public insurers include CCHP, LA Care, and Valley. The regional private insurers include Chinese Community, Molina, Oscar, Sharp, United, and Western. (\*) CCHP only participated in 2014 and (\*\*) United only participated in 2016.

## 1.2 Descriptive Evidence

My data indicate important differences exist between the insurers' enrollee populations. Figure 2 summarizes enrollee characteristics in the markets where a public firm was available. The public insurers' enrollee populations disproportionately draw from low-income and disadvantaged communities, consistent with the public insurers' mission statements. About 75.1% of the public insurers' enrollees have income below 250% of the federal poverty level (FPL), whereas only 67.4% of the large private insurers' enrollees and 71.5% of the regional private insurers' enrollees have income below 250% of FPL.<sup>6</sup> Consumers with income above 400% of FPL account for only 6.8%

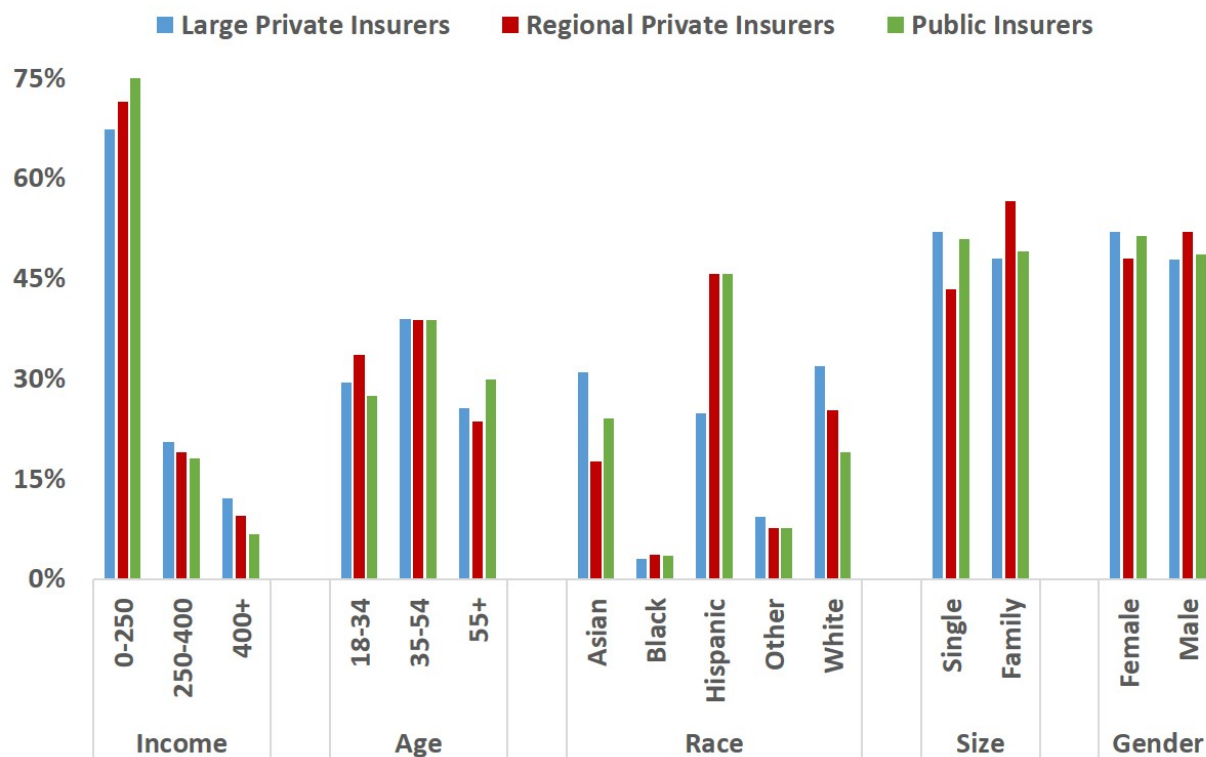
<sup>5</sup><https://cchealth.org/healthplan/pdf/Exchange-FAQs.pdf>

<sup>6</sup>Large private insurers include Anthem, Blue Shield, Health Net, and Kaiser. Regional private insurers include Molina and Oscar. The federal poverty level is adjusted each year and varies with household size. The federal poverty level (i.e., 100% of FPL) was \$11,490 for a single person and \$23,550 for a family of four in 2014. The federal poverty level was \$12,490 for a single person and \$25,750 for a family of four in 2019.



of the public insurers' enrollees, but 12.1% of the large private insurers' enrollees. Non-Hispanic whites make up 18.9% of public insurers' enrollees, but 31.9% of large private insurers' enrollees and 25.4% of regional private insurers' enrollees. Public insurers' enrollees also skew slightly older. Gender and family size differences between the insurers are relatively small.

Figure 2: Enrollee Characteristics By Insurer Category



Notes: Figure summarizes enrollee demographic characteristics for the large private insurers (Anthem, Blue Shield, Health Net, and Kaiser), regional private insurers (Molina and Oscar) and public insurers (CCHP, LA Care, and Valley) in the counties where the public firm is available. Each bar corresponds to the share of enrollees within each insurer category with the given demographic. Income is measured as a percentage of the federal poverty level.

Figure 3 compares silver plan premiums and market shares over time in Santa Clara, East Los Angeles, and West Los Angeles. The four actuarial value (AV) or “metal” tiers include bronze (60% AV), silver (70% AV), gold (80% AV), and platinum (90%).<sup>7</sup> Every Covered California insurer must offer a plan in each metal tier; plans within a metal tier are standardized to have the same cost sharing parameters (e.g., deductible, copays, etc.). A majority of consumers choose silver

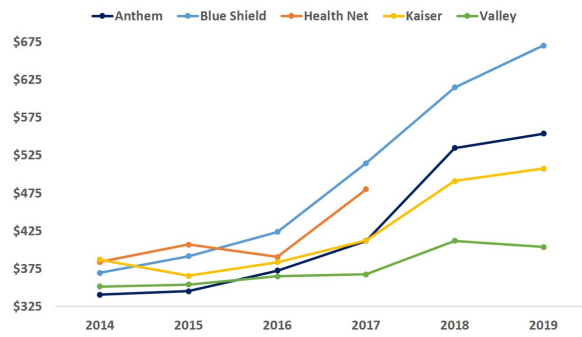
<sup>7</sup>The actuarial value of a plan is the expected share of enrollee claims that the plan will cover given the plan’s deductible, copays, coinsurance, etc.

because consumers must purchase a silver plan to receive cost sharing reductions (CSRs). Several important insights emerge from Figure 3: (1) consumers are highly sensitive to premiums; (2) the public insurers initially set similar premiums to the private insurers and had little market share, but then set relatively lower premiums and gained substantial market share; and (3) premiums alone cannot explain consumer choices. Evidence of high sensitivity to premiums is present in all three markets. In 2014, Anthem had the lowest silver premium and 62.2% market share in Santa Clara. Over the next five years, Anthem's silver premium increased 62.7%, making it the second-most expensive in Santa Clara, and its market share plummeted to 10.1%. In East and West Los Angeles, Anthem's increasing premiums also resulted in substantial market share declines before its exit in 2018. Molina's market share in both East and West Los Angeles peaked in 2017 when it had the lowest silver premiums. However, Molina raised premiums the following year by 62.1% in East Los Angeles and by 52.4% in West Los Angeles. As a result, Molina's market share fell from 13.3% to 1.2% in East Los Angeles and from 21.8% to 4.4% in West Los Angeles.

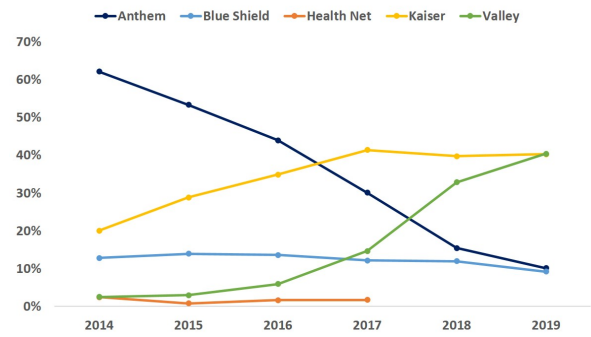
During the ACA's initial years, the public insurers set similar premiums to the private insurers. Valley sold the second-cheapest silver plan in Santa Clara in 2014, approximately 3.3% more expensive than Anthem's premium, and its market share was 2.5%. In 2014, LA Care sold the second-cheapest silver plan in East Los Angeles and third-cheapest silver plan in West Los Angeles; its silver plan market shares were 1.6% in East Los Angeles and 2.0% in West Los Angeles. Starting in 2016, Valley's silver plan became the cheapest and its relative premium continued to decline compared to the private insurers. Valley's silver premium in 2019 was 20.5% cheaper than Kaiser's, 27.1% cheaper than Anthem's, and 33.9% cheaper than Blue Shield's. Valley achieved 40.4% market share in 2019, exceeding Kaiser's 40.2% market share. In Los Angeles, LA Care became the cheapest insurer in 2018 because of Molina's aggressive pricing in 2017. LA Care's market share increased to 18.6% in East Los Angeles and 32.1% in West Los Angeles by 2019.

Although premiums are a key component of consumer preferences, the descriptive evidence in Figure 3 suggests other, potentially unobserved plan characteristics may be driving consumer plan choices (note that plan generosity is held constant in Figure 3). In Santa Clara, about as many consumers chose Kaiser as Valley in 2019, despite Valley's silver plan being 20.5% cheaper. Blue Shield's market share was relatively steady between 2014 and 2019, despite its silver plan costing only 5.1% more than Valley's in 2014 and 66.1% more than Valley's in 2019. In West Los Angeles, Blue Shield's market share was relatively steady at just under 25% between 2014 and 2019, despite its silver plan costing only 9.4% more than LA Care's in 2014 and 45.7% more than LA Care's in 2019. In both Santa Clara and West Los Angeles, Kaiser gained market share throughout the study time frame despite increasing pricing pressure from the public insurer. In East Los Angeles,

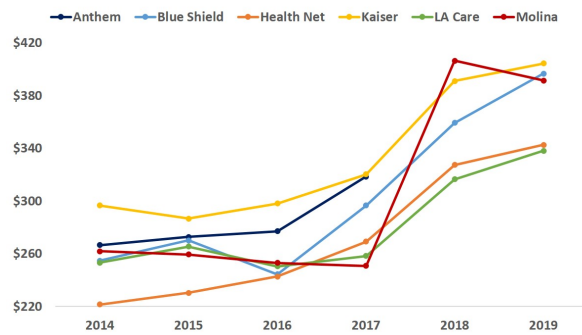
Figure 3: Average Premiums and Market Shares By Insurer and Year



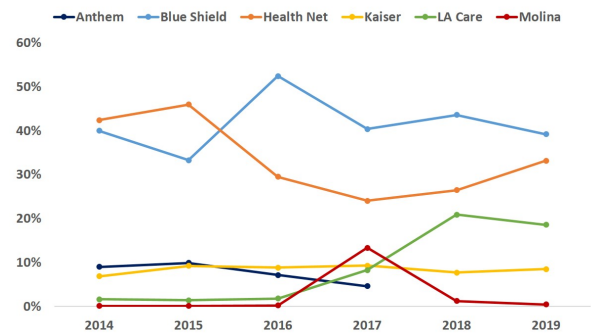
(a) Silver Premiums (Santa Clara)



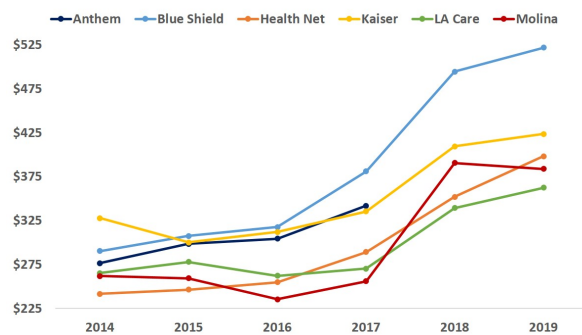
(b) Silver Market Shares (Santa Clara)



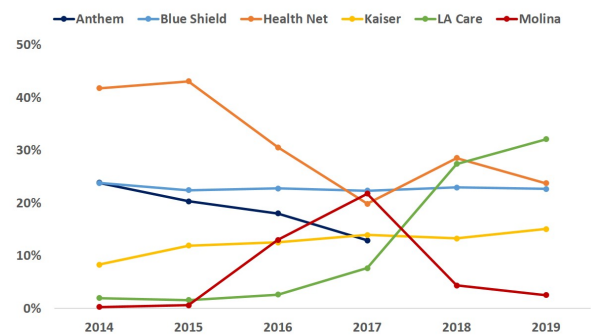
(c) Silver Premiums (East Los Angeles)



(d) Silver Market Shares (East Los Angeles)



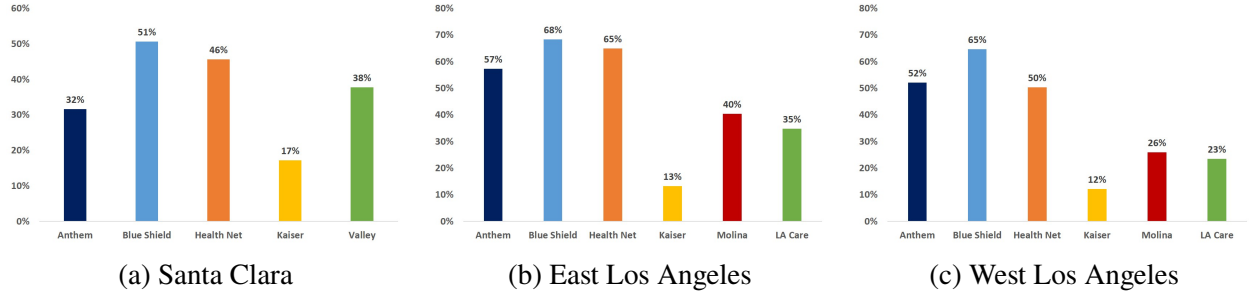
(e) Silver Premiums (West Los Angeles)



(f) Silver Market Shares (West Los Angeles)

Notes: Figure shows silver premiums and market shares by insurer and year for Santa Clara County (rating area 7), East Los Angeles County (rating area 15), and West Los Angeles County (rating area 16). I report each insurer's silver premium for a 40-year-old (the premium for all other ages is proportional to the 40-year-old premium and can be obtained using the CMS age rating curve). For insurers that offer multiple silver plans (e.g., an HMO plan and a PPO plan), I report a weighted average silver premium using enrollee plan shares. I omit Oscar from the Los Angeles County figures because it only participated in the later years and never had more than 4% silver market share.

Figure 4: Provider Network Breadth By Insurer



Notes: Figure shows provider network breadth by insurer for Santa Clara County (rating area 7), East Los Angeles County (rating area 15), and West Los Angeles County (rating area 16). Provider network breadth is the percentage of physicians that are covered within a consumer's market.

Kaiser's market share remained relatively steady at just under 10% despite being the most expensive insurer in every year except 2018.

Figure 4 compares the firms' provider networks. I calculate provider network breadth as the percentage of physicians that are covered within a consumer's 3-digit zip code. Overall, the public firms offer provider network breadth that is on the lower end of the range of the private firms' network breadth. The public firm's network breadth is 38% in Santa Clara, 35% in East Los Angeles, and 23% in West Los Angeles. Blue Shield and Health Net have substantially higher network breadth than the public firms, whereas Kaiser has lower network breadth because of its vertically-integrated, staff HMO model. To the extent network breadth is a measure of plan quality, the public firms may offer relatively lower quality than many of the private firms.

### 1.3 Model

Households choose the plan that maximizes their (indirect) utility

$$U_{ijt} \equiv \beta_i^p p_{ijt}(\mathbf{p}_t) + \beta_{ij}^y y_{ij(t-1)}(\mathbf{p}_{t-1}) + \beta_i^w w_j + x'_{ij} \beta^x + \xi_j + \epsilon_{ijt}^d \quad (1)$$

or choose to forgo insurance and realize utility  $U_{i0t} \equiv \beta_i^p \rho_{it} + \epsilon_{i0t}^d$ . The vector  $\mathbf{p}_t$  is the plan base premiums in year  $t$ ,  $p_{ijt}(\mathbf{p}_t)$  is consumer  $i$ 's premium for plan  $j$  as a function of the plan base premiums in year  $t$ ,  $y_{ij(t-1)}$  is an indicator for the household's choice in year  $t - 1$  as function of the plan base premiums in year  $t - 1$ ,  $w_j$  is an indicator of whether the plan is sold by a private firm,  $x_{ij}$  is a vector of observable non-premium plan characteristics such as the brand, plan AV, and network type,  $\xi_j$  is unobserved plan characteristics,  $\rho_{it}$  is the household-specific penalty for not having insurance, and  $\epsilon_{ijt}^d$  is an error term. The premium parameter  $\beta_i^p = \beta^p + z'_{it} \phi$  is a function of

household characteristics  $z_{it}$ , the inertia parameter  $\beta_{ij}^y = \beta^y + x'_{ij}\kappa + z'_{it}\nu$  is a function of plan and household characteristics, and the private plan parameter  $\beta_i^w = \beta^w + z'_{it}v$  is a function of household characteristics. The private plan parameter  $\beta_i^w$  represents the additional utility household  $i$  obtains from choosing a private plan ceteris paribus, assuming  $w_j$  is uncorrelated with unobservables  $\xi_j$ . Alternatively, the negative of the private plan parameter  $-\beta_i^w$  is the disutility or “stigma” that household  $i$  realizes from choosing a public plan. The household’s premium  $p_{ijt}(p)$  is

$$p_{ijt}(p) = \max \left\{ \underbrace{\sigma_{it}p_{jmt}}_{\text{full premium}} - \underbrace{\max\{\sigma_{it}p_{bmt} - \zeta_{it}, 0\}}_{\text{premium subsidy}}, 0 \right\} \quad (2)$$

where  $\sigma_{it}$  is the household’s rating factor,  $p_{jmt}$  is the base premium of plan  $j$  in market  $m$  and year  $t$ ,  $p_{bmt}$  is the base premium of the benchmark plan, and  $\zeta_{it}$  is the household’s income contribution cap. The product of the rating factor and the base premium is the household’s full premium.

Equations (1)-(2) include the key ACA demand-side policies, including (1) modified community rating; (2) premium subsidies; (3) cost sharing reductions (CSRs); and (4) the individual mandate. The ACA’s modified community rating rules restrict variation in the household rating factor  $\sigma_{it}$  in equation (2). Insurers cannot consider health status to determine household premiums and can only rate by age and geographic residence.<sup>8</sup> Insurers can charge a 64-year-old up to three times as much as a 21-year-old. Figure 1 shows the partition of California’s 58 counties into 19 rating areas. Premiums within a rating area must be the same for all consumers of the same age.

In California, approximately 90% of enrollees receive premium subsidies.<sup>9</sup> The premium subsidy in equation (2) is the difference between the household’s full premium for the benchmark plan ( $\sigma_{it}p_{bmt}$ ) and income-based contribution cap  $\zeta_{it}$ . ACA premium subsidies are endogenous because they depend on the premium of the benchmark plan, defined as the second-cheapest silver plan available to the household. The benchmark plan varies across households because of heterogeneous firm entry. Subsidies can be applied to the purchase of any metal plan. Equation (2) prevents the subsidy from exceeding the premium, which could occur for certain bronze plans. This nonlinearity is an exogenous source of variation that I use to identify the premium parameter as discussed below. Before passage of the ARP, the income-based contribution cap ranged from 2% to 9.5% of annual income, as shown in Table 2. The ARP substantially enhances ACA subsidies by reducing

<sup>8</sup>Most states also allow rating by tobacco usage, but California prohibits tobacco rating.

<sup>9</sup>To be subsidy eligible, consumers must (1) have income between 100% and 400% of FPL; (2) be citizens or legal residents; (3) be ineligible for Medicaid/CHIP, Medicare, etc.; and (4) lack access to an affordable health insurance offer from an employer. The ACA defines “affordable” as an offer for which the employee’s contribution to the employer’s single coverage plan is less than 9.5% of the employee’s household income. The IRS adjusts this percentage annually.

contribution caps and allowing consumers with income above 400% of FPL to receive subsidies.

Table 2: Comparison of Original ACA Subsidies and Enhanced Subsidies Under ARP

Income (% of FPL)	Max. Contribution to Benchmark Plan (% of Income)	
	Original ACA Subsidies	ARP Enhancement
100%-138%	2%	0%
138%-150%	3% - 4%	0%
150%-200%	4% - 6.3%	0% - 2%
200%-250%	6.3% - 8.05%	2% - 4%
250%-300%	8.05% - 9.5%	4% - 6%
300%-400%	9.5%	6% - 8.5%
> 400%	N/A	8.5%

Notes: Table compares the income-based contribution caps ( $\zeta_{it}$ ) under the original ACA and under the ARP. Consumers receive a subsidy that ensures they pay no more for the benchmark plan than the percentage of income specified in the table. Under the original ACA, consumers with income above 400% of FPL were ineligible for subsidies. Within each income range, linear interpolation is used to determine the precise contribution cap. The IRS adjusts these contribution caps very slightly each year to account for inflation.

Consumers with income below 250% of FPL are eligible for CSRs, which reduce deductibles, copays, etc. Consumers must purchase a silver plan to receive CSRs. CSRs increase the AV of the silver plan in equation (1) from 70% to (1) 94% for consumers with income below 150% of the federal poverty level (FPL); (2) 87% for consumers with income between 150% and 200% of FPL; and (3) 73% for consumers with income between 200% and 250% of FPL. About two-thirds of consumers in my data are eligible for CSRs.

Consumers who fail to purchase insurance may be required to pay a penalty. Certain groups are exempt from the individual mandate, including individuals (1) with income below the tax filing threshold and (2) without access to a plan that is less than about 8% of their income. In 2014, the penalty for a single person was the greater of \$95 and 1% of income exceeding the tax filing threshold. The penalty was fully phased in by 2016, when it was the greater of \$695 and 2.5% of income. The Tax Cuts and Jobs Act of 2017 set the penalty to zero starting in 2019.

## 1.4 Estimation and Identification

I assume the error term  $\epsilon_{ijt}^d$  has the generalized extreme value distribution to estimate the demand parameters  $\beta = (\beta_i^p, \beta_{ij}^y, \beta_i^w, \beta^x)$ . This assumption implies equation (1) is a nested logit model at the consumer level (Train, 2009). I define two nests: (1) all exchange plans and (2) the outside

option (i.e., forgoing insurance). The household-level choice probabilities are

$$q_{ijt}(\mathbf{p}_t) = \frac{e^{V_{ijt}(\mathbf{p}_t)/\lambda} \left( \sum_j e^{V_{ijt}(\mathbf{p}_t)/\lambda} \right)^{\lambda-1}}{1 + \left( \sum_j e^{V_{ijt}(\mathbf{p}_t)/\lambda} \right)^\lambda} \quad (3)$$

where  $V_{ijt}(\mathbf{p}_t) \equiv \beta_i^p p_{ijt}(\mathbf{p}_t) + \beta_{ij}^y y_{ij(t-1)}(\mathbf{p}_{t-1}) + \beta_i^w w_j + x'_{ij} \beta^x + \xi_j$  and  $\lambda$  is the nesting parameter. The household choice probabilities converge to the standard logit choice probabilities as  $\lambda \rightarrow 1$ . I estimate the model parameters using maximum likelihood at the consumer level following [Train \(2009\)](#). Define  $J_{mt}$  as the set of plans offered in market  $m$  at time  $t$  and  $J_{ft}$  as the set of plans offered by firm  $f$  at time  $t$ . The sensitivity of the choice probability to the base premium is

$$\frac{\partial q_{ikt}(\mathbf{p}_t)}{\partial p_{jmt}} = \sum_{l \in J_{mt}} \frac{\partial q_{ikt}(\mathbf{p}_t)}{\partial p_{ilt}(\mathbf{p}_t)} \frac{\partial p_{ilt}(\mathbf{p}_t)}{\partial p_{jmt}} \quad (4)$$

for all plans  $j, k$ , where

$$\frac{\partial q_{ikt}(\mathbf{p}_t)}{\partial p_{ijt}} = \begin{cases} \beta_i^p q_{ijt}(\mathbf{p}_t) \left[ \frac{1}{\lambda} + \frac{\lambda-1}{\lambda} q'_{ijt}(\mathbf{p}_t) - q_{ijt}(\mathbf{p}_t) \right] & k = j \\ \beta_i^p q_{ijt}(\mathbf{p}_t) \left[ \frac{\lambda-1}{\lambda} q'_{ikt}(\mathbf{p}_t) - q_{ikt}(\mathbf{p}_t) \right] & k \neq j \end{cases} \quad (5)$$

and  $q'_{ijt}(\mathbf{p}_t)$  is the probability of choosing  $j$ , conditional on choosing a plan. Assuming the subsidy does not exceed the full premium, it follows from equation (2) that

$$\frac{\partial p_{ilt}(\mathbf{p}_t)}{\partial p_{jmt}} = \begin{cases} 0 & l = j, j = b \\ \sigma_{it} & l = j, j \neq b \\ -\sigma_{it} & l \neq j, j = b \\ 0 & l \neq j, j \neq b \end{cases}. \quad (6)$$

Equation (6) shows the marginal relationship between the plan base premium and the consumer's premium. Except for the benchmark plan, a dollar increase in a plan's base premium results in consumers paying  $\sigma_{it}$  additional dollars for that plan and does not affect what consumers pay for any other plan. However, a dollar increase in the benchmark premium increases the subsidy by  $\sigma_{it}$  dollars; consumers pay the same amount for the benchmark plan, but now pay less for all other plans. Firms may be able to exploit the benchmark plan premium to increase profit, particularly in a monopoly market. My model explicitly accounts for this potential gaming behavior in equation (6).

Define plan  $j$ 's demand  $q_{jmt}(\mathbf{p}_t) = \sum_{i \in I} (\mathbb{I}_{i,m,t}) q_{ijt}(\mathbf{p}_t)$  and firm  $f$ 's demand  $q_{ft}(\mathbf{p}_t) = \sum_{k \in J_{ft}} q_{kmt}(\mathbf{p}_t)$ , where  $\mathbb{I}_{i,m,t}$  indicates whether household  $i$  resides in market  $m$  at time  $t$ . Using equation (4), I calculate the sensitivities of plan and firm demand to the base premium as



$$\frac{\partial q_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} = \sum_{i \in I} (\mathbb{I}_{i,m,t}) \frac{\partial q_{ikt}(\mathbf{p}_t)}{\partial p_{jmt}} \quad (7)$$

$$\frac{\partial q_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} = \sum_{k \in J_{ft}} \frac{\partial q_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} \quad (8)$$

My analysis of consumer plan choices requires credible identification of the premium parameter  $\beta_i^p$  and the private parameter  $\beta_i^w$ . Most plan characteristics are observed, but some unobserved plan characteristics that vary at the insurer-market level such as customer service or the plan formulary may be correlated with premiums. My richest specification includes insurer-market fixed effects to control for these time-invariant unobserved plan characteristics. Key institutional details of the ACA setting also generate plausibly exogenous variation in premiums that I can exploit with consumer-level data. First, the phase-in of the mandate penalty between 2014 and 2016 and elimination of the penalty in 2019 creates exogenous variation in household premiums relative to the outside option. Second, exogenous age rating factors ( $\sigma_{it}$ ) are used to translate premiums set by insurers to household premiums, creating variation in premiums across households and plans. To leverage this variation for identification, I allow the premium parameter in equation (1) to vary by age group and assume premium sensitivity does not vary within each age group (but premiums do vary within age groups). Third, the ACA’s nonlinear subsidy formula in equation (2) creates exogenous variation between plans in each household’s choice set. Some households have access to “free” bronze plans if the household’s subsidy exceeds the full premium. The set of “free” plans varies across markets, time, and exogenously-determined household characteristics. In previous work, I also estimated the demand parameters using the control function of [Petrin and Train \(2010\)](#) with geographic cost factors as instruments, finding minimal differences in the estimated parameters ([Saltzman, 2019](#)). I do not use the control function approach here because the first stage imposes a hedonic pricing model, precluding me from evaluating alternative public firm objectives.

The private variable may also be correlated with unobserved plan characteristics. Identification of the private parameter leverages plausibly exogenous variation in public firm participation across markets. In this setting, temporal variation in public firm participation (i.e., CCHP’s participation in 2014 and departure in 2015) is quite limited and does not allow for a credible difference-in-difference analysis. Table 1 shows the geographic variation in firm penetration. An example of exploiting this variation is to compare the choices of consumers in Santa Clara County, who can choose between the four large firms and the public firm, with those in neighboring Alameda County, who only have access to the same four large firms. Consumers may view the public firm as another



regional firm. I address this concern by comparing, for example, consumer choices in Los Angeles County, where all firm categories are present, with those in neighboring Orange County, where only the same large and regional firms as in Los Angeles County are present.

Leveraging these sources of geographic variation to identify the private variable requires two important identifying assumptions. First, the availability of a public firm must not persuade consumers to relocate. Although no data exist relating public firm availability to household migration, demographic patterns between 2010 when the ACA was enacted and 2019 suggest population growth in Los Angeles and Santa Clara Counties was actually outpaced by its neighbors. Los Angeles County’s population grew by 2.2% between 2010 and 2019, compared to 5.3% in Orange County. Santa Clara County’s population grew by 7.9% between 2010 and 2019, compared to 10.5% in Alameda County.<sup>10</sup> Second, entry of the public firms must not be correlated with unobserved ACA exchange consumer characteristics. As discussed above, the formation of all three public firms long preceded creation of the ACA exchanges in 2014 and targeted a different population than ACA exchange consumers. It is therefore unlikely that entry of a public firm is endogenous. Many of the regional private insurers in the California exchange, including Chinese Community in the Bay Area, Western Health in Sacramento, and Sharp in San Diego, were also founded in their communities long before creation of the ACA exchanges.

## 1.5 Results

Parameter estimates of  $\beta$  are available in Appendix C.<sup>11</sup> To interpret these parameter estimates, I compute elasticities and willingness-to-pay (WTP) for a private plan relative to a public plan. Table 3 indicates California exchange consumers are highly premium sensitive, consistent with the previous literature (Domurat, 2018; Drake, 2019; Saltzman, 2019; Tebaldi, 2022). The mean own-premium elasticity is -6.13 and the mean elasticity for exchange coverage is -0.90. Minority populations and especially young adults are highly premium sensitive.

Table 4 illustrates how consumers substitute between firms. The diagonal elements indicate the average response of a firm’s demand to a change in one of its own premiums; the off-diagonal indicate the average response of the “row firm’s” demand to a change in the premium of a plan sold by the “column firm.” The Blues – Anthem Blue Cross and Blue Shield – have high cross-premium elas-

<sup>10</sup><https://www.census.gov/data/datasets/time-series/demo/popest/2010s-counties-total.html>

<sup>11</sup>Appendix C includes specifications with provider network breadth and without provider network breadth. Provider network breadth data are unavailable for Contra Costa and United, which requires eliminating those insurers’ plans when estimating the specification with provider network breadth. The premium and private parameters are largely unchanged across specifications. I use the specification without provider network breadth in the analysis below.

Table 3: Mean Own-Plan and Coverage Elasticities

	Own-Premium	Exchange Coverage
Overall	-6.13	-0.90
Age		
0-17	-5.98	-0.80
18-34	-9.25	-1.22
35-54	-6.82	-0.91
55+	-4.10	-0.56
Gender		
Female	-6.00	-0.88
Male	-6.28	-0.92
Race/Ethnicity		
Asian	-7.01	-0.98
Black	-6.49	-0.91
Hispanic	-7.68	-1.07
Other	-5.59	-0.80
Non-Hispanic White	-5.28	-0.76
Household Size		
Single	-5.96	-0.88
Family	-6.64	-0.97

Notes: Table reports mean plan elasticities by demographic group. The first column indicates how a plan's demand responds to a change in its own premium before subsidies. The second column indicates how total exchange enrollment responds to a change in all exchange premiums.

Table 4: Firm Elasticities

	Anthem	Blue Shield	Health Net	Kaiser	Regional Insurer	Public Insurer
Anthem	-4.90	1.50	1.29	1.11	1.02	1.12
Blue Shield	1.46	-5.56	1.36	1.26	1.12	0.91
Health Net	0.66	0.68	-5.89	0.61	0.65	0.78
Kaiser	1.57	2.38	2.14	-3.85	1.70	1.13
Regional Insurer	0.71	1.07	0.83	0.86	-4.94	0.43
Public Insurer	0.57	0.88	0.59	0.63	0.48	-4.66

Notes: Table reports firm elasticities in matrix form. The diagonal elements indicate the average response of a firm's demand to a change in one of its own plan premiums. The off-diagonal elements indicate the average response of the "row firm's" demand to a change in the premium of a plan sold by the "column firm."

ticities, suggesting that they are close substitutes. The large cross-premium elasticities in Kaiser’s row indicates that Kaiser is an attractive alternative for consumers when other firms’ premiums rise. The cross-premium elasticities for the public insurer are generally the lowest, indicating consumers do not view public and private plans as close substitutes. Hence, the public firm can build a distinct consumer base from the private insurers rather than “steal business” from the private insurers.

Figure 5 provides further evidence that private and public firms serve differentiated consumer bases. I calculate WTP for a private plan relative to a public plan by computing the ratio of the private parameter to the premium parameter (i.e.,  $\frac{\beta_i^w}{\beta_i^p}$ ). The average WTP is \$39 or 8.9% of the average premium. Older, higher-income, non-Hispanic White, and female consumers have a much higher WTP. Conversely, Hispanic and Black consumers have a negative WTP and therefore prefer public plans, all else equal. Hence, the public firm expands the market to disadvantaged subpopulations, consistent with their mission statements.

Figure 5: Willingness-to-Pay for a Private Plan Relative to a Public Plan



Notes: Figure shows consumers’ willingness-to-pay (WTP) for a private plan relative to a public plan. WTP is the ratio  $\frac{\beta_i^w}{\beta_i^p}$ . I show heterogeneity in WTP by income, age, race, family size, and gender. Overall WTP of \$39 is shown by the black line.

## 2 Public Firm Objectives

Now I evaluate alternative specifications of the public firm’s objective function. The goal of this section is to determine which objective best fits the observed data. The first subsection describes the data, the second subsection presents descriptive evidence, the third subsection develops a model,

the fourth subsection discusses model estimation, and the fifth subsection presents the results.

## 2.1 Data

To estimate the supply-side of the model, I need data on the firms' cash flows in profit equation (9), including premium revenue collected, medical claims incurred, risk adjustment received or paid, reinsurance received, variable administrative costs, and fixed costs. I obtain most of these data from insurer rate filings ([Department of Managed Health Care, 2016](#)), which all insurers participating in the individual market must complete to justify their premiums.<sup>12</sup> The rate filings provide plan-market-year level information on premium revenue collected, incurred medical claims, risk adjustment received or paid, and reinsurance received. The filings indicate whether the plan was offered on or off the California exchange. I supplement the rate filings with data from the CMS medical loss ratio (MLR) reports to obtain the firms' variable administrative costs (e.g., taxes, fees, commissions) and fixed costs (e.g., building overhead, salaries). All insurers are required to submit MLR reports to show that they are spending at least 80% of collected premiums on medical claims. To endogenize risk adjustment in the model, I also require data on risk scores and geographic cost factors (defined in detail below). I obtain risk scores at the plan-year-market level from California's supplement rate review template (SRRT). The geographic cost factors are from CMS and provided in Appendix D ([Centers for Medicare and Medicaid Services, 2022](#)).

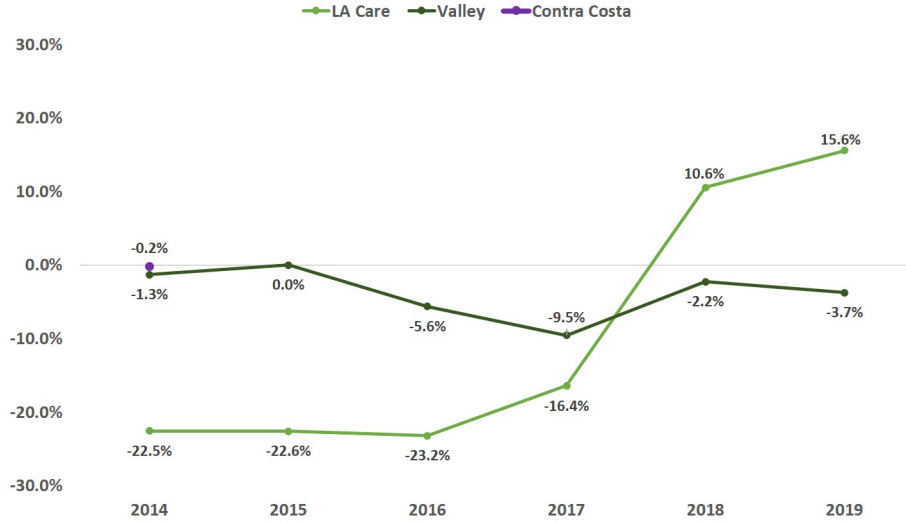
## 2.2 Descriptive Evidence

Figure 6 plots profit margins for the public insurers over time as reported in the MLR data. Overall, the data indicate that the public insurers were willing to sustain fairly substantial losses during the study timeframe. Valley operated at a loss in every year except 2015 and had nearly a -10% profit margin in 2017. LA Care sustained losses of more than 16% through 2017, peaking at 23.2% in 2016. In 2018 and 2019, LA Care earned positive profit, recouping some of the losses in the preceding years. This empirical evidence suggests the public insurers (1) either did not operate with a budget constraint or were only constrained to earn zero profit over a long time horizon and (2) may have objectives that diverge from profit maximization.

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<sup>12</sup>Rate filings with the California Department of Managed Care include all data that CMS makes available in their rate review data, plus additional data such as the SRRT.

Figure 6: Public Insurer Profit Margins By Year



Notes: Figure shows profit margins by year for the public insurers, including LA Care (Los Angeles County), Valley (Santa Clara County), and Contra Costa (Contra Costa County). Contra Costa only operated in the California exchange in 2014. Profit margins are calculated from the MLR data and include administrative costs.

## 2.3 Model

I now develop a mixed oligopoly model that incorporates alternative specifications of the public firm's objective function. Consider a two-stage game where (1) private firms set premiums to maximize expected profit and public firms set premiums to maximize their objective as defined below and (2) consumers choose plans to maximize utility as discussed in Section 1. I first discuss the private firm's objective and then propose alternative specifications of the public firm's objective.

### 2.3.1 Private Firms

Assume multi-product private firms are risk neutral and choose the base premium  $p_{jmt}$  for each plan that they sell to maximize expected profit

$$\pi_{ft}(\mathbf{p}_t) = R_{ft}(\mathbf{p}_t) - C_{ft}(\mathbf{p}_t) + RA_{ft}(\mathbf{p}_t) + RI_{ft}(\mathbf{p}_t) - V_{ft}(\mathbf{p}_t) - FC_{ft}. \quad (9)$$

where  $R_{ft}(\mathbf{p}_t)$  is firm  $f$ 's total premium revenue,  $C_{ft}(\mathbf{p}_t)$  is total medical claims,  $RA_{ft}(\mathbf{p}_t)$  is risk adjustment received,  $RI_{ft}(\mathbf{p}_t)$  is reinsurance received,  $V_{ft}(\mathbf{p}_t)$  is variable administrative costs (e.g., commissions), and  $FC_{ft}$  is fixed cost (e.g., overhead).<sup>13</sup> Differentiating equation (9) with respect

<sup>13</sup>Reinsurance was a temporary ACA program in effect through 2016 that provided "insurance to insurers" for their

to the base premium yields the first-order conditions

$$0 = \frac{\partial \pi_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} = \frac{\partial R_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} - (1 - \iota_{ft}) \frac{\partial C_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} + \frac{\partial RA_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} - \frac{\partial V_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} \quad (10)$$

for all plans  $j$  sold by firm  $f$  in market  $m$  at time  $t$ , where  $\iota_{ft}$  is the AV of the reinsurance contract. Equation (10) accounts for potential intra-firm cannibalization of demand between plans. Below I write the revenue, claims, risk adjustment, and administrative cost variables in equations (9) and (10) in terms of three estimate variables (and their partials): (1) household choice probabilities  $q_{ijt}(\mathbf{p}_t)$  in equation (3); (2) plan risk scores  $r_{jmt}(\mathbf{p}_t)$  in equation (14); and (3) plan average claims  $c_{jmt}(\mathbf{p}_t)$  in equation (22).

### Revenue:

Firm revenue  $R_{ft}(\mathbf{p}_t) = \sum_{i \in I, m \in M, k \in J_{fmt}} \mathbb{I}_{i,m,t} \sigma_{it} p_{kmt} q_{ikt}(\mathbf{p}_t)$  is the sum of all (unsubsidized) premiums collected by the firm across all plans and markets. Its sensitivity to a premium change is

$$\frac{\partial R_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} = \sum_{i \in I, k \in J_{fmt}} \mathbb{I}_{i,m,t} \sigma_{it} \left( q_{ijt}(\mathbf{p}_t) + p_{kmt} \frac{\partial q_{ikt}(\mathbf{p}_t)}{\partial p_{jmt}} \right) \quad (11)$$

### Claims:

Total firm claims  $C_{ft}(\mathbf{p}_t) = \sum_{m \in M, k \in J_{fmt}} c_{kmt}(\mathbf{p}_t) q_{kmt}(\mathbf{p}_t)$  are the sum of all claims paid out across plans and markets. Its sensitivity to a premium change is

$$\frac{\partial C_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} = \sum_{k \in J_{fmt}} \left[ c_{kmt}(\mathbf{p}_t) \frac{\partial q_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} + q_{kmt}(\mathbf{p}_t) \frac{\partial c_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} \right] \quad (12)$$

### Risk Adjustment:

Risk adjustment is a permanent program that disincentivizes insurers from cherry-picking low-risk consumers by transferring money from insurers with lower-than-average risk enrollees to insurers with higher-than-average risk enrollees. In my notation, the official risk adjustment transfer  $RA_{ft}(\mathbf{p}_t)$  as derived by [Pope et al. \(2014\)](#) equals<sup>14</sup>

$$\begin{aligned} RA_{ft}(\mathbf{p}_t) &= \sum_{m \in M, k \in J_{fmt}} [\hat{c}_{kmt}(\mathbf{p}_t) - \tilde{c}_{kmt}(\mathbf{p}_t)] q_{kmt}(\mathbf{p}_t) \\ &= \sum_{m \in M, k \in J_{fmt}} \left( \frac{\hat{h}_{kmt}(\mathbf{p}_t)}{\sum_{n \in M, l \in J_{nt}} \hat{h}_{lnt}(\mathbf{p}_t) q_{lnt}(\mathbf{p}_t)} - \frac{\tilde{h}_{kmt}(\mathbf{p}_t)}{\sum_{n \in M, l \in J_{nt}} \tilde{h}_{lnt}(\mathbf{p}_t) q_{lnt}(\mathbf{p}_t)} \right) q_{kmt}(\mathbf{p}_t) \nu \bar{p} \end{aligned} \quad (13)$$

where  $\hat{c}_{jmt}(\mathbf{p}_t)$  is the plan's expected average claims with adverse selection and  $\tilde{c}_{jmt}(\mathbf{p}_t)$  is the plan's highest-cost enrollees. I describe risk adjustment in detail in the text below.

<sup>14</sup>[Saltzman \(2021\)](#) uses a simplified version the risk adjustment formula in [Pope et al. \(2014\)](#)'s Appendix A1. I use the full version in [Pope et al. \(2014\)](#)'s Appendix A2 here.

expected average claims without adverse selection. The plan's market share is  $s_{lmt}(\mathbf{p}_t)$ , the average statewide premium is  $\bar{p}$ , and the expected percentage of collected premiums that is spent on claims is  $\nu$ .<sup>15</sup> The cost factor  $\hat{h}_{jmt}(\mathbf{p}_t) \equiv \text{IDF}_j \text{GCF}_{mt} r_{jmt}(\mathbf{p}_t)$  is the product of the plan's induced demand factor, geographic cost factor, and risk score. The cost factor  $\tilde{h}_{jmt}(\mathbf{p}_t) \equiv \text{AV}_j \text{IDF}_j \text{GCF}_{mt} a_{jmt}(\mathbf{p}_t)$  is the product of the plan's AV, induced demand factor, geographic cost factor, and average ACA age rating factor  $a_{jmt}(\mathbf{p}_t) \equiv \frac{\sum_{i \in I} (\mathbb{I}_{i,m,t}) a_{it} q_{ijt}(\mathbf{p}_t)}{q_{jmt}(\mathbf{p}_t)}$  across the plan's enrollees, where  $a_{it}$  is the household's CMS age rating factor. The induced demand factor accounts for expected moral hazard associated with lower cost sharing when enrolled in a more generous plan. CMS sets  $\text{IDF}_j$  equal to 1 for bronze plans, 1.03 for silver plans, 1.08 for gold plans, and 1.15 for platinum plans. The geographic cost factors account for regional differences in the cost of doing business (e.g., input prices, provider market power, etc.) Appendix D summarizes the CMS geographic cost factors by market and year in California. CMS uses a regression-based procedure that calculates the ACA risk score, a measure of ex-ante enrollee risk (not ex-post spending on health care), as a function of plan generosity and enrollee characteristics, including age, gender, and diagnosed medical conditions (Kautter et al., 2014). I write the plan risk score  $r_{jmt}(\mathbf{p}_t)$  as

$$\ln r_{jmt}(\mathbf{p}_t) = \sum_{d \in D} \gamma^d s_{djmt}(\mathbf{p}_t) + MT_j' \gamma^{MT} + \epsilon_{jmt}^r \quad (14)$$

where  $s_{djmt}(\cdot)$  is the share of plan  $j$ 's enrollees in market  $m$  and time  $t$  with demographic characteristic  $d$ ,  $MT_j$  is a metal tier fixed effect, and  $\epsilon_{jmt}^r$  is an error term. I discuss estimation of the risk score parameters  $\gamma = (\gamma^d, \gamma^{MT})$  below.

Average transfer formula (13) redistributes funds so that each firm faces the same (unobserved) enrollee health risk. It does not compensate firms for observable differences in age, geography, moral hazard, or plan AV that firms can price for. The cost factor  $\hat{h}_{jmt}(\mathbf{p}_t)$  in the firm term accounts for differences in moral hazard and geography, as well as age, plan AV, and enrollee health risk in the plan risk score. The cost factor  $\tilde{h}_{jmt}(\mathbf{p}_t)$  in the second term accounts for differences in moral hazard, geography, age, and plan AV, but not enrollee health risk. Therefore, the difference between the first and second terms compensates firms for differences in enrollee health risk only.

A plan's realized average claims  $c_{jmt}(\mathbf{p})$  may diverge from the plan's expected average claims with adverse selection  $\hat{c}_{jmt}(\mathbf{p}_t)$  for several reasons. Some plans may include more expensive providers in their networks, whereas other plans may have narrow networks or restrict access to specialists (e.g., an HMO plan). There may also differences in a plan's bargaining leverage with providers in negotiating reimbursement rates. Formula 13 does not compensate plans for these cost differences or any other efficiencies that plans may realize.

<sup>15</sup>From 2014-2017,  $\nu$  was set to 100% in the ACA transfer formula. Starting in 2018,  $\nu$  was set to 86%.

Define  $rs_{kmt}(\mathbf{p}_t) \equiv \frac{\hat{h}_{kmt}(\mathbf{p}_t)q_{kmt}(\mathbf{p}_t)}{\sum_{n \in M, l \in J_{nt}} \hat{h}_{lnt}(\mathbf{p}_t)q_{lnt}(\mathbf{p}_t)}$  and  $us_{kmt}(\mathbf{p}_t) \equiv \frac{\tilde{h}_{kmt}(\mathbf{p}_t)q_{kmt}(\mathbf{p}_t)}{\sum_{n \in M, l \in J_{nt}} \tilde{h}_{lnt}(\mathbf{p}_t)q_{lnt}(\mathbf{p}_t)}$ . Let  $R_t(\mathbf{p}_t) \equiv \sum_{f \in F} R_{ft}(\mathbf{p}_t)$  be total premiums collected. The sensitivity of the firm's risk adjustment transfer to the base premium is

$$\frac{\partial RA_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} = \nu \sum_{k \in J_{fnt}} \left[ \frac{\partial R_t(\mathbf{p}_t)}{\partial p_{jmt}} (rs_{kmt}(\mathbf{p}_t) - us_{kmt}(\mathbf{p}_t)) + R_t(\mathbf{p}_t) \left( \frac{\partial rs_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} - \frac{\partial us_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} \right) \right] \quad (15)$$

where

$$\begin{aligned} \frac{\partial rs_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} &= \left( \sum_{n \in M, l \in J_{nt}} \hat{h}_{lnt}(\mathbf{p}_t)q_{lnt}(\mathbf{p}_t) \right)^{-1} \left[ \left( \hat{h}_{kmt}(\mathbf{p}_t) \frac{\partial q_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} + q_{kmt}(\mathbf{p}_t) \frac{\partial \hat{h}_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} \right) \right. \\ &\quad \left. - rs_{kmt}(\mathbf{p}_t) \sum_{l \in J_{mt}} \left( \hat{h}_{lmt}(\mathbf{p}_t) \frac{\partial q_{lmt}(\mathbf{p}_t)}{\partial p_{jmt}} + q_{lmt}(\mathbf{p}_t) \frac{\partial \hat{h}_{lmt}(\mathbf{p}_t)}{\partial p_{jmt}} \right) \right] \\ \frac{\partial us_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} &= \left( \sum_{n \in M, l \in J_{nt}} \tilde{h}_{lnt}(\mathbf{p}_t)q_{lnt}(\mathbf{p}_t) \right)^{-1} \left[ \left( \tilde{h}_{kmt}(\mathbf{p}_t) \frac{\partial q_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} + q_{kmt}(\mathbf{p}_t) \frac{\partial \tilde{h}_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} \right) \right. \\ &\quad \left. - us_{kmt}(\mathbf{p}_t) \sum_{l \in J_{mt}} \left( \tilde{h}_{lmt}(\mathbf{p}_t) \frac{\partial q_{lmt}(\mathbf{p}_t)}{\partial p_{jmt}} + q_{lmt}(\mathbf{p}_t) \frac{\partial \tilde{h}_{lmt}(\mathbf{p}_t)}{\partial p_{jmt}} \right) \right] \end{aligned}$$

Computing these partials requires computing the partials for the cost factors, which are

$$\begin{aligned} \frac{\partial \hat{h}_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} &= \text{IDF}_k \text{GCF}_{mt} \left[ \frac{r_{kmt}(\mathbf{p}_t)}{q_{kmt}(\mathbf{p}_t)} \sum_{d \in D} \gamma^d \left[ \frac{\partial q_{dkmt}(\mathbf{p}_t)}{\partial p_{jmt}} - s_{dkmt}(\mathbf{p}_t) \frac{\partial q_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} \right] \right] \\ \frac{\partial \tilde{h}_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} &= \text{AV}_k \text{IDF}_k \text{GCF}_{mt} \frac{\sum_{i \in I} (\mathbb{I}_{i,m,t}) a_{it} \frac{\partial q_{ikt}(\mathbf{p}_t)}{\partial p_{jmt}} - a_{kmt}(\mathbf{p}_t) \frac{\partial q_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}}}{q_{kmt}(\mathbf{p}_t)} \end{aligned}$$

### Variable Administrative Costs and Fixed Costs:

Variable administrative costs include expenses such as fees and commissions. Fixed costs include expenses such as building overhead and administrative staff. I obtain data on both from the CMS MLR data. Let  $v_{ft}$  be per-capita variable administrative cost and  $V_{ft}(\mathbf{p}_t) = v_{ft}q_{ft}(\mathbf{p}_t)$  be firm variable administrative cost. The sensitivity of variable administrative costs to the base premium is

$$\frac{\partial V_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} = v_{ft} \frac{\partial q_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} \quad (16)$$

### 2.3.2 Public Firms

Most of the industrial organization (IO) literature assumes all firms maximize profit. I generalize the standard oligopoly model to a mixed oligopoly model with alternative specifications of the public firm's objective. [Timmins \(2002\)](#) and [Lim and Yurukoglu \(2018\)](#) consider regulator objectives. A



parallel literature considers nonprofit objectives in the hospital industry (Newhouse, 1970; Pauly and Redisch, 1973; Steinberg, 1986; De Fraja and Delbono, 1990; Matsumura, 1998; Malani et al., 2003; Lakdawalla and Philipson, 2006; Gaynor et al., 2015; Philipson and Posner, 2009; Horwitz and Nichols, 2009; Dranove et al., 2017; Chang and Jacobson, 2017; Capps et al., 2020). The most common objective is weighted social surplus. Others include budget (or revenue) maximization and output maximization. Let the weight  $\omega \in [0, 1]$ . I define four families of public firm objectives:

$$MW(\mathbf{p}_t, \omega) \equiv \omega CS_{mt}(\mathbf{p}_t) + (1 - \omega)\pi_{mt}(\mathbf{p}_t) \quad (17a)$$

$$FW(\mathbf{p}_t, \omega) \equiv \omega CS_{mt}(\mathbf{p}_t) + (1 - \omega)\pi_{ft}(\mathbf{p}_t) \quad (17b)$$

$$MREV(\mathbf{p}_t, \omega) \equiv \omega R_{mt}(\mathbf{p}_t) + (1 - \omega)\pi_{mt}(\mathbf{p}_t) \quad (17c)$$

$$FREX(\mathbf{p}_t, \omega) \equiv \omega R_{ft}(\mathbf{p}_t) + (1 - \omega)\pi_{ft}(\mathbf{p}_t) \quad (17d)$$

where  $CS_{mt}(\mathbf{p}_t) = \sum_{i \in I} \mathbb{I}_{i,m,t} CS_{it}(\mathbf{p}_t)$  is market consumer surplus,  $\pi_{mt}(\mathbf{p}_t) \equiv \sum_{f \in F} \pi_{fmt}(\mathbf{p}_t)$  is market profit including the public firm's profit, and  $R_{mt}(\mathbf{p}_t) \equiv \sum_{f \in F} R_{fmt}(\mathbf{p}_t)$  is market revenue including the public firm's revenue. Household consumer surplus is

$$CS_{it}(\mathbf{p}_t) = -\frac{1}{\beta_i^p} \ln \left( \left( \sum_{l \in J} \exp(V_{ilt}(\mathbf{p}_t)/\lambda) \right)^\lambda + \exp(\beta_i^p \rho_{it}) \right) + \sum_{l \in J} q_{ilt}(\mathbf{p}_t) \frac{\beta_{il}^y y_{il(t-1)}}{\beta_i^p} \quad (18)$$

The first term of equation (18) is the nested logit formula for consumer surplus and the second term of equation (18) “corrects” the first term to reflect gains in surplus that result from inertia.

The public firm objectives in (17) nest a wide range of firm behavior. Objective (17a) is equivalent to maximizing social welfare in the public firm's market when  $\omega = 0.5$ .<sup>16</sup> Objectives (17b) and (17d) are equivalent to profit maximization when  $\omega = 0$ . Objectives (17a) and (17c) are equivalent to maximizing market profit when  $\omega = 0$ . Objectives (17a) and (17b) are equivalent to maximizing consumer surplus when  $\omega = 1$ . Objective (17d) is equivalent to budget maximization and objective (17c) is equivalent to market budget maximization when  $\omega = 1$ . I do not constrain the public firm's profit to be nonnegative because the descriptive evidence in Subsection 2.2 indicates the public firms were willing to incur substantial losses. Losses are reflected in the objective for  $\omega < 1$ .

Differentiating the objectives in (17) with respect to the premium yields

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<sup>16</sup>Spending on premium subsidies, CSRs, and other related expenditures is not included as a welfare cost because it is borne at the federal level, not the county level.

$$-\omega \frac{\partial CS_{mt}(\mathbf{p}_t)}{\partial p_{jmt}} \equiv (1 - \omega) \frac{\partial \pi_{mt}(\mathbf{p}_t)}{\partial p_{jmt}} \quad (19a)$$

$$-\omega \frac{\partial CS_{mt}(\mathbf{p}_t)}{\partial p_{jmt}} \equiv (1 - \omega) \frac{\partial \pi_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} \quad (19b)$$

$$-\omega \frac{\partial R_{mt}(\mathbf{p}_t)}{\partial p_{jmt}} \equiv (1 - \omega) \frac{\partial \pi_{mt}(\mathbf{p}_t)}{\partial p_{jmt}} \quad (19c)$$

$$-\omega \frac{\partial R_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} \equiv (1 - \omega) \frac{\partial \pi_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} \quad (19d)$$

As for the private firms' first-order conditions in equation (10), I can write all variables in equation (19) in terms of the household choice probabilities, plan risk scores, and plan average claims. The partial  $\frac{\partial \pi_{ft}(\mathbf{p}_t)}{\partial p_{jmt}}$  is computed as in Section 2.3.1. For brevity, I omit an explicit formula for  $\frac{\partial \pi_{mt}(\mathbf{p}_t)}{\partial p_{jmt}}$  because it is the same as the formula for  $\frac{\partial \pi_{ft}(\mathbf{p}_t)}{\partial p_{jmt}}$ , except that the variables in equation (10) are summed within a market instead of within a firm. I compute  $\frac{\partial R_{ft}(\mathbf{p}_t)}{\partial p_{jmt}}$  using equation (11); the formula for  $\frac{\partial R_{mt}(\mathbf{p}_t)}{\partial p_{jmt}}$  is identical except the variables are summed within a market instead of within a firm. Finally, the partial derivative of consumer surplus with respect to the base premium is

$$\begin{aligned} \frac{\partial CS_{mt}(\mathbf{p}_t)}{\partial p_{jmt}} = & - \sum_{i \in I} \left[ \frac{(\mathbb{I}_{i,m,t}) \left[ \sum_{l \in J} \exp(V_{ilt}(\mathbf{p}_t)/\lambda) \right]^{\lambda-1} \sum_{l \in J} \left[ \exp(V_{ilt}(\mathbf{p}_t)/\lambda) \frac{\partial p_{ilt}(\mathbf{p}_t)}{\partial p_{jmt}} \right]}{\left( \sum_{l \in J} \exp(V_{ilt}(\mathbf{p}_t)/\lambda) \right)^\lambda + \exp(\beta_i^p \rho_{it})} \right] \\ & + \sum_{i \in I, l \in J} \left[ (\mathbb{I}_{i,m,t}) \frac{\partial q_{ilt}(\mathbf{p}_t)}{\partial p_{jmt}} \frac{\beta_{il}^y * y_{il(t-1)}}{\beta_i^p} \right] \end{aligned} \quad (20)$$

The model equilibrium conditions are the private firms' first-order conditions in (10) and the public firm's first-order conditions in (19), given the weight  $\omega$  and objective family. The vector of premiums that solve these equilibrium conditions define a Nash-in-premiums equilibrium.

## 2.4 Estimation and Identification

I now discuss estimation of average claims. Following Nevo (2001), I assume firms are playing a Nash equilibrium and obtain nonparametric estimates of average claims by inverting the equilibrium conditions. Solving equation (10) for  $\frac{\partial C_{ft}(\mathbf{p}_t)}{\partial p_{jmt}}$  and substituting in equation (12) yields

$$\frac{1}{1 - \iota_{ft}} \left[ \frac{\partial R_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} + \frac{\partial RA_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} - \frac{\partial V_{ft}(\mathbf{p}_t)}{\partial p_{jmt}} \right] = \sum_{k \in J_{f_{mt}}} \left[ c_{kmt}(\mathbf{p}_t) \frac{\partial q_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} + q_{kmt}(\mathbf{p}_t) \frac{\partial c_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} \right] \quad (21)$$

Every term in equation (21) can be computed using estimates of demand except for average claims

$c_{kmt}(\mathbf{p}_t)$  and its partial  $\frac{\partial c_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}}$ . The partial  $\frac{\partial c_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} = 0$  in a typical market without selection, which implies average claims equal marginal claims. Hence, it is straightforward to solve for average claims using equation (21). If adverse selection is present, average claims are increasing in premiums such that  $\frac{\partial c_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} > 0$ . Because there are two unknowns (average claims and its partial), I need to make one additional assumption to identify average claims. Define  $CF_{jmt}(\mathbf{p}_t) \equiv \frac{\hat{h}_{jmt}(\mathbf{p}_t)}{\sum_{n \in M, l \in J_{nt}} \hat{h}_{lnt}(\mathbf{p}_t) q_{lnt}(\mathbf{p}_t)}$ . I assume the functional form

$$\begin{aligned} c_{jmt}(\mathbf{p}_t) &= \hat{c}_{jmt}(\mathbf{p}_t) + \zeta_{jmt} \\ &= CF_{jmt}(\mathbf{p}_t) \nu R_t(\mathbf{p}_t) + \zeta_{jmt} \end{aligned} \quad (22)$$

where  $\hat{c}_{jmt}(\mathbf{p}_t)$  is expected average claims with adverse selection from equation (13) and  $\zeta_{jmt}$  captures factors such as the provider network that result in average claims diverging from  $\hat{c}_{jmt}(\mathbf{p}_t)$ . Differentiating equation (22) with respect to the premium yields

$$\frac{\partial c_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} = \nu \left[ CF_{kmt}(\mathbf{p}_t) \frac{\partial R_t(\mathbf{p}_t)}{\partial p_{jmt}} + R_t(\mathbf{p}_t) \left( \frac{\partial CF_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} \right) \right] \quad (23)$$

where

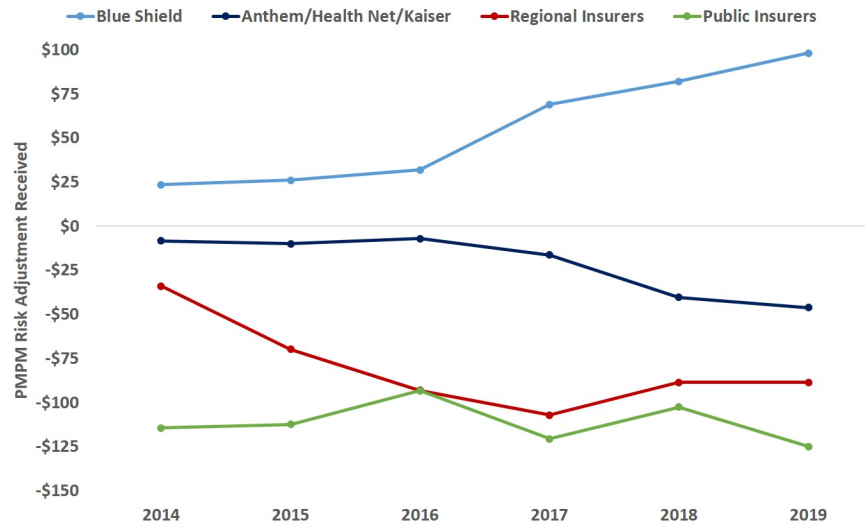
$$\begin{aligned} \frac{\partial CF_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} &= \left( \sum_{n \in M, l \in J_{nt}} \hat{h}_{lnt}(\mathbf{p}_t) q_{lnt}(\mathbf{p}_t) \right)^{-1} \left[ \frac{\partial \hat{h}_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}} \right. \\ &\quad \left. - CF_{kmt}(\mathbf{p}_t) \sum_{l \in J_{mt}} \left( \hat{h}_{lmt}(\mathbf{p}_t) \frac{\partial q_{lmt}(\mathbf{p}_t)}{\partial p_{jmt}} + q_{lmt}(\mathbf{p}_t) \frac{\partial \hat{h}_{lmt}(\mathbf{p}_t)}{\partial p_{jmt}} \right) \right] \end{aligned}$$

Equation (23) provides a closed-form expression for computing  $\frac{\partial c_{kmt}(\mathbf{p}_t)}{\partial p_{jmt}}$  using only the demand estimates from Section 1 and data published by CMS. Substituting equation (23) into equation (21) allows me to identify and solve for average claims  $c_{jmt}(\mathbf{p}_t)$ . Using (22), I can calculate the difference  $c_{jmt}(\mathbf{p}_t) - \hat{c}_{jmt}(\mathbf{p}_t)$  to obtain estimates of the premium-independent portion of cost  $\zeta_{jmt}$ .

Equation (22) makes one strong assumption: ACA risk adjustment accurately captures selection. Geruso and Layton (2020) find private plans engage in upcoding and generate 6-16% higher enrollee risk scores than they would under traditional Medicare. Although I have no evidence of upcoding in my setting, Figure 7 indicates the private firms reported that their enrollees were substantially less healthy than the public firms' enrollees, particularly Blue Shield. Less healthy consumers may prefer private firm plans because of their generally more robust provider networks, but private firms may also engage in upcoding. Upcoding implies that the private firms can take advantage of any adverse selection that is unaccounted for in equation (22). Private firms would be at a competitive disadvantage if instead the public firm attracts unobservably healthy patients. Early critics of the

ACA risk adjustment formula also thought it overcompensated firms with higher-than-average risk enrollees. In response, CMS reduced  $\nu$  from 1 to 0.86 in 2018. I perform numerous robustness checks below to determine the degree to which the risk adjustment assumption biases my estimates.

Figure 7: Average Risk Adjustment Received



Notes: Figure shows the statewide average or per-member per-month risk adjustment transfer received. Transfers are positive if a transfer was received and negative if a transfer was paid. I group insurers into the following categories: (1) Blue Shield; (2) other large private insurers (Anthem, Health Net, Kaiser); (3) regional private insurers (Chinese Community, Molina, Oscar, Sharp, United, Western); and (4) public insurers (LA Care, Valley, Contra Costa).

To obtain credible estimates of average claims, I need unbiased estimates of the risk score parameters  $\gamma$  in equation (14). The main identification challenge is that I do not observe diagnosed medical conditions, potentially biasing estimates of  $\gamma^d$ . I address this potential source of omitted variable bias by computing predicted demographic shares using the estimated consumer-level choice probabilities from equation (3) instead of the observed demographic shares in my data, which may be endogenous. My identifying assumption is that predictions of the demographic shares are based on exogenous determinants of consumer-level demand, whereas the observed shares may be a function of unobserved medical conditions. Intuitively, the choice model serves as the “first stage” of an IV regression for obtaining unbiased plan risk score estimates. Similar empirical approaches are often used in the hospital choice literature to calculate unbiased estimates of hospital market concentration (Kessler and McClellan, 2000). Estimates of  $\gamma$  are available in Appendix C.

## 2.5 Results

For each family of public firm objectives, I obtain 200 sets of average claims estimates corresponding to the model with weight  $\omega \in \{0, \frac{1}{200}, \frac{2}{200}, \frac{3}{200}, \dots, \frac{198}{200}, \frac{199}{200}\}$ . I compute the root mean square error (RMSE) and mean absolute error (MAE) to assess how well these estimates match my data from the California rate filings.<sup>17</sup> Figure 8 summarizes these goodness-of-fit measures.

For the objective family weighting market profit and consumer surplus (MW), the objective that results in the smallest RMSE places 63% weight on consumer surplus and 37% weight on market profit; the RMSE is about 32% smaller than the RMSE for market profit maximization ( $\omega = 0$ ). The objective that results in the smallest MAE places 59% weight on consumer surplus and 41% weight on market profit; the MAE is about 34% smaller than the MAE for market profit maximization. These results indicate that in the best-fitting model, the public firm places more weight on consumer surplus than on profit.

For the objective family weighting firm profit and consumer surplus (FW), the objective that results in the smallest RMSE places 59% weight on consumer surplus and 41% weight on firm profit; the RMSE is about 25% smaller than the RMSE for firm profit maximization ( $\omega = 0$ ). The objective that results in the smallest MAE places 59% weight on consumer surplus and 41% weight on firm profit; the MAE is about 20% smaller than the MAE for firm profit maximization. The RMSE and MAE for the best-fitting model in this family (FW) are worse than the RMSE and MAE for the best-fitting model in the family that weights market profit and consumer surplus (MW).

The objective family that weights market profit and market revenue (MREV) is a poor fit. The objective that results in the smallest RMSE and MAE places 100% weight on market profit and 0% weight on market revenue. The objective family that weights market profit and firm revenue (FREX) performs better, but not as well as the other two objective families. The objective that results in the smallest RMSE places 37% weight on the public firm's revenue and 63% weight on its profit. The objective that results in the smallest MAE places 28% weight on the public firm's revenue and 72% weight on market profit.

I now test whether the best-fitting objectives in each family yield statistically significant better predictions than profit maximization. Define the difference in squared prediction errors (DSE) as

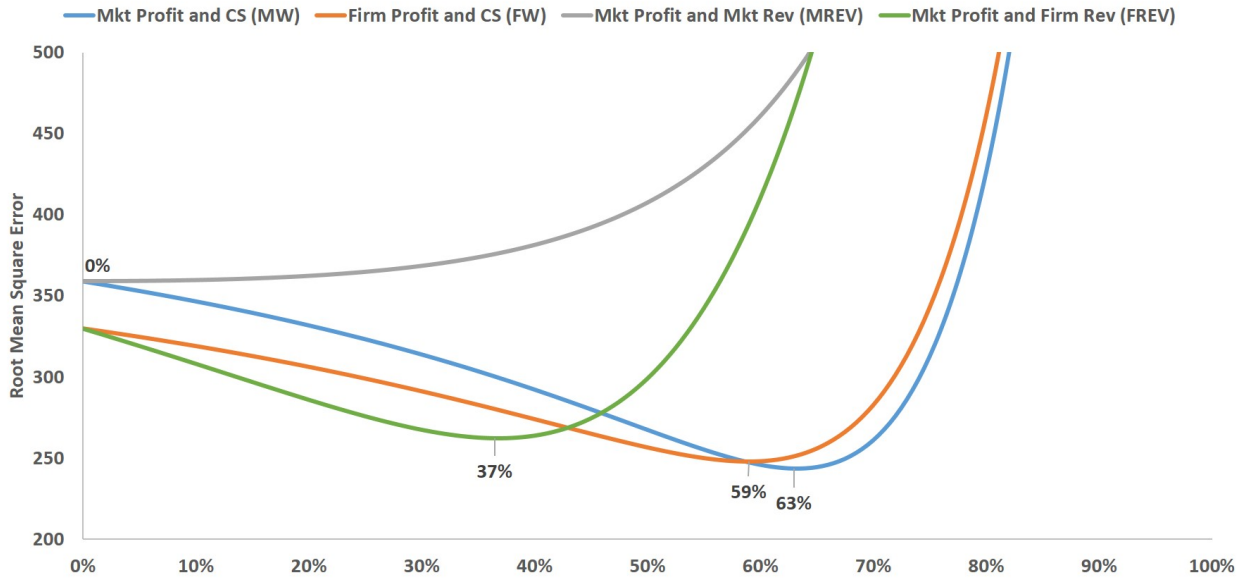
$$DSE = (c_{jmt}(\mathbf{p}, \omega) - c_{jmt})^2 - (c_{jmt}^*(\mathbf{p}) - c_{jmt})^2 \quad (24)$$

where  $c_{jmt}$  is observed average claims,  $c_{jmt}(\mathbf{p}, \omega)$  is average claims estimated from the alternative model, and  $c_{jmt}^*(\mathbf{p})$  is average claims under profit maximization. Following [Doraszelski et al.](#)

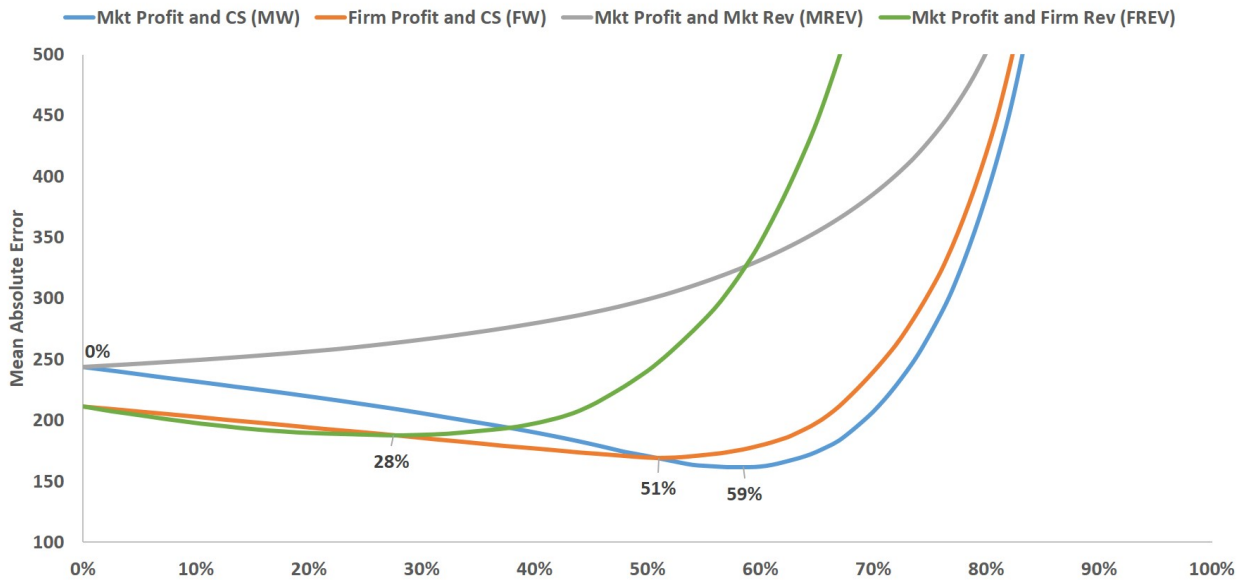
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<sup>17</sup>  $RMSE = \sqrt{\frac{1}{|J|} \sum_{j \in J, m \in M, t \in T} (c_{jmt}(\mathbf{p}, \omega) - c_{jmt})^2}$  and  $MAE = \frac{1}{|J|} \sum_{j \in J, m \in M, t \in T} |c_{jmt}(\mathbf{p}, \omega) - c_{jmt}|$ , where  $c_{jmt}(\mathbf{p}, \omega)$  is average claims estimated from the alternative model and  $c_{jmt}$  is observed average claims.

Figure 8: Comparing Specifications of the Public Firm's Objective



(a) Root Mean Square Error



(b) Mean Absolute Error

Notes: Figure compares how well each model objective predicts observed average claims. Two goodness-of-fit measures are shown: (1) root mean square error (RMSE) and (2) mean absolute error (MAE). Panel (a) plots RMSE for each of the four families of objectives. Panel (b) plots MAE for each of the four families of objectives. I obtain estimates of plan average claims for weight intervals of 0.5% between 0% and 100% and plot smoothed curves.

Table 5: Comparison of Alternative Public Firm Objectives with Profit Maximization

	$MW(\mathbf{p}_t, 0.63)$		$FW(\mathbf{p}_t, 0.59)$		$MREV(\mathbf{p}_t, 0)$		$FREV(\mathbf{p}_t, 0.37)$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	-1007.163*	-1385.915**	-966.624*	-1273.796*	411.022***	519.040***	-815.720*	-990.421
	(418.914)	(515.637)	(414.536)	(514.578)	(89.056)	(108.233)	(404.557)	(507.606)
2014		1744.193		1431.030		-443.482		889.298
		(1100.562)		(1098.302)		(231.009)		(1083.422)
2015		357.634		271.521		-162.695		69.583
		(1152.998)		(1150.631)		(242.015)		(1135.042)

Notes: Table shows regression results that compare the fit of alternative public firm objectives (the best-fitting one from each family) to the fit of profit maximization. The dependent variable is DSE as defined in equation (24). A negative (positive) estimate means the alternative objective fits better (worse) than profit maximization.

(2018), I regress  $DSE$  on a constant. Table 5 shows statistically significant improvements in fit compared to profit maximization. One concern with the estimates is that the market may not have been in equilibrium in the first couple of years. When I control for the years 2014 and 2015, I find both objectives yield an even greater improvement in fit over profit maximization for 2016 and later. Hence, the results may understate the enhancement in fit in the later years when the market is more likely to be in equilibrium.

I perform two sensitivity analyses to assess the robustness of my results to the identifying assumption that the ACA risk adjustment formula accurately captures selection. First, I vary the expected percentage  $\nu$  of collected premiums that is spent on claims from 80% (the MLR limit) to 100%. Figure A1a in Appendix A indicates this parameter has minimal impact on the RMSE. Second, I allow the private firms to manipulate their coding of patients by increasing and decreasing their risk scores by up to 20%; risk scores for the public firm are held fixed. Figure A1b indicates upcoding has some impact on the results, but the qualitative conclusion that the public firm places more weight on consumer surplus than market profit remains unaffected. If ACA risk scores overstate true risk by 20%, the best-fitting objective places 53.5% weight on consumer surplus and 46.5% weight on market profit. If ACA risk scores understate true risk by 20%, the best-fitting objective places 68% weight on consumer surplus and 32% weight on market profit.

### 3 Impact of Adding a Public Firm

In this section, I use the best fitting model from Section 2 ( $MW(\mathbf{p}_t, 0.63)$ ) to simulate the impact of adding a public firm. Several key stories emerge: (1) adding a public firm decreases premiums



and increases enrollment, although there is substantial heterogeneity in the magnitude of the change across markets; (2) disadvantaged subpopulations benefit most from the addition of a public firm; (3) adding a public firm improves social welfare in rural markets. The first subsection explains my simulation methodology and the second subsection summarizes my results.

### 3.1 Simulation Methodology

I simulate the impact of adding a public firm in five markets: Alameda County (rating area 6), Monterey, San Benito, and Santa Cruz Counties (rating area 9), Kern County (rating area 14), Orange County (rating area 18), and San Diego County (rating area 19). I choose these markets because they are diverse in their consumer demographic distribution and levels of firm competition. Alameda is an urban county with relatively limited insurer competition, whereas Orange and San Diego are urban counties with robust insurer competition. Rating area 9 and 14 are more rural with limited competition. Rating area 9 presents an interesting case because Valley expanded to San Benito in 2020 and Monterey in 2021. The methodology described below can be used to simulate adding a public firm to any market without one or removing the public firm from markets with one.

To simulate adding a public firm in a local market, I perform the following steps: (1) I add four plans (bronze, silver, gold, and platinum) to each consumer’s choice set that have the same plan characteristics as the existing public firm plans in California; (2) I allow a multiproduct public firm to set the premiums of the four plans to maximize the objective  $MW(\mathbf{p}_t, 0.63)$ , assuming plan average costs equal plan average costs of the existing public firms adjusted by the local market’s CMS geographic cost factor; and (3) I solve for the new vector of premiums that satisfies the private firms’ first-order conditions in equation (10) and the public firm’s first-order condition in equation (19a). The new vector of premiums satisfying the first-order conditions may not be unique; I tested several different starting points for each simulation and obtained the same premium vector.

Correctly simulating ACA risk adjustment in counterfactuals poses a significant computational challenge because there is dependency between local markets. Solving for the new vector of premiums in all 19 markets simultaneously is computationally infeasible with as many as 40 plans per market. [Saltzman \(2021\)](#) addresses this challenge by endogenizing risk adjustment at the state level, but reduces the number of premium variables by assuming the ratios of plan premiums across local markets remain fixed. [Tebaldi \(2022\)](#) simulates each local market separately and allows plan premiums to vary without restriction, but holds risk adjustment fixed in counterfactuals. I develop a computationally feasible method that endogenizes risk adjustment and allows local market premiums to vary without restriction. The key insight is that risk adjustment transfers in a local market



$m$  depend on consumer choices in other markets, but consumer choices in other markets do not respond to premium changes in market  $m$ . Mathematically, the partial derivative  $\frac{\partial q_{knt}(\mathbf{p}_t)}{\partial p_{jmt}} = 0$  because plan  $k$ 's demand in market  $n$  does not respond to plan  $j$ 's premium in market  $m$ . Using this fact, I only need to hold in memory consumer choices in other markets when simulating a change in market  $m$ . To see this, write  $rs_{kmt}(\mathbf{p}_t)$  as

$$\begin{aligned} rs_{kmt}(\mathbf{p}_t) &\equiv \frac{\hat{h}_{kmt}(\mathbf{p}_t)q_{kmt}(\mathbf{p}_t)}{\sum_{n \in M, l \in J_{nt}} \hat{h}_{lnt}(\mathbf{p}_t)q_{lnt}(\mathbf{p}_t)} \\ &= \frac{\hat{h}_{kmt}(\mathbf{p}_t)q_{kmt}(\mathbf{p}_t)}{\hat{h}_{lmt}(\mathbf{p}_t)q_{lmt}(\mathbf{p}_t) + \sum_{n \in M, n \neq m, l \in J_{nt}} \hat{h}_{lnt}(\mathbf{p}_t)q_{lnt}(\mathbf{p}_t)} \end{aligned} \quad (25)$$

The summation in the denominator of equation (25) depends on consumer choices in other markets, but neither the cost factor  $\hat{h}_{lnt}(\mathbf{p}_t)$  nor plan demand  $q_{lnt}(\mathbf{p}_t)$  depend on premiums in market  $m$ . Hence, I only need to hold in memory the summation  $\sum_{n \in M, n \neq m, l \in J_{nt}} \hat{h}_{lnt}(\mathbf{p}_t)q_{lnt}(\mathbf{p}_t)$  when simulating market  $m$ . The same reasoning applies for computing  $us_{kmt}(\mathbf{p}_t)$ .

For each simulation, I compute several outcome measures of the new equilibrium, including average premiums, enrollment, and social welfare. Net social welfare in year  $t$  is

$$SW_t = CS_t + \pi_t - \delta GS_t$$

where  $CS_t$  is consumer surplus,  $\pi_t$  is profit earned by the private firms, and  $GS_t$  is net government spending adjusted by the deadweight loss of taxation  $\delta$  that results from distortions in prices and consumer behavior. The deadweight loss of taxation corresponds to the additional compensation consumers need in order to obtain their original utility levels (i.e., before government spending) at the distorted prices (Hausman and Poterba, 1987). Following Hausman and Poterba (1987) and Decarolis et al. (2020), I set  $\delta = 1.3$ .

A shortcoming of logit discrete choice models is that they overestimate consumers' taste for variety, particularly if there are many products in the market (Petrin, 2002; Akerberg and Rysman, 2005). To address this issue, I compute two measures of consumer surplus. The first measure is

$$CS_t^{UB} = - \sum_{i \in I} \frac{1}{\beta_i^p} \ln \left( \sum_{j \in J} \exp(V_{ijt}(p; \beta_t)/\lambda)^\lambda + \exp(\beta_{it}^p \rho_{it}) \right) + \sum_{j \in J} \left[ q_{ijt}(p) * \frac{\beta_{ij}^y * y_{ij(t-1)}}{\beta_i^p} \right] \quad (26)$$

where the first term of equation (26) is the standard nested logit formula for consumer surplus and the second term "corrects" the first term to remove gains in welfare that result from inertia. I refer to this measure as the "upper bound" because of the logit model's tendency to overestimate consumers' taste for variety. A conservative lower bound measure of consumer surplus is

$$CS_t^{LB} = -\sum_{i \in I} \frac{1}{\beta_i^P} \ln \left( \sum_{j \in J_{\text{priv}}} \exp(V_{ijt}(p; \beta_t)/\lambda)^\lambda + \exp(\beta_{it}^P \rho_{it}) \right) + \sum_{j \in J_{\text{priv}}} \left[ q_{ijt}(p) * \frac{\beta_{ij}^y * y_{ij(t-1)}}{\beta_i^P} \right] \quad (27)$$

where  $J_{\text{priv}}$  is the set of plans sold only by the private firms. This lower bound measure assumes consumers obtain zero utility from purchasing the public firm's plans. The public firm may indirectly increase consumer utility by decreasing private firm premiums.

Total Profit  $\pi_t$  is computed as the sum of firm profits using equation (9). Note that the fixed cost term drops out in the firms' first-order conditions, but is included in equation (9). I compute firm-level fixed costs by year from the MLR reports.

Net government spending  $GS_t$  is calculated as

$$GS_t = PS_t + CSR_t + UC_t - PEN_t - \pi_t^{PUB} \quad (28)$$

where  $PS_t$  is spending on premiums subsidies,  $CSR_t$  is spending on CSRs,  $UC_t$  is uncompensated care for the uninsured,  $PEN_t$  is revenue collected from the individual mandate penalty, and  $\pi_t^{PUB}$  is profit earned by the public firm. The overwhelming majority of government spending in equation (28) is premium subsidy spending, which is calculated as the sum of subsidies received by each consumer in equation (2). Spending on CSRs is computed as

$$CSR_t = \sum_{i \in I, j \in J} s_j^g q_{ijt}(p) c_{jmt}(p)$$

where  $s_j^g$  is the expected share of claims paid by the government for plan  $j$ .<sup>18</sup> I calculate spending on uncompensated care by multiplying the number of uninsured that I estimate in each scenario by \$2,025, the estimated annual uncompensated care cost per uninsured<sup>19</sup>, and a factor accounting for the change in the uninsured population's risk score. Penalty revenue collected by the government equals  $\sum_{i \in I} q_{i0t} \rho_{it}$ , where  $q_{i0t}$  is the household's probability of choosing the outside option. I also include any operating gains or losses incurred by the public firm in government spending. I do not include any one-time entry costs that the public firm may incur.

<sup>18</sup>Ignoring moral hazard, the government's expected outlay is  $94 - 70 = 24\%$  of claims for the 94% CSR plan,  $87 - 70 = 17\%$  of claims for the 87% CSR plan, and  $73 - 70 = 3\%$  of claims for the 73% CSR plan. To account for moral hazard, I follow Pope et al. (2014) and assume there is no moral hazard for consumers in the 73% plan, while consumers in the 87% and 94% plans increase consumption by 12%. Including moral hazard, the  $s_j^g = 26.88\%$  for the 94% CSR plan,  $s_j^g = 19.04\%$  for the 87% CSR plan, and  $s_j^g = 3\%$  for the 73% CSR plan.

<sup>19</sup>I multiply the per-capita amount of medical costs that are paid on behalf of the nonelderly uninsured as estimated by Coughlin et al. (2014) by an inflation factor using data from the National Health Expenditure Accounts to adjust the estimates to the time frame of this study (Centers for Medicare and Medicaid Services, 2018).

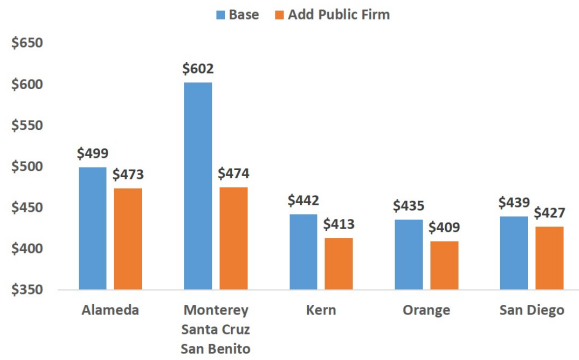
## 3.2 Results

Figure 9 summarizes the impact of adding a public firm on premiums and enrollment. Adding a public firm reduces premiums and increases enrollment with considerable heterogeneity across markets. Average unsubsidized premiums decline by 2.7% in San Diego County and by 21.2% in Monterey, San Benito, and Santa Cruz Counties. Average subsidized premiums also decline in all markets. Changes in enrollment are consistent with the premium changes. The percentage of consumers enrolled in the exchange increases by 6.3 percentage points in Monterey, San Benito, and Santa Cruz Counties, but by only 1.9 percentage points in Orange County. Across the five markets, the public firm captures 11.9% market share. The private plans retain significant market share and remain viable in the presence of a public firm.

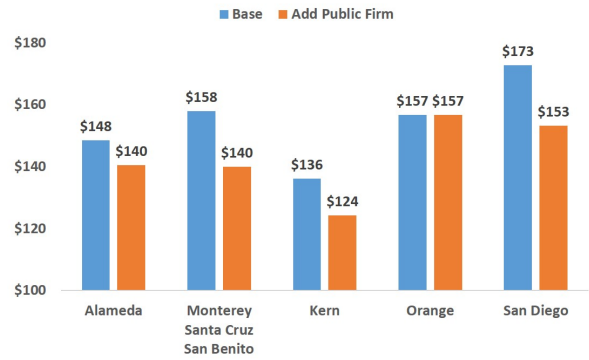
Figure 10 summarizes the welfare impact of adding a public firm. Adding a public firm reduces annual per-capita profit. Profit decreases by less than 20% in four of the five markets and by only 5.2% in San Diego County, making it unlikely that adding a public firm would lead to a mass private firm exodus. In contrast, profit falls by 48.5% in Monterey, Santa Cruz, and San Benito Counties where in the Base case, profit was nearly double the profit earned in the other markets. The impact on government spending is mixed, depending on reductions in premium subsidy spending (because of lower premiums) and operating losses incurred by the public firm. Annual per-capita net government spending falls by \$779 in Monterey, Santa Cruz, and San Benito Counties because the reductions in premium subsidy spending dominate. Operating losses incurred by the public firm dominate in San Diego County, resulting in annual per-capita net government spending increasing by \$244. Adding a public firm enhances consumer surplus. The upper bound measure of the annual per-capita consumer surplus gain exceeds \$100 in all five markets; the lower bound measure of the annual per-capita consumer surplus gain exceeds \$50 in four of the five markets. Annual per-capita consumer surplus gains are largest in Monterey, Santa Cruz, and San Benito Counties (\$76-\$271) and smallest in Orange County (\$7-\$101). The net effect of adding a public firm on social welfare varies considerably by market. Annual per-capita social welfare increases \$266 to \$462 in Monterey, Santa Cruz, and San Benito Counties, but decreases \$173 to \$261 in San Diego County. Changes in per-capita social welfare are smaller in Alameda, Kern, and Orange Counties.

Figure 11 shows the distributional impact of adding a public firm. The African American and Hispanic communities benefit most. African American enrollment increases 10.5% and Hispanic enrollment increases 10.6%. Annual per-capita consumer surplus increases \$250 for African American consumers and \$236 for Hispanic consumers. For consumers earning less than 250% of FPL, annual per-capita consumer surplus increases by \$185 because of reduced subsidized premiums. Single consumers and those over age 55 also have relatively large consumer surplus gains.

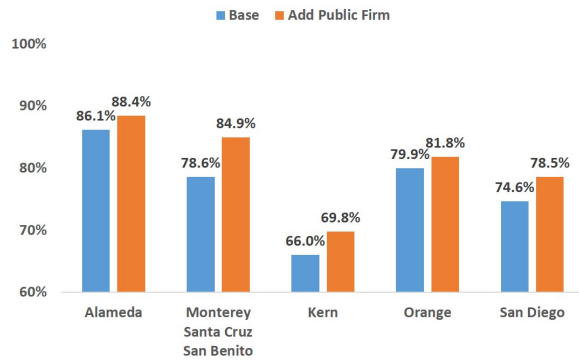
Figure 9: Impact of Adding Public Firm on Premiums and Enrollment



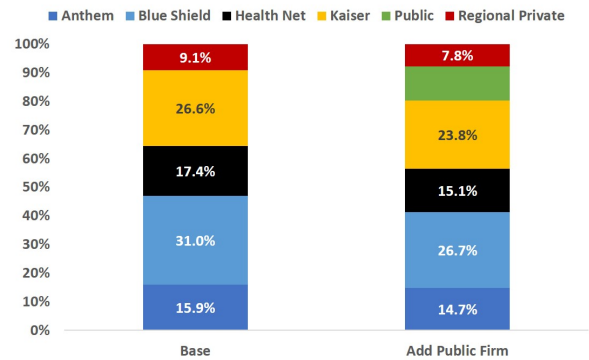
(a) Average Unsubsidized Premiums



(b) Average Subsidized Premiums



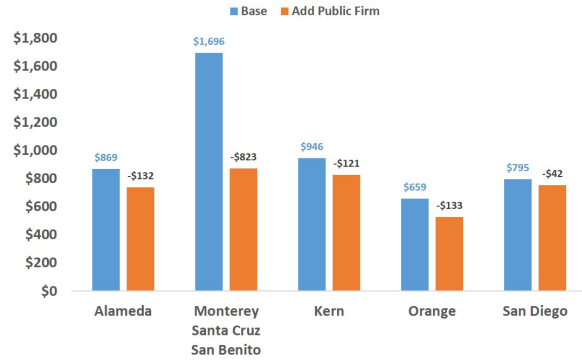
(c) % of Consumers Enrolled in Exchange



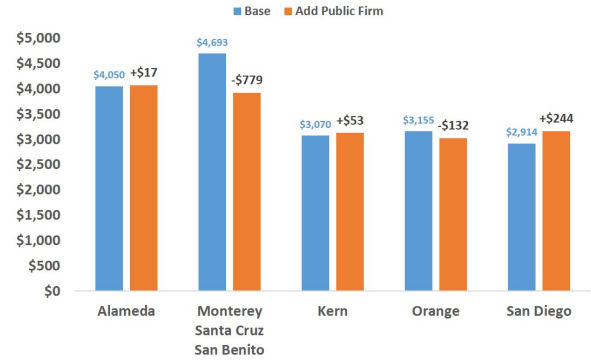
(d) Firm Market Share

Notes: Figure shows the impact of adding a public firm on average unsubsidized premiums (panel a), average subsidized premiums (panel b), the percentage of consumers enrolled in the exchange (panel c), and firm market share (panel d). The effects of these policy changes are shown for five markets without a public firm in the ACA/Base scenario: Alameda County (rating area 6), Monterey, Santa Cruz, and San Benito Counties (rating area 9), Kern County (rating area 14), Orange County (rating area 18), and San Diego County (rating area 19). Average premiums in panels (a) and (b) are computed using enrollee plan shares as weights. Firm market shares in panel (d) is across the five rating areas.

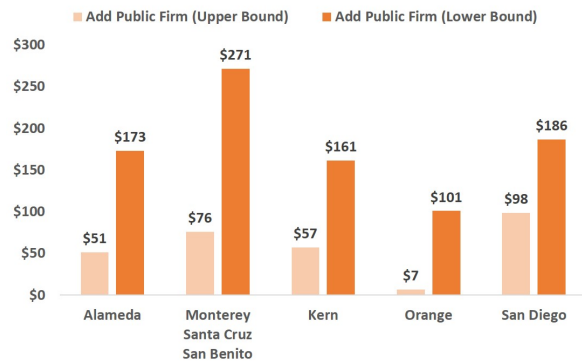
Figure 10: Impact of Adding Public Firm on Social Welfare



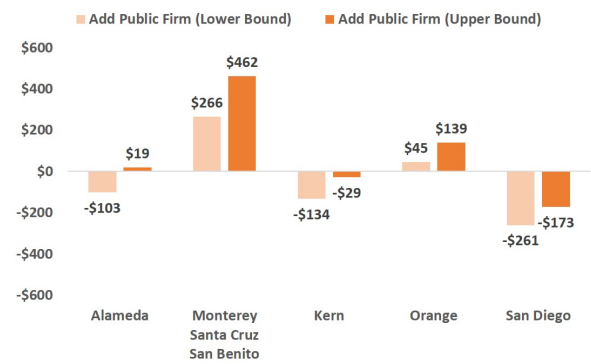
(a) Annual Per-Capita Profit



(b) Annual Per-Capita Net Government Spending



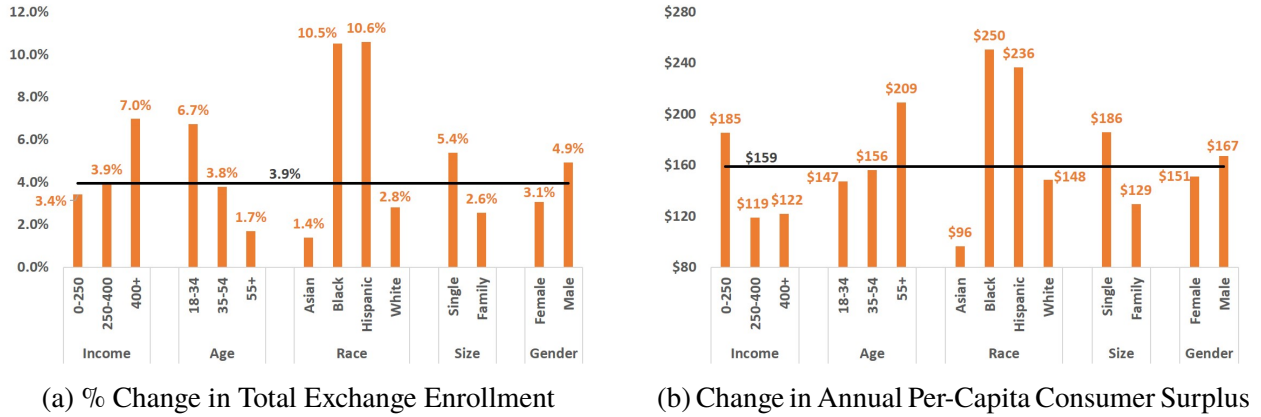
(c) Change in Annual Per-Capita Consumer Surplus



(d) Change in Annual Per-Capita Social Welfare

Notes: Figure shows the impact of adding a public firm on annual per-capita profit (panel a), annual per-capita government spending (panel b), the change in annual per-capita consumer surplus relative to the Base scenario (panel c), and the change in annual per-capita social welfare relative to the Base scenario (panel d). The effects of these policy changes are shown for five markets without a public firm in the ACA/Base scenario: Alameda County (rating area 6), Monterey, Santa Cruz, and San Benito Counties (rating area 9), Kern County (rating area 14), Orange County (rating area 18), and San Diego County (rating area 19). Panels (c) and (d) report changes rather than levels because absolute consumer surplus levels are not identified. In panels (c) and (d), the scenario “Add Public Firm (Lower Bound)” uses equation (27) to compute consumer surplus and the scenario “Add Public Firm (Upper Bound)” uses equation (26) to compute consumer surplus.

Figure 11: Distributional Impact of Adding Public Firm



Notes: Figure shows the distributional impact of adding a public firm on the percentage change in the number of consumers enrolled (panel a) and the change in consumer surplus (panel b). The effects of adding a public firm are summarized across five markets: Alameda County (rating area 6), Monterey, Santa Cruz, and San Benito Counties (rating area 9), Kern County (rating area 14), Orange County (rating area 18), and San Diego County (rating area 19). The distributional impacts are shown by income (as a percentage of FPL), age, race, family size, and gender. Consumer surplus is calculated using equation (26). The thick black lines indicate the average percentage change (3.9%) and average consumer surplus change (\$159) in panels (a) and (b), respectively.

My model precludes the possibility that private firms exit when a public firm is added. Although my simulations indicate all private insurers continue to earn positive profits when a public firm is added, some may find better uses of their factors of production. Figure A2 in Appendix B considers a counterfactual scenario where I add a public firm and remove the private insurer earning the least profit in each of the five markets. For the most part, I find the results are qualitatively similar to introducing a public firm without the loss of a private insurer. Average (unsubsidized) premiums fall substantially, particularly in Monterey, Santa Cruz, and San Benito. As before, annual per-capita social welfare increases in Monterey, Santa Cruz, and San Benito, but falls in San Diego. The remaining private insurers largely benefit from the exit of the lowest-profit private insurer, particularly Anthem and Kaiser. Total coverage, however, declines in Alameda and Orange Counties. My results are therefore largely robust to the loss of the lowest-profit private insurer.

## 4 Proposed Policy Interventions

I now use my estimated empirical framework to evaluate proposed alternatives for a public option in health insurance. The objective of this section is to understand the economic tradeoffs and welfare

implications of alternative policy designs. The first subsection provides institutional background on the public option. The second subsection evaluates alternative design features of the public option. The third subsection compares the public option to enhancing subsidies for private plans.

## 4.1 What is the Public Option in Health Insurance?

The term “public option” has been used to describe a broad range of proposed policy reforms. The public option most commonly refers to a publicly insured plan that competes directly with private health insurance plans in a managed competition market ([Halpin and Harbage, 2010](#)). The idea represents a compromise between a “Medicare-for-All” or single payer system where the government serves as the sole health insurer and the ACA exchange model of managed competition between private health insurance plans. Advocates of the public option point to its potential to reduce administrative costs, stimulate competition between insurers, and leverage the bargaining power of a large government payer to negotiate lower provider reimbursement rates. Opposition to the public option is strong among private insurers, who fear they will be unable to compete with the public option, and providers, who fear losing revenue due to lower reimbursement rates.

The idea of a public option first surfaced in California in 2001, but failed to gain traction at the state or federal level ([Halpin and Harbage, 2010](#)). The public option featured prominently in the original debate on the ACA, but was omitted from the final legislation due to lack of political support in Congress. Adding a public option to the ACA exchanges continues to be a top political issue. President Biden proposed including a public option in the ACA exchanges during the 2020 presidential campaign. Most recently, four separate bills for a public option were proposed during the 117<sup>th</sup> Congress.<sup>20</sup> As in the California setting, these proposals add public plans to the existing state exchanges that are structured largely the same as private firm plans.<sup>21</sup> The proposals diverge on how to reimburse providers. Two of the bills allow the public firm to negotiate directly with providers; negotiated rates must be no less than reimbursement rates paid by Medicare and no more than the average reimbursement rate paid by the private firms on the exchange. The public firm sets reimbursement rates unilaterally at Medicare levels or slightly above under the other two bills. All four proposals require providers that take Medicare to also accept the public firm. At the state level, Washington, Colorado, and Nevada have adopted legislation to implement reforms similar to a public option in their state exchanges. The state legislation differs from the federal proposals

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<sup>20</sup>These include the CHOICE Act, the Public Option Deficit Reduction Act, the Medicare-X Choice Act of 2021, and the Choose Medicare Act of 2021 ([Monahan and Lucia, 2022](#)).

<sup>21</sup>The Medicare-X Choice Act and Choose Medicare Act of 2021 also add public plans to the employer-sponsored insurance market.



by having private firms administer the public plans using public financing (Nevada) or requiring private firms to offer certain public plans using their own financing (Washington and Colorado).<sup>22</sup>

## 4.2 Evaluating Alternative Design Features of the Public Option

In this section, I evaluate alternative policy scenarios for the public option, including (1) adding a profit-maximizing private firm instead of a public firm with an altruistic objective; (2) adding a public firm that can negotiate “Medicare-like” reimbursement rates; and (3) adding a public firm in a market without inertia. The first scenario compares the relative importance of competition versus firm objectives, the second asks whether a public firm that negotiates lower, “Medicare-like” reimbursement rates can achieve welfare gains, and the third investigates whether inertia protects incumbent private firms from entry of a public firm. There are other design features, such as administrative cost savings and plan quality requirements, that I considered using my model, but omit for brevity. For each simulation, I add four plans (bronze, silver, gold, and platinum) to each consumer’s choice set in Alameda, Monterey/San Benito/Santa Cruz, Kern, Orange, and San Diego. The reported results in Figures 12 and 13 are enrollee-weighted across the five simulated markets. The results for the scenarios “Base” and “Add Public Firm” are the same as in Figures 9 and 10, but reported as an enrollee-weighted average across the five simulated markets.

Figures 12 and 13 show there is a substantial difference between adding an altruistic public firm and a profit-maximizing firm. This difference occurs regardless of whether consumers view the profit-maximizing firm as a public firm (i.e., the private dummy  $w_j = 0$ ) or as a private firm (i.e., the private dummy  $w_j = 1$ ). Average unsubsidized premiums decline 1.5% with  $w_j = 0$  and 2.7% with  $w_j = 1$  when adding a profit-maximizer, far smaller than the 6.4% reduction when adding a public firm. Average subsidized premiums decline 12.8% with  $w_j = 0$  and 13.5% with  $w_j = 1$  when adding a profit-maximizer, greater than the 6.2% reduction when adding a public firm. Total enrollment growth is similar, but adding a profit-maximizer results in substantially less redistribution in market share between the private firms. The profit-maximizer takes 4.7% market share with  $w_j = 0$  and 2.2% market share with  $w_j = 1$ , compared to 11.9% market share for the altruistic public firm. Not surprisingly, firm profits remain substantially higher when adding a profit maximizer. Adding a profit-maximizer results in lower average subsidized premiums and therefore higher consumer surplus. However, the additional spending on premium-linked subsidies results in annual per-capita government spending increasing \$140 with  $w_j = 0$  and \$117 with  $w_j = 1$ , compared to a decrease in annual per-capita government spending of \$24 when adding a public firm.

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<sup>22</sup>These plans must meet stronger cost containment, quality, and network breadth requirements compared to the private plans.



Overall, annual per-capita social welfare decreases \$73 with  $w_j = 0$  and \$44 with  $w_j = 1$  when adding a profit-maximizer, but increases \$34 when adding a public firm. These results indicate that the public firm’s altruistic objective plays a key role in determining the public option’s impact.

Introducing a strong public option that can negotiate Medicare-like reimbursement rates would have a substantially different impact. The previous literature has generally found that Medicare reimbursement is approximately between 45% and 85% of private firm reimbursement (Lopez et al., 2020; Cooper et al., 2019; White and Whaley, 2019; Selden, 2020; Pelech, 2018; Ginsburg, 2010). I simulate “Medicare-like” reimbursement rates by multiplying claims paid by the public firm by 50% and solving for the premiums satisfying the firms’ first-order conditions. Adding a strong public option results in average unsubsidized premiums declining by 15.0% and average subsidized premiums declining by 18.3%. The percentage of consumers enrolled in the exchange increases by 5.9 percentage points and the public firm captures 25.1% market share. Lower premiums reduce government spending on premium subsidies, but operating losses by the public firm and the cost of unreimbursed claims<sup>23</sup> result in greater net government spending. As a result, the change in annual per-capita social welfare is negative when introducing a strong public option. The change in welfare would be positive, however, if unreimbursed claims were not included as a social cost.

Finally, Figures 12 and 13 suggest that consumer inertia protects incumbent private firms from entry of the public option. I simulate the elimination of inertia by setting the inertia variable  $y_{ij(t-1)}$  equal to zero and solving for the premiums satisfying the firms’ first-order conditions. Average unsubsidized premiums decrease by 11.5% when adding a public firm without inertia, nearly double the 6.4% decrease when adding a public firm with inertia. Average subsidized premiums decrease by 14.1% when adding a public firm without inertia, more than double the 6.2% decrease when adding a public firm with inertia. Total enrollment is largely unchanged when adding a public firm without inertia because of two offsetting forces: (1) an enrollment increase due to lower premiums and (2) an enrollment decrease because some consumers elect to forgo coverage when inertia is eliminated. Annual per-capita profit plummets by 50.7% when adding a public firm without inertia, compared to a decline of 18.6% when adding a public firm with inertia. This result indicates that inertia is a key source of firm market power that insulates private firms from entry of a public option. Annual per-capita government spending declines by about \$200 because the lower premiums reduce spending on premium-linked subsidies. To compute the change in annual per-capita consumer surplus, I assume that inertia represents a choice error (e.g., inattention) as in equation (26)

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<sup>23</sup>To compute social welfare, I include unreimbursed claims as a cost to the government (that would likely be paid through provider tax write-offs or disproportionate share payments as is done for Medicare). Unreimbursed claims are likely to have many general equilibrium impacts that are beyond the scope of this paper.

rather than a true switching cost. Adding a public option without inertia increases annual per-capita consumer surplus by \$689 and annual per-capita social welfare by \$527 if inertia is the result of a choice error. These changes are smaller if inertia represents a true switching cost.

### 4.3 Enhancing Premium Subsidies for Private Firm Plans

Enhancing premium subsidies for private firm plans is an alternative policy intervention to a public option for expanding coverage and increasing affordability. There are numerous ways to allocate premium subsidies that may have different welfare implications, such as targeting subsidies to certain groups (Tebaldi, 2022; Polyakova and Ryan, 2021). I focus on enhanced subsidies under the ARP here because they have been implemented in practice. I simulate ARP subsidies by (1) replacing the income-based contribution caps in the first column of Table 2 with the ones in the second column and (2) solving for the new vector of premiums that satisfies the firms' first-order conditions.

Figures 12 and 13 summarize the results. In contrast to adding a public firm which increases supply, enhancing premium subsidies under the ARP increases demand. Consequently, average unsubsidized premiums increase 1.5% when adding ARP subsidies, but decrease 6.4% when adding a public firm. In contrast, the larger subsidies imply that average subsidized premiums decrease 22.1%, compared to a 6.2% decrease from adding a public firm. The substantial reduction in subsidized premiums results in a 5.9 percentage point increase in total exchange coverage, compared to a 3.0 percentage point increase in total exchange coverage from adding a public firm.

Whereas adding a public firm decreases profit, enhancing premium subsidies increases annual per-capita profit 14.7%. Consumers also benefit; annual per-capita consumer surplus increases \$209 when adding ARP subsidies, compared to an increase of \$53 when adding a public firm. These gains are more than offset by spending on premium subsidies. Annual per-capita social welfare decreases \$362 when adding ARP subsidies, but increases \$34 when adding a public firm.<sup>24</sup>

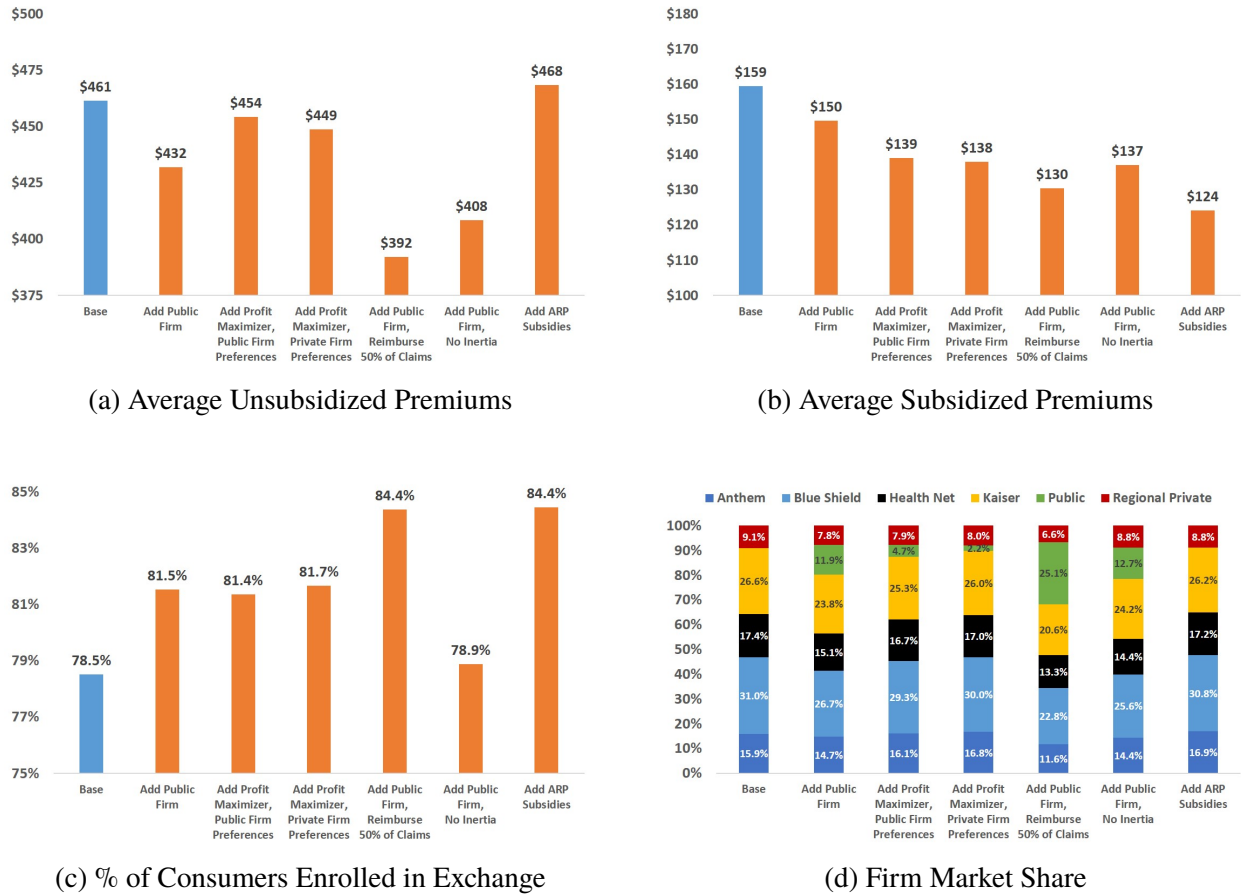
## 5 Conclusion

Governments often have to decide if and how to intervene in markets that are perceived to undersupply a socially consequential good or service. I study the equilibrium and social welfare implications of one such intervention: introducing a public firm that competes with private firms. I estimate a mixed oligopoly model with alternative objectives using data from the California ACA exchange,

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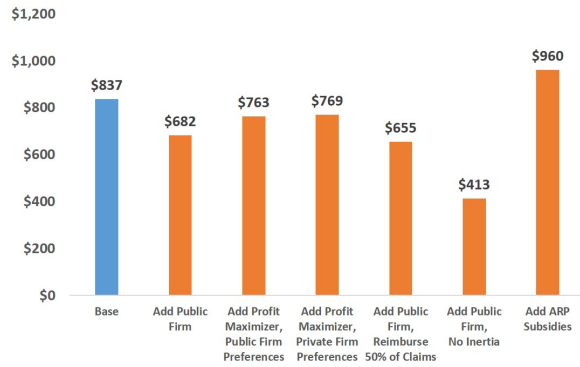
<sup>24</sup>These welfare calculations do not account for any one-time entry costs for the public firm or the cost of setting up and administering an income verification system for determining premium subsidy eligibility and levels.

Figure 12: Impact of Policy Interventions on Premiums and Enrollment

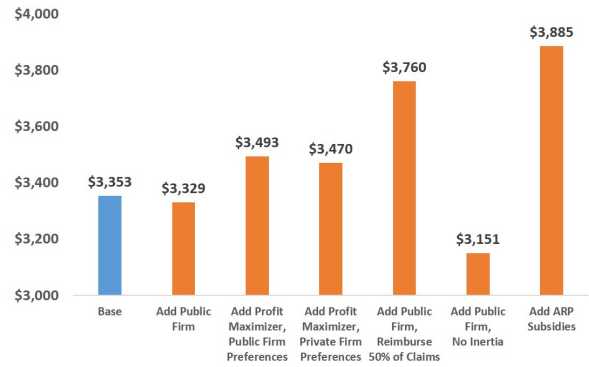


Notes: Figure shows the impact of policy interventions on average unsubsidized premiums (panel a), average subsidized premiums (panel b), the percentage of consumers enrolled in the exchange, and firm market share (panel d). I consider six interventions: (1) adding a public firm as it currently exists in California (same as Figure 9); (2) adding a firm that maximizes profit but consumers perceive as a public firm; (3) adding a public firm that maximizes profit and consumers perceive as a private firm; (4) adding a public firm that reimburses 50% of medical claims; (5) adding a public firm in a market where there is no consumer inertia; and (6) enhancing premium subsidies according to the ARP. The reported results are enrollee-weighted across the five simulated markets (Alameda, Monterey/San Benito/Santa Cruz, Kern, Orange, and San Diego).

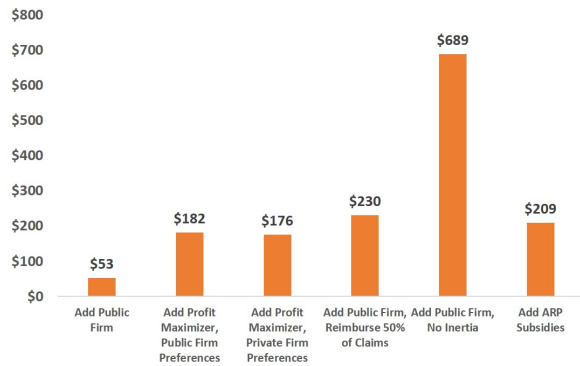
Figure 13: Impact of Policy Interventions on Social Welfare



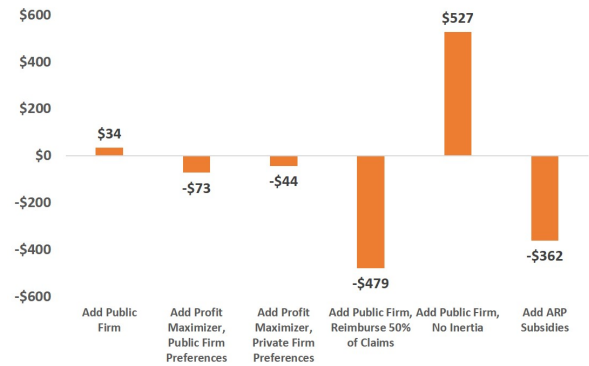
(a) Annual Per-Capita Profit



(b) Annual Per-Capita Net Government Spending



(c) Change in Annual Per-Capita Consumer Surplus



(d) Change in Annual Per-Capita Social Welfare

Notes: Figure shows the impact of policy interventions design on annual per-capita profit (panel a), annual per-capita government spending (panel b), the change in annual per-capita consumer surplus relative to the Base scenario (panel c), and the change in annual per-capita social welfare relative to the Base scenario (panel d). I consider six interventions: (1) adding a public firm as it currently exists in California (same as Figure 9); (2) adding a firm that maximizes profit but consumers perceive as a public firm; (3) adding a public firm that maximizes profit and consumers perceive as a private firm; (4) adding a public firm that reimburses 50% of medical claims; (5) adding a public firm in a market where there is no consumer inertia; and (6) enhancing premium subsidies according to the ARP. The reported results are enrollee-weighted across the five simulated markets (Alameda, Monterey/San Benito/Santa Cruz, Kern, Orange, and San Diego). I compute consumer surplus using equation (26).

where approximately one-third of consumers in three different counties had access to a public firm. In the best-fitting model, the public firm places 63% weight on consumer surplus and 37% weight on producer surplus and consumers from disadvantaged subpopulations have stronger preferences for the public firm. I use the model to simulate the impact of adding a public firm to five different markets in the California ACA exchange. Adding a public firm reduces premiums by up to 21.2%, improves social welfare in rural markets with limited competition, and increases consumer surplus most for disadvantaged subpopulations. Adding a public firm compares favorably with a prominent alternative intervention, enhancing premium subsidies. Enhancing subsidies under the ARP increases (unsubsidized) premiums by increasing demand and reduces social welfare in all markets. My simulations also indicate the potential impact of public option proposals in health insurance is quite sensitive to its design, including the public firm's objective and reimbursement levels.

The analysis in this paper can be extended in several directions. First, it would be informative to endogenize firm entry or exit. In four of the five markets I simulate, I find firm profit falls by less than 20% when adding a public firm and all firms continue to earn positive profit, making it unlikely that private firms would exit. For the most part, firm exits are minimal in the California exchange and one firm (Oscar) even entered Los Angeles County where a public firm was present. Anthem exited most California markets in 2018, but one of the three it remained in was Santa Clara County. Another useful extension would be to endogenize formation of the public firm's provider network. Previous work has considered network formation in other contexts assuming firms maximize profit ([Gowrisankaran et al., 2015](#); [Ho et al., 2017](#); [Ho and Lee, 2019](#); [Ghili, 2022](#); [Shepard, 2022](#)).

My study has important policy implications. Introducing a public firm that competes with private firms can be an effective intervention in rural markets with limited competition and may be an important vehicle for expanding health care access in disadvantaged subpopulations. Adding a public firm compares favorably to enhancing subsidies for purchasing plans from private firms, a leading alternative intervention that was adopted in the ARP. When ARP subsidies come up for renewal in 2025, policymakers should consider whether an alternative approach such as a public option would be a more efficient use of taxpayer funds. The empirical framework advanced in this paper can illuminate the tradeoffs involved with alternative interventions.

## References

Abdulkadiroğlu, A., J. D. Angrist, S. M. Dynarski, T. J. Kane, and P. A. Pathak (2011). Accountability and flexibility in public schools: Evidence from boston's charters and pilots. *The Quarterly Journal of Economics* 126(2), 699–748.

- Abito, J. M. (2014). Welfare gains from optimal pollution regulation. *Wharton School, University of Pennsylvania, unpublished manuscript*.
- Akerberg, D. A. and M. Rysman (2005). Unobserved product differentiation in discrete-choice models: Estimating price elasticities and welfare effects. *RAND Journal of Economics*, 771–788.
- Aguirregabiria, V. and P. Mira (2007). Sequential estimation of dynamic discrete games. *Econometrica* 75(1), 1–53.
- Bajari, P., C. L. Benkard, and J. Levin (2007). Estimating dynamic models of imperfect competition. *Econometrica* 75(5), 1331–1370.
- Blumberg, L. J., J. Holahan, E. Wengle, and C. Elmendorf (2019). Is there potential for a public option to reduce premiums of competing insurers? *The Urban Institute, Washington DC*.
- Capps, C. S., D. W. Carlton, and G. David (2020). Antitrust treatment of nonprofits: Should hospitals receive special care? *Economic Inquiry* 58(3), 1183–1199.
- Casadesus-Masanell, R. and P. Ghemawat (2006). Dynamic mixed duopoly: A model motivated by linux vs. windows. *Management Science* 52(7), 1072–1084.
- Centers for Medicare and Medicaid Services (2018, January). *National Health Expenditure Data*. <https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical.html>.
- Centers for Medicare and Medicaid Services (2022, June). *Premium Stabilization Programs*. <https://www.cms.gov/CCIIO/Programs-and-Initiatives/Premium-Stabilization-Programs>.
- Chang, T. and M. Jacobson (2017). What do nonprofit hospitals maximize? evidence from california’s seismic retrofit mandate. *NBER Working Paper Series*.
- Chetty, R., J. N. Friedman, and J. E. Rockoff (2014). Measuring the impacts of teachers i: Evaluating bias in teacher value-added estimates. *American economic review* 104(9), 2593–2632.
- Cooper, Z., S. V. Craig, M. Gaynor, and J. Van Reenen (2019). The price ain’t right? hospital prices and health spending on the privately insured. *The quarterly journal of economics* 134(1), 51–107.
- Coughlin, T., J. Holahan, K. Caswell, and M. McGrath (2014, May). *Uncompensated Care for Uninsured in 2013: A Detailed Examination*. <https://kaiserfamilyfoundation.files.wordpress.com/2014/05/8596-uncompensated-care-for-the-uninsured-in-2013.pdf>.

- Craig, S. V. (2022). Competition in employer sponsored health insurance: Implications for a public option. Technical report, Working paper.
- De Fraja, G. and F. Delbono (1990). Game theoretic models of mixed oligopoly. *Journal of economic surveys* 4(1), 1–17.
- Decarolis, F. (2015, April). Are insurers gaming the low income subsidy design? *The American Economic Review* 105(4), 1547–1580.
- Decarolis, F., M. Polyakova, and S. Ryan (2020, May). Subsidy design in privately provided social insurance: Lessons from medicare part d. *Journal of Political Economy* 128(5).
- Department of Managed Health Care (2016). *Premium Rate Review Filings*. <http://wpsso.dmhc.ca.gov/ratereview/>.
- Diamond, R., M. J. Dickstein, T. McQuade, P. P. R. Diamond, M. J. Dickstein, T. McQuade, and P. Persson (2021, March). Insurance without commitment: Evidence from the aca marketplaces. Working paper.
- Domurat, R. (2018). How do supply-side regulations in the aca impact market outcomes? evidence from california. UCLA Working Paper.
- Doraszelski, U., G. Lewis, and A. Pakes (2018). Just starting out: Learning and equilibrium in a new market. *The American Economic Review* 108(3), 565–615.
- Drake, C. (2019). What are consumers willing to pay for a broad network health plan?: Evidence from covered california. *Journal of Health Economics* 65, 63–67.
- Dranove, D., C. Garthwaite, and C. Ody (2017). How do nonprofits respond to negative wealth shocks? the impact of the 2008 stock market collapse on hospitals. *The RAND Journal of Economics* 48(2), 485–525.
- Einav, L., A. Finkelstein, and P. Tebaldi (2019, March). Market design in regulated health insurance markets: Risk adjustment vs. subsidies. Working paper.
- Epple, D., R. E. Romano, and M. Urquiola (2017). School vouchers: A survey of the economics literature. *Journal of Economic Literature* 55(2), 441–92.
- Fiedler, M. (2020). Capping prices or creating a public option: How would they change what we pay for health care? *USC-Brookings Schaeffer Initiative for Health Policy*.
- Gagnepain, P. and M. Ivaldi (2002). Incentive regulatory policies: the case of public transit systems in france. *RAND Journal of Economics*, 605–629.
- Gaynor, M., K. Ho, and R. J. Town (2015). The industrial organization of health-care markets. *Journal of Economic Literature* 53(2), 235–84.



- Geruso, M. and T. Layton (2020). Upcoding: evidence from medicare on squishy risk adjustment. *Journal of Political Economy* 128(3), 984–1026.
- Ghili, S. (2022). Network formation and bargaining in vertical markets: The case of narrow networks in health insurance. *Marketing Science* 41(3), 501–527.
- Ginsburg, P. B. (2010). *Wide variation in hospital and physician payment rates evidence of provider market power*. Center for Studying Health System Change Washington (DC).
- Gowrisankaran, G., A. Nevo, and R. Town (2015). Mergers when prices are negotiated: Evidence from the hospital industry. *American Economic Review* 105(1), 172–203.
- Halpin, H. A. and P. Harbage (2010). The origins and demise of the public option. *Health Affairs* 29(6), 1117–1124.
- Hausman, J. and J. Poterba (1987). Household behavior and the tax reform act of 1986. *Journal of Economic Perspectives* 1(1), 101–119.
- Ho, K., J. Hogan, and F. Scott Morton (2017). The impact of consumer inattention on insurer pricing in the medicare part d program. *The RAND Journal of Economics* 48(4), 877–905.
- Ho, K. and R. S. Lee (2019). Equilibrium provider networks: Bargaining and exclusion in health care markets. *American Economic Review* 109(2), 473–522.
- Horwitz, J. R. and A. Nichols (2009). Hospital ownership and medical services: Market mix, spillover effects, and nonprofit objectives. *Journal of health economics* 28(5), 924–937.
- Jaffe, S. and M. Shepard (2020). Price-linked subsidies and imperfect competition in health insurance. *American Economic Journal: Economic Policy* 12(3), 279–311.
- Kautter, J., G. Pope, M. Ingber, S. Freeman, L. Patterson, M. Cohen, and P. Keenan (2014). The hhs-hcc risk adjustment model for individual and small group markets under the affordable care act. *Medicare and Medicaid Research Review* 4(3), 1–46.
- Kessler, D. and M. McClellan (2000). Is hospital competition socially wasteful? *Quarterly Journal of Economics* 115, 577–615.
- Lakdawalla, D. and T. Philipson (2006). The nonprofit sector and industry performance. *Journal of Public Economics* 90(8-9), 1681–1698.
- Lim, C. S. and A. Yurukoglu (2018). Dynamic natural monopoly regulation: Time inconsistency, moral hazard, and political environments. *Journal of Political Economy* 126(1), 263–312.
- Liu, J., A. Wilks, S. Nowak, P. Rao, and C. Eibner (2020). Effects of a public option on health insurance costs and coverage. *The RAND Corporation, Santa Monica, CA*.
- Lopez, E., T. Neuman, G. Jacobson, and L. Levitt (2020). *How Much More Than Medicare Do Private Insurers Pay? A Review of the Literature*. Kaiser Family Foundation.

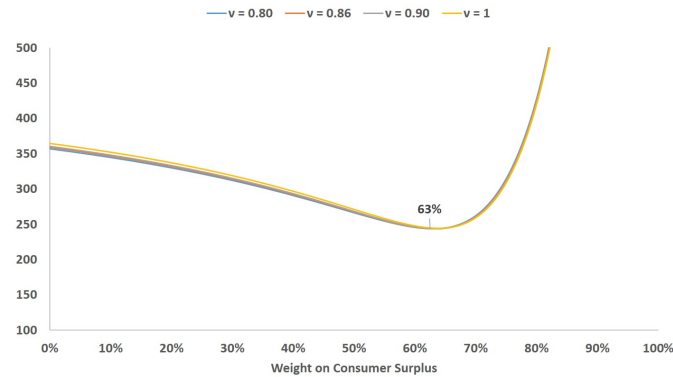


- Malani, A., T. Philipson, and G. David (2003). Theories of firm behavior in the nonprofit sector. a synthesis and empirical evaluation. In *The governance of not-for-profit organizations*, pp. 181–216. University of Chicago Press.
- Matsumura, T. (1998). Partial privatization in mixed duopoly. *Journal of Public Economics* 70(3), 473–483.
- Monahan, C. and K. Lucia (2022, November). Congressional proposals for a federal public health insurance option. *The Commonwealth Fund*.
- Nevo, A. (2001). Measuring market power in the ready-to-eat cereal industry. *Econometrica* 69(2), 307–342.
- Newhouse, J. P. (1970). Toward a theory of nonprofit institutions: An economic model of a hospital. *The American economic review* 60(1), 64–74.
- Panhans, M. (2019). Adverse selection in aca exchange markets: Evidence from colorado. *American Economic Journal: Applied Economics* 11(2), 1–36.
- Pauly, M. and M. Redisch (1973). The not-for-profit hospital as a physicians’ cooperative. *The American Economic Review* 63(1), 87–99.
- Pelech, D. (2018). *An Analysis of Private-sector Prices for Physicians’ Services*. Congressional Budget Office Washington (DC).
- Petrin, A. (2002). Quantifying the benefits of new products: The case of the minivan. *Journal of political Economy* 110(4), 705–729.
- Petrin, A. and K. Train (2010). A control function approach to endogeneity in consumer choice models. *Journal of Marketing Research* 47(1), 3–13.
- Philipson, T. J. and R. A. Posner (2009). Antitrust in the not-for-profit sector. *The Journal of Law and Economics* 52(1), 1–18.
- Polyakova, M. and S. Ryan (2021). Subsidy targeting with market power. *The National Bureau of Economic Research*.
- Pope, G., H. Bachofer, A. Pearlman, J. Kautter, E. Hunter, D. Miller, and P. Keenan (2014). Risk transfer formula for individual and small group markets under the affordable care act. *Medicare and Medicaid Research Review* 4(3), 1–46.
- Ruggles, S., S. Flood, R. Goeken, M. Schouweiler, and M. Sobek (2022, February). *IPUMS USA: Version 12.0 [dataset]*.
- Saltzman, E. (2019). Demand for health insurance: Evidence from the california and washington aca exchanges. *Journal of Health Economics* 63, 197–222.

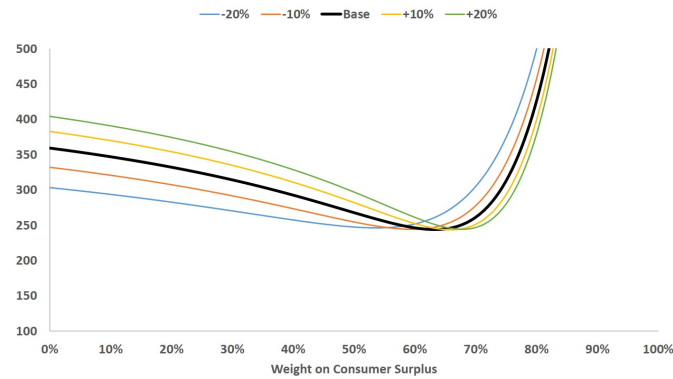
- Saltzman, E. (2021). Managing adverse selection: Underinsurance vs. underenrollment. *The RAND Journal of Economics* 52(2), 359–381.
- Selden, T. M. (2020). Differences between public and private hospital payment rates narrowed, 2012–16: A data analysis comparing payment rate differences between private insurance and medicare for inpatient hospital stays, emergency department visits, and outpatient hospital care. *Health Affairs* 39(1), 94–99.
- Sen, A. P. and T. DeLeire (2018). How does expansion of public health insurance affect risk pools and premiums in the market for private health insurance? evidence from medicaid and the affordable care act marketplaces. *Health Economics* 27, 1877–1903.
- Shepard, M. (2022). Hospital network competition and adverse selection: evidence from the massachusetts health insurance exchange. *American Economic Review* 112(2), 578–615.
- Shepard, M., K. Baicker, and J. Skinner (2020). Does one medicare fit all? the economics of uniform health insurance benefits. *Tax Policy and the Economy* 34(1), 1–41.
- Steinberg, R. (1986). The revealed objective functions of nonprofit firms. *The RAND Journal of Economics*, 508–526.
- Tebaldi, P. (2022, January). Estimating equilibrium in health insurance exchanges: Price competition and subsidy design under the aca. Working paper.
- Timmins, C. (2002). Measuring the dynamic efficiency costs of regulators’ preferences: Municipal water utilities in the arid west. *Econometrica* 70(2), 603–629.
- Train, K. (2009). *Discrete Choice Methods with Simulation*. Cambridge: Cambridge University Press.
- White, C. and C. Whaley (2019). Prices paid to hospitals by private health plans are high relative to medicare and vary widely. *Santa Monica, CA: Rand Corporation. Found on 10*.
- Wolak, F. A. (1994). An econometric analysis of the asymmetric information, regulator-utility interaction. *Annales d’Economie et de Statistique*, 13–69.

## A Sensitivity to Risk Adjustment

Figure A1: Robustness of Risk Adjustment Assumption



(a) Sensitivity of Results to Amount Transferred

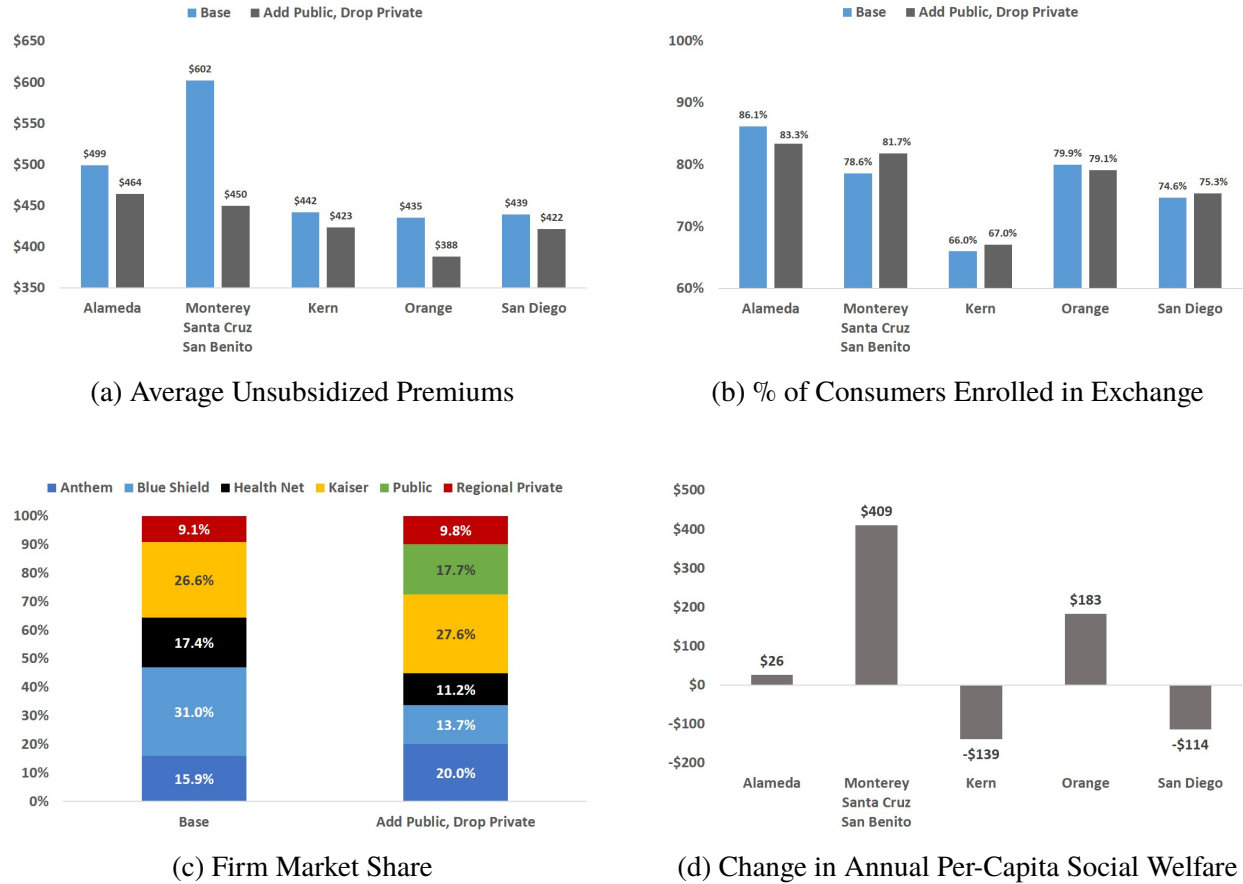


(b) Sensitivity of Results to Risk Score Upcoding

Notes: Figure shows the robustness of the model fit to the assumption that risk adjustment accurately captures adverse selection. Both panels show how well each model predicts observed average claims in terms of the root means square (RMSE) for objective family (17a). Panel (a) shows the robustness of the model fit to the amount of risk adjustment transferred between firms (i.e., the parameter  $\nu$  in equation 13). The value of  $\nu$  was 1 through 2017 and 0.86 after 2017. Panel (b) shows the robustness of the model fit to risk score upcoding. I compare the Base case to alternative settings where the true risk score relative to the public firm is 20% lower (-20%), 10% lower (-10%), 10% higher (+10%), and 20% higher (+20%).

## B Robustness Checks

Figure A2: Impact of Adding the Public Option and Dropping the Lowest-Profit Private Insurer



Notes: Figure shows the impact of adding a public option and removing the private insurer earning the least profit on average subsidized premiums (panel a), the percentage of consumers enrolled in the exchange (panel b), firm market share (panel c), and the change in annual per-capita social welfare (panel d). The impact is shown for five markets without a public option in the ACA/Base scenario. Average premiums in panels (a) and (b) are computed using enrollee plan shares as weights. Firm market shares in panel (d) is across the five rating areas.

## C Model Parameter Estimates

Table A1: Demand Parameter Estimates

	(1)	(2)		(1)	(2)
Monthly Premium (\$100) ×	−0.409*** (0.003)	−0.406*** (0.004)	AV	2.940*** (0.020)	2.726*** (0.021)
Ages 0 to 17	−0.271*** (0.012)	−0.241*** (0.013)	Silver	0.749*** (0.006)	0.824*** (0.006)
Ages 18 to 34	−0.718*** (0.005)	−0.712*** (0.005)	HMO	−0.353*** (0.005)	0.003 (0.007)
Ages 35 to 54	−0.380*** (0.004)	−0.382*** (0.004)	Network Breadth		1.989*** (0.019)
Male	−0.039*** (0.004)	−0.039*** (0.004)	Anthem	0.166*** (0.007)	0.292*** (0.008)
Family	−0.094*** (0.003)	−0.101*** (0.004)	Blue Shield	0.347*** (0.007)	0.142*** (0.008)
Asian	−0.240*** (0.005)	−0.250*** (0.005)	Kaiser	0.689*** (0.006)	1.116*** (0.009)
Black	−0.167*** (0.011)	−0.165*** (0.011)	Health Net	0.107*** (0.007)	−0.124*** (0.007)
Hispanic	−0.332*** (0.005)	−0.336*** (0.005)	Nesting Parameter	0.710*** (0.004)	0.763*** (0.004)
Other race	−0.043*** (0.007)	−0.047*** (0.008)	Previous Choice ×	2.364*** (0.045)	2.446*** (0.047)
Private Insurer ×	0.477*** (0.024)	0.509*** (0.026)	Ages 0 to 17	−0.405*** (0.032)	−0.425*** (0.034)
Ages 0 to 17	0.302*** (0.033)	0.268*** (0.034)	Ages 18 to 34	0.159*** (0.014)	0.172*** (0.015)
Ages 18 to 34	−0.407*** (0.013)	−0.419*** (0.013)	Ages 35 to 54	0.077*** (0.012)	0.078*** (0.013)
Ages 35 to 54	−0.251*** (0.013)	−0.251*** (0.013)	Male	0.248*** (0.013)	0.263*** (0.014)
Male	−0.341*** (0.010)	−0.347*** (0.011)	Family	−0.335*** (0.010)	−0.362*** (0.011)
Family	0.261*** (0.009)	0.275*** (0.009)	Asian	−0.289*** (0.012)	−0.287*** (0.013)
Asian	0.310*** (0.014)	0.338*** (0.015)	Black	0.216*** (0.040)	0.243*** (0.042)
Black	−0.811*** (0.024)	−0.832*** (0.025)	Hispanic	0.197*** (0.013)	0.207*** (0.014)
Other race	0.543*** (0.023)	0.566*** (0.024)	Other race	−0.173*** (0.020)	−0.184*** (0.021)
Hispanic	−0.822*** (0.010)	−0.835*** (0.011)	250% to 400% of FPL	0.302*** (0.012)	0.319*** (0.013)
250% to 400% of FPL	0.343*** (0.010)	0.338*** (0.010)	> 400% of FPL	1.171*** (0.021)	1.232*** (0.022)
> 400% of FPL	0.420*** (0.013)	0.408*** (0.013)	Anthem	−0.144*** (0.027)	−0.122*** (0.028)
			Blue Shield	0.287*** (0.028)	0.313*** (0.029)
			Kaiser	0.010 (0.016)	0.021 (0.018)
			Health Net	0.046** (0.018)	−0.055*** (0.019)
			HMO	0.218*** (0.024)	0.277*** (0.024)
			AV	1.470*** (0.048)	1.615*** (0.052)
			Silver	−0.906*** (0.012)	−0.984*** (0.013)

Notes: Robust standard errors are in parentheses (\*\*\*) indicates statistical significance at the 1% level, \*\* at the 5% level, and \* at the 10% level). Specification (1) omits the network breadth variable and Specification (2) network breadth variable. In Specification (2), I exclude United and Contra Costa plans from consumers' choice sets because network data are unavailable for these two insurers. Contra Costa was only in the market in 2014 and United was only in the market in 2016. Parameter estimates for the market fixed effects in equation (1) are omitted.

Table A2: Estimated Risk Score Parameters

Silver	0.771*** (0.016)	Share Ages 26 to 34	−1.140*** (0.085)
Gold	0.841*** (0.020)	Share Ages 35 to 44	−0.119 (0.249)
Platinum	1.085*** (0.020)	Share Male	−0.230 (0.250)
Share Ages 18 to 25	−3.533*** (0.316)	Share Special Enrollment	0.104 (0.107)

Notes: Robust standard errors are in parentheses (\*\*\*) indicates statistical significance at the 1% level, \*\* at the 5% level, and \* at the 10% level). Specification (1) omits the network breadth variable and specification (2) network breadth variable. Network breadth data are unavailable for Contra Costa and United. Parameter estimates for the market fixed effects in equation (1) are omitted.

## D CMS Geographic Cost Factors

Table A3: CMS Geographic Cost Factors

Rating Area	Counties	2014	2015	2016	2017	2018	2019
1	Northern Counties	1.04	1.04	1.14	1.16	1.35	1.38
2	North Bay Area	1.20	1.20	1.22	1.21	1.21	1.19
3	Greater Sacramento	1.15	1.14	1.19	1.18	1.13	1.12
4	San Francisco	0.92	1.23	1.24	1.26	1.24	1.25
5	Contra Costa	1.15	1.15	1.19	1.18	1.17	1.16
6	Alameda	1.17	1.15	1.16	1.16	1.15	1.15
7	Santa Clara	1.19	1.15	1.19	1.19	1.15	1.12
8	San Mateo	1.19	1.29	1.34	1.34	1.30	1.30
9	Monterey, Santa Cruz, San Benito	1.24	1.23	1.31	1.42	1.43	1.53
10	Central Valley	1.03	0.96	1.02	1.00	1.13	1.10
11	Fresno, Kings, Madera	0.99	0.96	0.95	0.93	0.88	0.84
12	San Luis Obispo, Santa Barbara, Ventura	1.09	1.10	1.10	1.10	1.02	1.02
13	Imperial, Inyo, Mono	1.34	1.30	1.12	1.02	1.11	1.03
14	Kern	0.95	0.94	0.96	0.93	0.91	0.91
15	Los Angeles East	0.83	0.81	0.79	0.80	0.80	0.81
16	Los Angeles West	0.93	0.93	0.91	0.92	0.94	0.95
17	Riverside, San Bernardino	0.90	0.89	0.86	0.84	0.88	0.88
18	Orange	0.96	0.96	0.94	0.95	0.95	0.96
19	San Diego	1.01	1.02	1.01	0.99	0.99	0.95

Notes: Figure shows the geographic cost factors published by CMS by rating area and year. Rating areas with higher-than-average cost have a geographic cost factor greater than 1 and those with lower-than-average cost have a geographic cost factor less than 1.