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Abstract

The Health Insurance Marketplaces have received considerable attention for their narrow network health insurance plans. Yet, little is known about consumer tastes for network breadth and how it affects health plan selection. I estimate demand for health plans in California's Marketplace, Covered California. Using 2017 individual enrollment data and provider network directories obtained from Covered California, I develop a geospatial measure of network breadth that reflects the physical locations of households and in-network providers. I find that households are sensitive to network breath in their plan choices. Overall willingness to pay (WTP) to switch from a narrow to a broad network plan is $22.09 in monthly premiums. Variation in this WTP by age indicates that a selection mechanism exists whereby older households sort into broader network plans. I also find that Covered California households are highly premium sensitive, which may be a result of plan standardization regulations in Covered California.

Keywords: ACA; Health Insurance Marketplace; Covered California; discrete choice; health insurance; provider network

JEL Codes: I11, I13, I18, C21, C25

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1. Introduction

Limited provider network health insurance plans, commonly known as “narrow” network plans, have grown in popularity since the implementation of the Affordable Care Act (ACA) in 2014. They have become common in the Health Insurance Marketplaces created by the ACA, but also are expanding in employer-based health insurance markets. Approximately 21% of 2017 Marketplace health plans had narrow networks (Polsky, Weiner, and Zhang 2017); 9% of large employers offered a narrow network plan in 2017 (Claxton et al. 2017). Narrow network plans tend to have lower premiums (Polsky, Cidav, and Swanson 2016; Sen et al. 2017; Dafny et al. 2017), but they may adversely impact enrollees’ access to and choice of providers, timely receipt of care, and financial security (Baicker and Levy 2015; Corlette et al. 2014).

It is not clear to what extent Marketplace consumers are willing to trade lower premiums for a narrower provider network. Survey evidence suggests both premiums and networks are important components of health plan choice for Marketplace consumers (Hamel et al. 2015). Commonwealth Fund researchers report that, among surveyed Marketplace enrollees that had the option to choose a narrow network with a lower premium, 45% did so and 54% did not (Gunja, Collins, and Bhupal 2017). Recent studies of Marketplace health plan demand indicate that consumers are premium elastic (Abraham et al. 2017; DeLeire and Marks 2015), but they do not estimate network elasticities. And while the literature does examine the relationship between networks and plan choice in other contexts, such as employer-sponsored insurance (Gruber and McKnight 2016; Ho 2006) and the pre-ACA Massachusetts health exchange (Shepard 2016; Ericson and Starc 2015), these studies may not be generalizable to the post-ACA individual insurance market.

Because of the decreased access and choice that may result from enrolling in narrow network plans and their prevalence in the individual health insurance market, it is important that policymakers understand the trade-off consumers are willing to make between network breadth and premiums. To fill this gap, I analyze demand for health insurance plans in the 2017 in California's State-Based Health Insurance Marketplace, Covered California. Covered California is the largest Health Insurance Marketplace. It covered over 1.5 million Californians in January 2017, which was 13% of Marketplace enrollment nationwide (Centers for Medicare & Medicaid Services 2017). In 2017, each of Covered California's 19 rating areas – geographic units in which insurers offer plans – had at least three competing insurers, each offering at least five plans. This, in conjunction with standardized benefits that drastically limit variation in plan characteristics except for premiums and network breadth, make it an ideal context in which to study Marketplace consumers' tastes for network breadth.

I use two rich data sets from Covered California on plan enrollment and provider networks to estimate plan choice. I obtain individual-level enrollment data from the 2017 plan year (i.e., the fourth open enrollment period). These data contain information on consumers' plan choices, geographic location, and demographics. I also obtain audited 2017 network directories from Covered California which list providers by their associated networks.

With these two data sets, I estimate discrete choice models of health plan choice using random parameters mixed logit models. I then calculate own-network breadth and own-premium elasticities and semi-elasticities of demand for different demographic groups. Own-network breadth semi-elasticities increase with age, income, and household size; own-premium semi-elasticities decrease with age, income, and household size. I also calculate willingness to pay to switch from a narrow to a broad network plan. Using the interquartile range of network breadth to define the difference between a broad and a narrow network plan, I find that the mean household is willing to pay roughly $22 in monthly premiums to switch from a narrow network to a broad network. This parameter, however, hides large heterogeneity in willingness to pay, particularly on age. For example, the mean single household with a premium tax credit in the youngest age group (18-29) is willing to pay about $3 to switch from a narrow to a broad network. Their counterpart in the oldest age group is willing to pay roughly $30. This gap in willingness to pay between age groups indicates that a selection mechanism exists whereby older households sort into plans with broader networks, though this is complicated by considerable heterogeneity in willingness to pay *within* age groups.

I also find that Covered California households are highly sensitive to premiums in their plan choices, more so than in other individual insurance markets. This finding is consistent with recent literature that finds that product standardization and standardized presentation of products results in more price sensitive consumers (Ericson and Starc 2016; Schmitz and Ziebarth 2017).

This study makes a methodological contribution to the literature by developing a geospatial measure of network breadth to use in demand estimation. Specifically, I define network breadth as the percentage of providers within a fixed-mile radius of consumers' homes (e.g., 15 miles) covered by a network. This measure is more precise than those that defined network breadth as the percentage of in-network providers covered within geopolitical units such as counties or rating areas, which may exhibit drastic variation in size and not capture network breadth as it is experienced by consumers. For example, in Covered California, rating area 1 consists of the northern third of California, while rating area 4 is San Francisco County. In rating area 1, consumers can live hundreds of miles away from in-network providers from whom they are unlikely to seek care. Yet, consumers living in rating area 4 could easily seek care outside of their rating area. As this example makes clear, measures of network breadth based on geopolitical boundaries are unlikely to capture variation in network breadth as it is experienced by consumers. While the literature contains another geospatial measure of network breadth known as network value (Capps, Dranove, and Satterthwaite 2003), using it requires the estimation of a separate demand system and often necessitates that the researcher have access to claims data. My geospatial measure of network breadth preserves much of the nuance of the network value approach without placing these constraints upon the researcher.

The paper proceeds as follows. Section 2 describes the market structure of the Health Insurance Marketplaces and Covered California. Section 3 reviews data sources and develops my network breadth measure. Section 4 specifies a discrete choice logit model of plan choice for Covered California health plans, develops an empirical model, and discusses identification. Results are presented in Section 5. Section 6 discusses findings and reviews policy implications. Section 7 concludes.

2. The ACA, Covered California, and Network Adequacy

2.1. The Affordable Care Act and Health Insurance Marketplaces

The Patient Protection and Affordable Care Act of 2010 (ACA) made major changes to the individual health insurance market, most of which went into effect in 2014 (Office of the Legislative Council 2010). The law banned insurers from denying coverage due to pre-existing conditions, as well as dropping enrollees from coverage due to changes in health status. It further mandated that all plans cover a minimum set of essential health benefits. Annual and lifetime coverage caps were banned, and maximum out-of-pocket payments were capped. Each plan must have a “metal” level that corresponds to its actuarial value – platinum, gold, silver, and bronze for 90, 80, 70, and 60% actuarial value, respectively. Catastrophic plans also are available to individuals under the age of 30. To reduce adverse selection, the ACA also implemented an individual mandate, requiring that individuals without insurance pay a pro-rated, income-based penalty. Though it has since been repealed, the mandate was in effect in 2017.

Insurers offering plans in the individual market are subject to modified community rating. Plan premiums may vary only by age, family size, smoking status, and geography. Under this form of modified community rating, individuals are assigned an age-adjustment factor based on their age, which is valued at one for 21-year-olds and gradually increases to a maximum of three for those aged 64 and above.[2] Age-adjustment factors are added together for each household member seeking coverage and multiplied by a plan's base premium. Most states charge a smoking surcharge, typically 1.5 times the base premium; California is not one of them. Each state designs its own rating areas. Rating areas typically are clusters of counties, but may be based on three-digit zip codes or metropolitan statistical areas.

The ACA created Health Insurance Marketplaces where individuals can shop for individual health plans. Consumers may easily compare Marketplace plans in a standardized format. Individuals with household incomes at or below 400% of the Federal Poverty Level (FPL) lacking affordable employer offers of health insurance qualify for income-based advanced premium tax credits to purchase Marketplace plans.[3] The size of a household's premium tax credit is based on its income as percentage of the Federal Poverty Level (FPL) and the premium of the second-lowest cost silver plan. Premium tax credits may be used to purchase any non-catastrophic plan. Premium tax credit-eligible Marketplace consumers with incomes below 250%

[2] The age-adjustment factor for those under age 21 is 0.635.

[3] Medicaid eligibility pre-empts premium tax credit eligibility, meaning that those under 138% of FPL in Medicaid expansion states and 100% of FPL in non-expansion states do not qualify for premium tax credits. Both the healthcare.gov and the Covered California websites direct individuals with Medicaid-eligible incomes to apply for Medicaid.

of the FPL also qualify for cost-sharing reduction subsidies that increase the actuarial value of silver plans by reducing their coinsurance rates, deductibles, and copays.[4] They only may be applied to silver plans, meaning that silver plans are often the dominant choice for cost-sharing reduction-eligible consumers (DeLeire et al. 2017). Each state has the option of having its own Marketplace, but all operate under a common set of ACA regulations. In 2017, 39 states opted to have the federal government manage their Marketplace using the healthcare.gov platform. The remaining 12 states, including California, operate their own State-Based Marketplaces that grant them greater regulatory flexibility.

While the ACA regulates many features of Marketplace plans, insurers are largely free to vary the breadth and composition of their plans' networks. The ACA has a reasonable access standard for networks, which requires that Marketplace plans maintain a network that is "sufficient in number and types of providers to assure that all services shall be accessible without unreasonable delay" (Centers for Medicare and Medicaid Services 2016). However, these standards do not appear to have been enforced.[5]

2.2. The Covered California Marketplace

California's State-Based Marketplace, Covered California, has operated since 2014. In January 2017, it insured 1.5 million individuals, approximately 13% of the 12.2 million individuals covered nationwide by the Health Insurance Marketplaces (Centers for Medicare & Medicaid Services 2017). Figure 1 shows that Covered California is divided into 19 rating areas.

[4] The discontinuation of CSR payments in late 2017 does not directly affect consumers because insurers are legally obligated to provide the CSR reductions.

[5] CMS' 2017 Letter to Issuers stipulates time- and distance-based network adequacy standards for ten specialties (Center for Consumer Information & Insurance Oversight 2016), though based on my conversations with insurers these standards do not appear to have been enforced. Regardless, the Trump Administration shifted network adequacy regulation to the states on February 27, 2017 (Department of Health and Human Services 2017).

Seventeen of the rating areas consist of groups of counties. The other two divide Los Angeles County by three-digit zip codes.

Figure 1: Rating Areas in Covered California

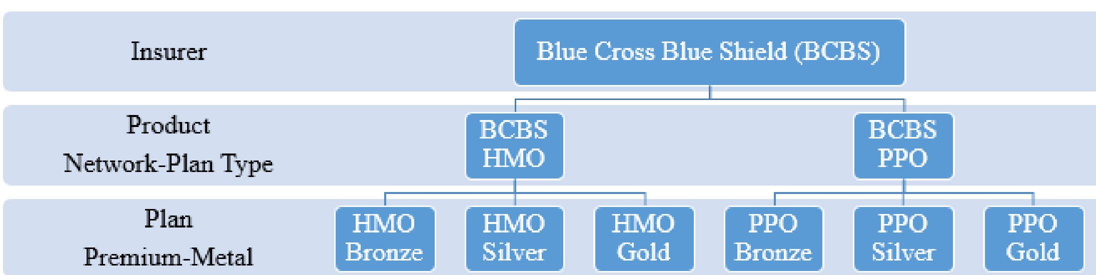
Source: CoveredCA.com

Every health plan in Covered California is associated with a product and an insurer. Covered California insurers offer one or more products. Products determine *all* plan benefit characteristics except metal level and premium. Product characteristics include plan type (e.g., HMO, PPO), network, and prescription drug formularies. For each product an insurer offers, they must provide *exactly* one health plan for each of the metal levels available in Covered California:

Platinum, gold, silver, bronze, high-deductible bronze, minimum coverage (i.e., catastrophic), and cost-sharing silver plans.

An example of the insurer-product-plan hierarchy is provided in Figure 2. The Covered California insurer Blue Cross Blue Shield (BCBS) offers two products, an HMO and a PPO. Each product has nine associated plans, one for each metal level (only gold, silver, and bronze are shown in Figure 2 for simplicity). Network and plan type vary across products (i.e., BCBS HMO and BCBS PPO), but not within plans associated with the same product (e.g., BCBS HMO Silver and BCBS HMO Bronze). Aside from metal level, premiums are the only characteristics that may vary across plans within the same product. Also note that BCBS *cannot* offer more than one plan with the same metal level for a given product. They are prohibited from doing so by Covered California; the only way for BCBS to offer two plans of the same metal level is to offer separate products.

Figure 2: Insurer-Product-Plan Levels in Covered California for Blue Cross Blue Shield



Notes: Platinum, minimum coverage, high deductible, and cost-sharing plans are excluded for illustrative purposes. This type of structure exists for all Covered California insurers, though the number of products ranges from one to three depending on the insurer.

Covered California also requires standardized cost-sharing for each metal level (Covered California 2016). For example, all silver Covered California plans must have a $35 copay for primary care, and a $2,500 ($5,000) deductible for individuals (families). These regulations are intended to reduce choice overload (Ericson and Starc 2016) and adverse selection on actuarial value (Bindman et al. 2016). Appendix Table 1 shows how primary care copays, deductibles, and maximum out-of-pocket levels are set by metal level.

Unlike many other states' Marketplaces, Covered California is characterized by robust enrollment and insurer competition. Table 1 shows each rating area's enrollee population, the number of competing insurers, the number of plans offered, market concentration measured by a Herfindahl-Hirchsman Index (HHI), and the rating area's lowest-premium silver plan for a single 21-year old (i.e., the base premium). Rating areas vary in size from 10,005 enrollees (rating area 13) to 185,167 enrollees (rating area 16). The modal rating area has four competing insurers, and the number of competitors ranges from three (rating area 12) to seven (rating area 16). Kaiser is the largest insurer in terms of enrollment. It insures 307,532 Covered California households, followed by BCBS (271,204), Anthem (195,098), Molina (122,024), and HealthNet (111,218). Enrollees have many plans from which to choose. Available plans range from 19 in rating area 6 to 38 in rating area 16.[6] Market concentration as measured by HHI is noticeably higher in northern California (i.e., rating areas 1-12) due to Kaiser's large market shares. As is typical, HHI is correlated with higher premiums. For example, the lowest-premium silver plan in northern San Francisco (rating area 4) is $318.35, over $100 more than the lowest-premium silver plan in Los Angeles larger rating area (rating area 16) at $200.43. And, as shown in Appendix Table 2, they are also different in terms of insurer composition and market share.

Covered California has more stringent Marketplace network regulations than the Federally-facilitated Marketplace. It requires that primary care and mental health providers must be available within 30 minutes or 15 miles of each covered person's residence or workplace.

[6] Plan totals do not include catastrophic plans, which only are available to those under age 30. Cost-sharing reduction plans are not included in addition to silver plans because consumers only have access to one cost-sharing reduction tier (none, 73, 87, or 94).

Similar standards exist for hospitals and some specialists at 60 minutes or 30 miles. California also mandates networks cover one full-time physician per 1,200 covered persons and one full-time primary care physician per 2,000 covered persons, and that some providers must be available during evenings and weekends. (California Department of Insurance 2016).

Table 1: Population, Competition, and Premiums across Covered California Rating Areas

Rating Area	Rating Area Characteristic				
	Enrollees	Insurers	Plans Offered	Market Concentration	Premium ($)
1	44,364	4	23	6,296	314.24
2	43,764	5	28	4,243	309.11
3	65,489	5	31	4,530	314.24
4	36,287	6	31	3,243	318.35
5	33,814	5	24	5,511	314.24
6	54,677	3	19	5,159	322.51
7	51,207	5	30	3,229	287.62
8	21,463	5	27	4,697	347.32
9	23,352	4	23	3,554	322.51
10	51,387	4	23	5,201	274.01
11	26,179	4	23	3,509	253.83
12	53,342	3	19	3,982	256.52
13	10,005	4	20	5,470	242.63
14	14,610	4	23	2,754	233.37
15	134,423	6	34	2,228	196.21
16	185,167	7	38	1,814	200.43
17	99,926	5	30	2,308	200.43
18	105,486	6	34	2,177	227.86
19	100,730	6	38	1,922	232.08

Notes: Market concentration is measured according to a Herfindahl-Hirchsman Index (HHI). Premium is measured as the lowest pre-premium tax credit silver premium for a single, 21-year-old adult (i.e., the base premium).

3. Data and Measures

3.1. Covered California Network Data

I obtained lists of providers associated with each Covered California plan in February of 2017 through a public records act request under the California Public Records Act. Covered

California consolidates all provider network directories into one unified file after receiving individual directories from insurers. The file is reviewed for accuracy by a third party to ensure Covered California insurers are compliant with California's network adequacy laws. Providers are listed by their National Provider Identifiers (NPI) and network associations.

I use providers' NPIs to determine their specialty and location. I obtain provider specialty by merging the Covered California network data with the full replacement monthly NPI file (i.e., NPPES downloadable file) distributed by CMS (Centers for Medicare and Medicaid Services 2017). The NPI file lists each provider's primary specialty according to a standard taxonomy distributed by the Washington Publishing Company (Washington Publishing Company 2018). I obtain providers' addresses by merging the Covered California network data with CMS Physician Compare file (Centers for Medicare and Medicaid Services 2018). The Physician Compare File lists addresses for Medicare-affiliated providers.[7] Upon merging addresses to the Covered California network data, I geocode providers' addresses (i.e., convert them to longitude-latitude coordinates) using Microsoft's Bing Maps application programming interface. I also use the Physician Compare file to identify providers that are *not* associated with any Covered California network.

Network breadth often is measured as the share of providers in a rating area who are included in a network (Polsky, Weiner, and Zhang 2017; Sen et al. 2017; Dafny et al. 2017). This approach is problematic for demand estimation due to variation in the physical size of geographic rating areas. Consider a large rating area such as California's rating area one. In this rating area, providers in the numerator and/or the denominator of the network breadth measure

[7] A 2015 Kaiser Family Foundation survey found that 93% of non-pediatric primary care physicians accepted Medicare, 2% did not, and 5% were not applicable or did not respond (Boccuti et al. 2015). Even those physicians that did not accept Medicare would be listed in the Physician Compare File if they previously accepted Medicare.

may practice hours away from enrollees' homes. Enrollees are unlikely to select a plan based on whether distant providers are in a plan's network.

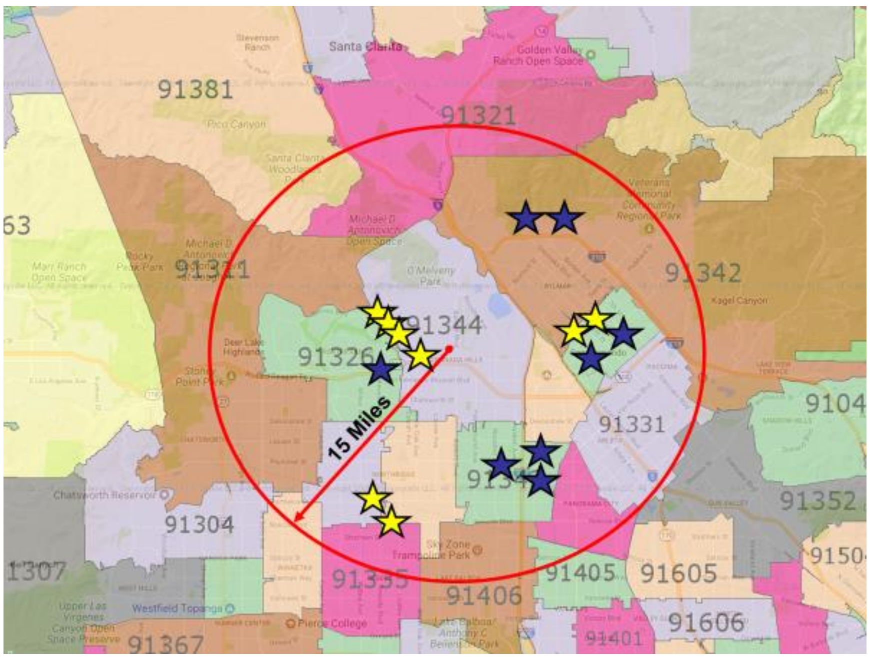
I use the geographic information contained in the network data to develop a network breadth measure that addresses this limitation. I define network breadth as the number of in-network primary care providers (PCPs) over the total number of PCPs *within 15 miles of a five-digit zip code*. This measure captures the breadth of a network available to an enrollee based on their home zip code. I select 15 miles as my distance measure because California's network adequacy laws mandate that PCPs must be available within 15 miles of a plan's enrollees (California Department of Insurance 2016). PCPs are defined as general practitioners, family practitioners, general internists, and nurse practitioners.[8] I select PCPs because they are the primary point of contact with the healthcare system for most privately insured patients, seeking care from them does not require enrollees to have a certain medical condition, and they often act as gatekeepers to the remainder of the medical system. While it would be preferable to separate demand for network breadth by provider type, this is not possible due to high collinearity between network breadth across provider types. For example, the correlation between PCP network breadth as defined above and specialist network breadth, defined as all internal medicine subspecialists, is over 0.95. Primary care provider network breadth thus serves as a more general measure of overall network breadth rather than a specific measure of PCP network breadth.

Figure 3 shows an example of the calculation of network breadth for a hypothetical network in the 91344 five-digit zip code in northwest Los Angeles. I begin by using a data set

[8] The standard definition of PCPs for the purposes of antitrust litigation includes general practitioners, family practitioners, and general internists (United States District Court for the District of North Dakota Western Division 2017). Pediatricians and OBYGNs are excluded because they, by themselves, cannot constitute a primary care network. I add nurse practitioners to this definition because they can function as a substitute for general practitioners, family practitioners, and general internists.

distributed by the Census Bureau[9] to identify the geographic centroid of the 91344 five-digit zip code. I proceed by drawing a 15-mile radius from the centroid. The centroid and its corresponding radius are shown in red in Figure 3. Then, I identify the number of in-network PCPs and total PCPs practicing within the 15-mile radius. In-network PCPs are shown with stars in Figure 3; eight are inside of the 15-mile radius, implying a PCP network size of eight for the example network in the 91344 five-digit zip code. Finally, in-network PCPs are divided by total PCPs and multiplied by 100 to calculate PCP network breadth.

Figure 3: Sample Network Breadth Calculation for the 91344 Zip Code



Notes: Image generated from http://maps.huge.info/ and subsequently edited. The red dot is the 91344 zip code centroid. A 15-mile radius is drawn from the centroid. The numerator of the network breadth measure for the 91344 zip code is the number of in-network primary care providers (PCPs) within the radius. In-network PCPs are shown as yellow stars. The denominator of the network breadth measure for the 91344 zip code is the total number of PCPs within the 15-mile radius. Out-of-network PCPs are shown as blue stars. In this example, there are eight in-network PCPs and eight out-of-network PCPs within the 15-mile radius. Network breadth is in the 91344 zip code is calculated as 100*(8/(8+8))=50.

[9] Census Bureau Gazetteer files are located at https://www.census.gov/geo/maps-data/data/gazetteer.html.

I aggregate the network breadth measure to the geographic unit at which I observe Covered California enrollees' location – combinations of three-digit zip codes and rating areas – by taking an enrollee-weighted average of five-digit zip code network breadth.[10] Each rating area in Covered California consists of many three-digit zip codes, which creates observable variation in network breadth for a given network within a rating area.

3.2. Covered California 2017 Household Demographics and Choices

I obtained individual-level Covered California enrollment data for 2017 through a public records act request. These data contain individual and household identifiers, plan selection, three-digit zip code, rating area, age, income as a percentage of the FPL, an indicator for whether the household received a premium tax credit. The data consist of 1,701,223 2017 enrollees that selected a plan during 2017 or the preceding open enrollment period in 2016. I collapse these data to the household level, leaving 1,155,673 households. I then reduce my sample to households that are above 133% of the FPL and do not contain missing data.[11] After these adjustments, the sample consists of 1,096,430 households, 94.87% of 2017 Covered California households. To reduce the computational burden of my model, I estimate plan choice using a 10% random sample, which I cluster on networks and three-digit zip codes to preserve variation in network breadth.

I augment the Covered California enrollment data with publicly available information on Covered California plan premiums and non-network benefits from Covered California (Covered

[10] The number of enrollees in each five-digit zip code is provided by Covered California here: http://hbex.coveredca.com/data-research/

[11] I remove all households in the following non-exclusive cases: plan selections are split within households (24,377); missing rating area (1); household max age below 18 (10,548); Federal Poverty Level below 133% (21,853); Household purchasing catastrophic coverage plan above age 30 (399); household has premium tax credit above 400% of the FPL (3,213); household's plan not contained in plan data (3).

California 2017) and the network data discussed above. Collectively, these data provide comprehensive information on plans available to Covered California enrollees.

4. Demand for Covered California Health Plans

4.1. Conceptual Model

Household i is located in three-digit zip code z in rating area r. Households maximize utility U over premiums P and the characteristic space of available plans, which includes network breadth N, metal level M, observed product characteristics θ and unobserved product characteristics ξ. Some product characteristics θ, such as plan type network, are observed by the researcher. Other product characteristics ξ, such as drug formularies and branding, are not.

Household sensitivity to plan characteristics may vary by demographic characteristics. I examine variation in tastes for premiums and network breadth by demographic characteristics, which include age A, income W, and household size S. Age is a correlate of health status, health risk, and risk aversion. Income and family size also may affect risk aversion and household decision making processes. Unobserved demographic characteristics, notably health status, may affect sensitivity to plan characteristics as well.

Premiums and network breadth, unlike other plan characteristics, exhibit variation below the plan-rating area level. Premium P for plan j in rating area r varies across households due to modified community rating and premium tax credits. Modified community rating forces premiums to vary according to households' age composition, income, and size, while premium tax credits household premiums based on their income and size. Network breadth N for product l's network varies across three-digit zip codes z. While a product's network breadth is set by an insurer across a rating area, the geographic proximity of households to in-network providers varies depending on a household's geographic location.

I model health insurance plan demand at the household level. I do so for several reasons. First, health insurance choices within households are highly correlated. That is, households tend to make health insurance decisions jointly (Royalty and Abraham 2006).[12] Second, households are likely to consider their collective health needs and financial constraints. Third, premium tax credits are calculated at the household level. Lastly, the infrastructure of Covered California is designed to support household-level applications for health insurance.[13]

4.2. Estimation

Household i's indirect utility U from plan j belonging to product l in three-digit zip code z in rating area r is defined as

$$U_{ijlzr} = -\alpha_i P_{ijr} + \beta_i N_{lzr} + \gamma M_{jr} + \theta_l + \xi_l + \epsilon_{ijlzr}$$

where P_{ijr} is household i's age-adjusted, post-premium tax credit premium for plan j in rating area r; N_{lz} is the network breadth of product l as experienced by households in three-digit zip code z; M_j is plan j's metal level where cost-sharing reduction silver metal levels are treated as separate from the standard silver metal level; θ_l and ξ_l are vectors of observed and unobserved product characteristics, respectively; and ϵ_{ijlzr} represents the idiosyncratic component of the household's utility function not observed by the researcher.

I estimate households' plan choice using a mixed logit discrete choice model, also known as a random parameters logit model (Train 2003; Hole 2007). The advantage of the mixed logit model is that it allows households to exhibit heterogeneous tastes for selected plan characteristics – premiums and network breadth in this case – according to observed *and* unobserved

[12] Just 15,441 of the 1.5 million 2017 enrollees (i.e., about 1%) were enrolled in a different Covered California plan than someone in their household.

[13] When searching for health insurance plans in Covered California, individuals are asked to input the age of each of their family members. Premiums are listed according to the modified age rating off all family members. Though individual family members may enroll in separate plans, they must fill out separate applications to do so.

demographic characteristics. I estimate the correlated random premium and network breadth sensitivity parameters α_i and β_i as

$$\alpha_i = \alpha + \delta \mathrm{A_i} + \Gamma W_i + \rho S_i + \mu_i$$

$$\beta_i = \beta + \Delta \mathrm{A_i} + \tau \mathrm{W_i} + \pi S_i + \omega_i$$

where A_i is a vector of maximum household age groups (18-29, 30-39, 40-49, 50-59, 60+), income W_i is proxied by whether an indicator for whether a household receives a premium tax credit, household size S_i is an indicator for whether a household is non-single, and μ_i and ω_i are normally-distributed, correlated error terms. The error terms μ_i and ω_i capture unobserved demographic characteristics, notably health status, that may affect α_i and β_i.

4.3. Identification

My identification strategy relies on two features of Covered California: Variation in premiums and network breadth at the sub-rating area level and plan standardization regulations. Specifically, I use exogenous household-plan-rating area level variation in premiums and three-digit zip code-product-level variation in network breadth to identify premium and network breadth demand parameters. Plan standardization allows me to use metal level and product fixed effects to capture all other plan characteristics. These fixed effects play a similar role to alternative specific constants, capturing all non-premium, non-network breadth characteristics and thereby capturing unobserved confounders. This type of identification strategy was pioneered by Chamberlain (1980). Ho and Pakes (2014), Geruso (2016), and Tebaldi (2017) have used similar identification strategies, the latter in a separate study of health plan in demand in Covered California.

Households experience all plan characteristics *except* premiums and network breadth at the rating area level. Age rating and premium tax credits cause premiums for plan j in a rating area r to vary across households based on their age, income, and size. Premiums thus vary at the demographic group-plan-rating area level. The geographic distribution of a plan's in-network providers causes their network breadth to vary across households within rating areas. I observe this variation in the Covered California data at the plan-three-digit zip code level. Figure 4, for example, shows variation in network breadth across three-digit zip codes for each network in rating area 15. This is discussed in greater detail in Section 4.1. Aside from premiums and cost-sharing – the latter of which is captured by metal fixed effects – insurers must set all plan characteristics at the product level. While some product characteristics are observed, such as network and plan type, others, such as prescription drug formularies and customer service quality, are not. I employ a vector of product fixed effects to capture all of these characteristics, which are represented as θ_l and ξ_l in the utility function.

My identifying assumption is that there are no unobserved plan characteristics that are correlated with premiums or network breadth. Covered California regulations strengthen the plausibility of this assumption by requiring that all plan characteristics besides premiums and metal level vary at the product level, where I employ fixed effects. However, it is possible that that non-plan benefit characteristics vary at other levels than the product level. Such characteristics could include the perceived quality of a network or advertising. Variation in network quality could occur if an insurer contracts with high-quality providers in one geographic area and low-quality providers in another area. However, this is unlikely for a number of reasons: (1) insurers are constrained by existing market structure in their ability to contract with providers; (2) varying network quality within a product would increase the costs of communicating the product's quality to consumers; (3) online insurer marketing materials for Covered California products do not appear to exhibit heterogeneity by geography. While advertising does increase Marketplace enrollment (Karaca-Mandic et al. 2017), over 80 percent of advertising for Covered California health plans is spent by the state to encourage consumers to sign up for insurance (Lee et al. 2017). These advertisements are not-insurer centric. Still, to reduce the potential for bias in my specification, I interact product fixed effects with an indicator for whether the product is in northern or southern California. This region interaction allows consumer tastes for Covered California products to vary between northern and southern California.[14] As shown in Table 1, the northern and southern parts of Covered California are significantly different from one another in terms of market concentration.

5. Results

5.1. Descriptive Statistics

Table 2 displays means, standard deviations, and percentiles of the distributions of Covered California enrollee household demographics and plan choice sets. Covered California enrollee households have a mean maximum age of 45.68 with a standard deviation of 13.23. The 75th percentile of household income is 249% of the FPL, meaning that nearly three-quarters of households qualify for both premium tax credits and cost-sharing reductions. Mean household size is 1.45 and the 75th percentile of household size is 2 – most Covered California households consist of 1 or 2 members.

Table 2 also shows summary statistics for households' plan choice sets. The mean household has 30.64 plan options. These plans have a wide variety of network breadths and premiums. Network breadth has a mean of 23.93%, a standard deviation of 14.18 percentage points, and an interquartile range of 23.01% from 13.03% to 34.33%. Variation in post-premium tax credit monthly premiums is large – the standard deviation is $349.53 while the mean is

[14] I define Southern California as rating areas 13 through 19. The border is defined by the northern borders of San Luis Obispo, Kern, and San Bernadino counties.

$375.66. The distribution of post-tax credit premiums has a long right tail consisting of households above 400% of the Federal Poverty Level that do not receive premium tax credits.

Table 2: Summary Statistics of Covered California Household Demographics and Plan Choices

	Statistic				
Characteristic	**Mean**	**SD**	**P25**	**P50**	**P75**
Household Demographics					
Maximum Age	45.68	13.23	33	48	58
Income	203.13	98.84	152	186	249
Household Size	1.45	0.78	1	1	2
Choices					
Number of Choices (Plans)	30.64	8.40	24	31	38
Premium: Post-Premium Tax Credit ($)	375.66	349.53	151.21	282.14	492.70
Network Breadth (%)	23.93	14.18	13.03	21.02	34.33

Notes: Income is reported as a percentage of the Federal Poverty Level. Household size only includes household members with Covered California coverage.

I contrast offered plans with those selected by consumers in Table 3. Like Gabel et al. (2017), I find that the mean selected premiums are lower than mean offered premiums. After premium tax credits are applied, this difference is approximately $140 per month. This contrast occurs across all household demographic groups though the magnitude of the difference varies, increasing in size for households that are older, receive premium tax credits, and are non-single. Mean selected networks are broader than mean offered networks. The mean selected plan's network breadth is approximately two percentage points larger than the network breadth of the mean offered plan. This difference increases for households that have higher maximum age, that do *not* receive premium tax credits, and are non-single. These differences suggest that these types of households are more sensitive to network breadth.

Table 3: Mean Premiums and Network Breadths of Offered and Selected Covered California Plans across Demographic Groups

	Premium: Post-Premium Tax Credit ($)		Network Breadth (%)	
Demographic Group	**Offered**	**Selected**	**Offered**	**Selected**
Overall	375.66	233.14	23.93	26.01
Maximum Age				
18-29	221.05	144.03	24.08	24.60
30-39	311.81	219.58	23.95	25.85
40-49	388.99	266.00	23.96	26.34
50-59	448.54	256.85	23.87	26.28
60+	492.38	263.02	23.81	26.78
Premium Tax Credit				
Yes	330.93	175.60	23.94	25.89
No	587.86	529.82	23.88	26.65
Household Type				
Single	289.29	183.48	23.89	25.84
Non-Single	572.77	340.99	24.02	26.38

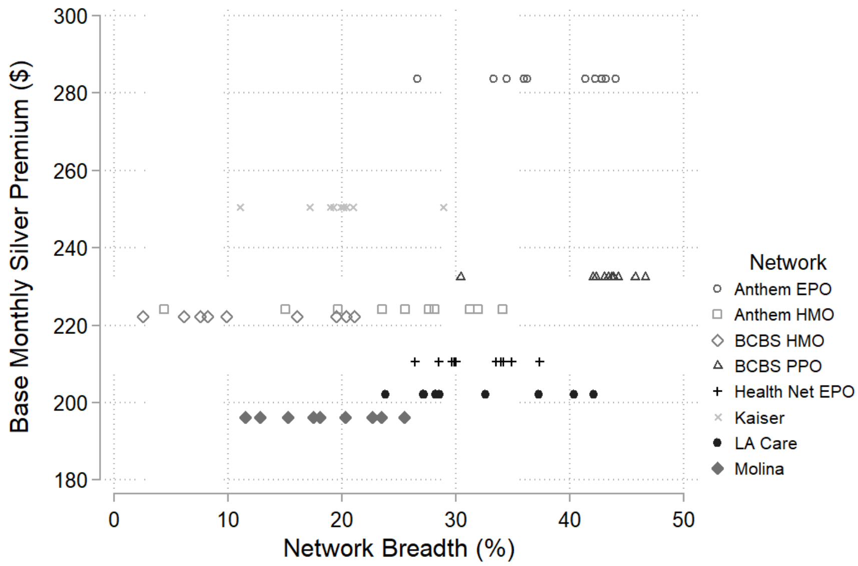
Notes: Differences between offered, selected categories are significant at the 0.001 level.

Figure 4 plots network breadth against base monthly silver premiums for each network-three-digit zip code pair in rating area 15, one of Los Angeles County's two rating areas. Base silver monthly premiums are the silver premium attached to each network's silver plan before age rating and premium tax credits are applied. Figure 4 shows that *network breadth varies widely within networks by three-digit zip codes*. For example, the network breadth of the Anthem HMO network ranges from approximately 5% to 35%. The minimum range of network breadth in rating area 15 is about ten percent for the Blue Cross Blue Shield PPO network. From the consumer's perspective, there is not a clear relationship between network breadth and base monthly premiums. Their overall correlation coefficient is 0.12.[15] This pattern – large within-

[15] Calculated as the correlation between base monthly premiums and network breadth at the plan-rating area level across Covered California.

rating area variation in network breadth by three-digit zip codes and a weak correlation between premiums and network breadth – persists across rating areas.

Figure 4: Variation in Mean Network Breadths and the Base Monthly Silver Premiums across Three-Digit Zip Codes in Rating Area 15



Notes: Each point represents a 3-digit zip code in the rating area. Rating area 15 is the larger of two rating areas contained in Los Angeles County. A network's base monthly silver premium is the premium of the silver plan attached to the network before it is adjusted for age rating and premium tax credits.

5.2. Mixed Logit Results

Coefficients and standard deviations of premium sensitivity and network breadth for the baseline model are presented in Table 4. I find that premium sensitivity is negative and decreasing in magnitude with age and for households receiving premium tax credits, though it increases in magnitude for non-single households. The standard deviation of the random premium sensitivity parameter is about 23% of the base premium sensitivity intercept, implying that idiosyncratic household variation in premium sensitivity is relatively small. Network breadth sensitivity parameters are positive and increasing in magnitude with age in all models. The standard deviation of the random network breadth sensitivity parameter, 0.0196, is roughly double that of the base network breadth sensitivity intercept, 0.0096, indicating that there is large heterogeneity in tastes for network breadth.

Table 4: Coefficients and Standard Deviations of Mixed Logit Discrete Choice Model of Covered California Health Plan Choice

Covariate	Coefficient	Standard Error
Monthly Premium ($100)		
Level	-2.4927	0.0257
Maximum Age: 30-39	0.7634	0.022
Maximum Age: 40-49	1.1216	0.0215
Maximum Age: 50-59	1.3442	0.021
Maximum Age: 60+	1.5551	0.0217
Family	0.6206	0.0093
Has Premium Tax Credit	-0.4128	0.0106
Network Breadth		
Level	0.0096	0.0009
Maximum Age: 30-39	0.0039	0.0009
Maximum Age: 40-49	0.0061	0.0009
Maximum Age: 50-59	0.0102	0.0008
Maximum Age: 60+	0.0139	0.0009
Family	0.0029	0.0006
Has Premium Tax Credit	-0.0054	0.0007
Standard Deviation		
Monthly Premium ($100)	0.5726	0.0077
Network Breadth	0.0196	0.0007
Model Statistics		
Choice Situations	3,323,475	
Unique Households	108,450	
Log Likelihood	-252,906.36	

Note: All coefficients significant at 0.001 level. All models include metal level and network-region fixed effects. Premium and network breadth interactions with demographic groups are recovered by substituting random parameter equations into the utility function.

Appendix Table 3 shows own-premium and own-network breadth elasticities calculated from the coefficients in Table 4 for each demographic group. Own-premium and own-network breadth elasticities η_P and η_N are given by

$$\eta_P \equiv \alpha_i P_{ijr}(1 - \Pr(J_r = j_{ir}))$$

$$\eta_N \equiv \beta_i N_{jz}(1 - \Pr(J_r = j_{ir}))$$

Own-premium elasticity η_P is the percentage change in the probability of a household choosing a plan resulting from a one percent increase in a plan's premium. I calculate household-specific values of α_i and β_i using the method developed by Revelt and Train (2000) in which information regarding a household's plan choice, demographics, and population parameters are used to simulate α_i and β_i.[16] As shown in Appendix Table 3, own-network breadth elasticities have a mean of 0.30 across all households. They range from 0.09 for age 18-29, single, subsidized households to 0.54 for age 60 or greater, non-single, unsubsidized households. Overall own-premium elasticity is -4.58. Own-premium elasticity exhibits an inconsistent pattern with age in which the middle age group (40-49) has the lowest magnitude own-premium elasticity. This seemingly counterintuitive result occurs because of contrary trends between premium sensitivity and premiums that occur as age increases. That is, while older households have higher premiums P_{ijr} for the same plan relative to their younger counterparts due to the ACA's age rating, they also have lower premium sensitivities α_i.

To obtain a standardized measure of premium and network breadth sensitivities that holds the change in premiums and network breadth constant, I calculate semi-elasticities. Own-premium and own-network breadth semi-elasticities are given by:

$$\zeta_P \equiv \alpha_i(100/12)(1 - \Pr(J_r = j_{ir}))$$

$$\zeta_N \equiv \beta_i(IQR(N_{jz}))(1 - \Pr(J_r = j_{ir}))$$

[16] Alternatively, η_P and η_N could be calculated as $E(\alpha_i)$ and $E(\beta_i)$. This approach, however, does not take advantage of the heterogeneity allowed by the mixed logit model. Regardless, both approaches yield very similar elasticities.

Own-premium semi-elasticity ζ_P is the percentage change in the probability of choosing a plan resulting from a $100 increase in annual premiums. Own-network breadth semi-elasticity ζ_N is the percent change in the probability that a household chooses a given plan resulting from an increase in network breadth equal to the interquartile range of network breadth, 21.30 percentage points, as shown in Table 2. This difference represents a plan shifting from a narrow network to a broad network. It also is roughly equal a 1.5 standard deviation increase in network breadth.

The means and standard deviations of own-premium and own-network breadth semi-elasticities are shown in Table 5. Mean own-network breadth semi-elasticity is 26.72, meaning that the mean household's percentage change in the probability of choosing a plan when the plan switches from a narrow to a broad network is 26.72 percent. Own-network breadth semi-elasticity increases from 8.07 from the youngest age group (18-29) to 39.58 for the oldest age group (60+) for single households with premium tax credits (the largest demographic group in the sample). Own-network breadth semi-elasticity increases for non-single households relative to single households, roughly by a value of 8, and for households without premium tax credits relative to those with them, roughly by a value of 12. Mean own-network breadth semi-elasticity can vary by as much as a factor of six, from 8.07 among the 18-29 maximum age, subsidized, single group to 49.56 among the 60 or greater maximum age, unsubsidized, single group.

Mean semi-elasticities, however, mask large variation in own-network breadth semi-elasticities. As Table 5 shows, the overall standard deviation of own-network breadth semi-elasticities (23.79) is relatively large (as compared to the mean of 26.72) for all demographic groups. Standard deviations remain large within demographic cells, though they are larger for younger age groups than older ones. For example, the standard deviation of own-network breadth semi-elasticity for single households with premium tax credits with a maximum age of

18-29 is 16.49 – over twice the mean of 8.07 – whereas the standard deviation is 22.34 for the 60 or greater age group – roughly half the mean of 39.58. Unobserved demographics thus have a large impact on tastes for network breadth even after conditioning on observable demographics.

Table 5: Means and Standard Deviations of Own-Premium and Own-Network Breadth Semi-Elasticities across Demographic Groups

	Own-Premium Semi-Elasticity		**Own-Network Semi-Elasticity**	
Maximum Age	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
		Overall		
All	-13.53	6.06	26.72	23.79
		Single Households with Premium Tax Credits		
18-29	-23.59	2.46	8.07	16.49
30-39	-17.47	2.38	14.96	17.97
40-49	-14.52	2.4	20.03	19.07
50-59	-12.49	2.61	30.31	21.53
60+	-10.59	2.66	39.58	22.34
		Non-Single Households with Premium Tax Credits		
18-29	-17.97	2.78	18.98	21.19
30-39	-11.76	2.84	26.75	23.64
40-49	-9.21	2.74	28.51	23.36
50-59	-7.68	2.6	34.56	22.39
60+	-6.31	2.47	39.37	21.43
		Single Households with Premium Tax Credits		
18-29	-20.19	2.41	20.12	20.05
30-39	-14.11	2.46	26.68	20.96
40-49	-11.1	2.78	32.14	24.01
50-59	-9.1	3.14	42.1	27.34
60+	-7.41	3.02	49.56	26.38
		Non-Single Households with Premium Tax Credits		
18-29	-14.07	3.05	35.38	26.15
30-39	-8.21	3.06	40.12	26.69
40-49	-5.84	3.01	40.19	26.33
50-59	-4.52	2.81	44.23	24.7
60+	-4.06	2.46	41.05	21.58

Notes: Own-premium semi-elasticity is calculated as $\alpha_i(100/12)(1 - \Pr(J_r = j_{jr})$. Own-network breadth semi-elasticity is calculated as $\beta_i(IQR(N_{lzr}))(1 - \Pr(J_r = j_{ir}))$, where

$IQR(N_{lzr})$ is the interquartile range of network breadth, 21.30. Household-specific sensitivity parameters α_i and β_i are estimated as described in Revelt and Train (2003).

Own-premium semi-elasticities, unlike own-premium elasticities, comport with premium sensitivity coefficients in indicating that older households are less premium sensitive. A $100 increase in premiums results in 23.59% and 10.59% decreases in the probability of enrollment between the single, subsidized, 18-29 age and 60 or greater age groups, respectively. Premium semi-elasticities are lower for non-single households without premium tax credits. Overall own-premium semi-elasticity is -13.53. Exact own-premium elasticities for each demographic group also are shown in Table 5. Heterogeneity in own-premium semi-elasticities is not as large as for own-network breadth semi-elasticity. The standard deviation of own-premium semi-elasticities is at most 60 percent of mean own-premium semi-elasticity (for maximum age 60 or greater, non-single households without premium tax credits), and as little as 10 percent of mean own-premium semi-elasticity (for maximum age 18-29, single households with premium tax credits).

I calculate willingness to pay (WTP) for network breadth as $-\beta_i/E(\alpha_i)$.[17] It represents the dollar amount enrollees will pay in monthly premiums for a one percentage point increase in network breadth. I proceed to calculate the WTP to switch from a narrow to a broad network plan as WTP for network breadth times the interquartile range of network breadth. Table 6 shows the means, standard deviations, 25th, 50th, and 75th percentiles of the distributions of WTP to switch from a broad to a narrow network plan within age groups by household type and receipt of a premium tax credit. Overall, WTP for network breadth has a mean of $1.06, a standard deviation of $1.19, a 25th percentile of $0.29 and a 75th percentile of $1.53, suggesting (correctly)

[17] I do not use the random premium parameter α_i as the willingness to pay denominator. As Greene (2011) explains, a ratio based on two variables without finite variances results in extreme results. Per Greene's suggestion, I make the denominator a fixed parameter by taking the expected value of α_i such that $E(\alpha_i) = E(\alpha) + E(\delta A_i) + E(\Gamma W_i) + E(\rho S_i) + E(\mu_i) = \alpha + \delta A_i + \Gamma W_i + \rho S_i + 0$.

that the distribution of WTP has a long right tail. Non-single households in higher maximum age groups and premium tax credits have higher WTP for network breadth. These differences are quite large. For example, median WTP to switch from a narrow to a broad network among 18-29 age group, single households with premium tax credits is $2.31, but is $142.16 among 60 or greater age group, non-single households without premium tax credits. Large heterogeneity exists within demographic groups as well, sufficiently so that younger households can be willing to pay more for broad networks than their older counterparts. For example, single households with premium tax credits in the maximum age of 40-49 in the 75th percentile of the WTP distribution are willing to pay more for a broad network ($18.09) than their counterparts with a maximum age of 60 or greater in the 25th percentile of the WTP distribution ($17.24).

5.3. Robustness Checks

I examine the robustness of my findings by estimating separate models and comparing their own-premium and own-network breadth semi-elasticities. I begin by examining the sensitivity of my results to length of the radius used in my network breadth measure, 15 miles, by estimating two models that measure network breadth using 10- and 20-mile radii, respectively. My results are robust to the length of the radius. Own-network breadth semi-elasticities decrease by roughly one and two percent when a 10- and 20-mile radii are used, respectively. Own-premium semi-elasticities do not change by more than one percent with 10- and 20-mile radii. I also estimate a model that excludes network breadth. Exclusion of network breadth has a small effect on the own-premium semi-elasticity, decreasing it by roughly 3%. The exclusion of network breadth thus results in a very small upward bias in own-premium semi-elasticity.

Table 6: Moments of the Distribution of Willingness to Pay to Switch from a Narrow to a Broad Network Plan across Demographic Groups

	Willingness to Pay for Network Breadth ($)				
Maximum Age	**Mean**	**SD**	**25th Percentile**	**Median**	**75th Percentile**
			Overall		
All	22.29	25.03	6.10	15.56	32.18
			Single with Premium Tax Credit		
18-29	2.73	5.68	-1.47	2.31	6.31
30-39	7.15	8.62	0.42	6.31	12.62
40-49	11.57	10.94	2.94	10.09	18.09
50-59	19.77	13.88	9.04	17.88	28.18
60+	30.07	16.61	17.24	27.34	40.38
			Non-Single with Premium Tax Credit		
18-29	8.41	9.46	1.47	6.94	14.30
30-39	18.09	15.77	5.89	15.77	27.34
40-49	25.03	20.40	9.25	21.87	37.85
50-59	37.64	24.18	18.93	33.86	54.68
60+	55.10	29.65	32.39	51.31	77.39
			Single without Premium Tax Credit		
18-29	8.20	8.20	1.89	6.10	13.25
30-39	15.77	12.41	5.68	13.88	23.76
40-49	23.97	17.88	8.83	21.66	36.17
50-59	37.43	24.18	16.82	35.33	54.26
60+	54.05	28.60	27.34	55.31	72.76
			Non-Single without Premium Tax Credit		
18-29	19.14	14.09	7.36	18.30	29.44
30-39	36.80	24.39	14.09	36.38	54.26
40-49	54.68	35.75	22.50	55.52	80.76
50-59	85.59	47.53	42.06	91.06	118.82
60+	132.28	69.19	65.61	142.16	184.22

Notes: Willingness to Pay (WTP) is calculated from the baseline model as $-\beta_i/E(\alpha_i)$ for each household. The normal distribution of the network breadth sensitivity parameter β_i results in WTP below zero in 10.91% of households.

6. Discussion

6.1. Network Breadth: Sensitivity and Selection

Covered California households, particularly older ones, are sensitive to network breadth. Consumers' valuation of network breadth may reflect a variety of factors, including: (1) choice of physicians from whom they may seek medical care; (2) reduced wait times to receive care from having more in-network physicians; (3) reduced financial risk arising from a lower need to see out-of-network physicians; or (4) continuity of care. My finding that network is an important determinant of plan choice suggests that future research should distinguish which of these factors dominates consumers' valuation of network breadth. Such research would be helpful in decomposing the large heterogeneity that consumers exhibit in network breadth sensitivity.

Network breadth sensitivity increases with household age, income, and household size. This finding is consistent with the literature (Ericson and Starc 2015; Shepard 2016; Gruber and McKnight 2016). As age increases, households' tastes for access to and choice of physicians may increase with declining health and the increased probability of developing a chronic condition. Existing relationships with providers also may increase demand for a broader network, or one that covers providers with whom the household has an existing relationship. Clearly, network information is salient enough in Covered California that, at least on average, consumers can factor it into their plan choice.

Heterogeneity in network breadth sensitivity across demographic groups indicates that *a selection mechanism exists in which older, lower-income, non-single households sort into plans with broader networks.* These selection mechanisms are likely to result in adverse selection, where a correlate of health care costs (age) results in selection on a plan characteristic (network breadth). Adverse selection normally would result in higher premiums or fewer plans with the characteristic that results in selection (broader networks). However, according to the chief actuary of Covered California, the ACA's risk adjustment program is working well in Covered California and preventing insurers from responding negatively to selection (Bertko, Feher, and Watkins 2017; Bertko 2016). It may also be the case that unobserved household characteristics that are not correlated with health care costs, such as preferences for continuity of care, limit the selection of higher-cost households into broader network plans. As explained by Ericson and Sydnor (2017), random variation in tastes for health insurance generosity can mitigate adverse selection costs.

6.2. Premium Sensitivity and Plan Standardization

Covered California enrollees are highly premium elastic. Mean overall own-premium elasticity is -5.16. The magnitude of this elasticity is higher than those found in studies of the Federally-facilitated Marketplace (Abraham et al. 2017; DeLeire and Marks 2015) as well as the pre-ACA California individual insurance market (Marquis et al. 2007). It is, however, similar to own-premium elasticity estimates in another highly-standardized insurance market: Medicare Part D (Decarolis, Polyakova, and Ryan 2015; Lucarelli, Prince, and Simon 2012).

Covered California's standardized cost-sharing may explain the magnitude of the own-premium elasticity. The presence of many close substitutes (several plans with the same cost-sharing attributes) can increase premium sensitivity, as can the presentation of many plans' post-premium tax credit premiums in a standardized format (Schmitz and Ziebarth 2017; Ryan, Krucien, and Hermens 2017; Bhargava, Loewenstein, and Sydnor 2015).[18] Covered California and Medicare Part D both have many close substitutes, standardized presentation, and some

[18] After a standard query, Covered California displays the premiums of nine plans simultaneously. Consumers in the Federally-facilitated Marketplace initially only see the premiums of 2-3 plans at one time without making adjustments to the basic search query.

standardized benefits, while the Federally-Facilitated Marketplace and the pre-ACA individual insurance market are lacking some or all of these features.

While standardization reduces choice overload, it may have had the unintended consequence of reducing households' willingness to pay for a less salient plan characteristic: network breadth. By definition, willingness to pay for all product characteristics decreases as price sensitivity increases. However, it is unclear to what extent standardized cost-sharing increases households' sensitivity to network breadth. The literature has not examined this subject. Consumers' sensitivity to network breadth may increase alongside premiums in response to standardization, or it may remain unchanged.

Standardized cost-sharing may be a useful tool for policymakers seeking to contain premium growth, particularly in other State-Based Marketplaces that are not dependent on the federal government to implement such policies. By increasing premium sensitivity, standardized cost-sharing could force insurers to increase premium competition in order to maintain (or gain) market share. This approach may not be appropriate, however, if increased premium competition reduces insurer profits such that insurers would exit the market.

6.3. Limitations

My study has three limitations. First, I do not observe plan enrollment for households purchasing individual health insurance off Covered California. This limitation is somewhat trivial for households participating in the individual market whose incomes are below 400% of the FPL – restricting premium tax credits to Covered California causes nearly all of this demographic group to purchase insurance on Covered California. However, many households with incomes above 400% of the FPL purchase insurance off Covered California. My findings are of limited generalizability to this group.

Second, I do not incorporate the uninsured “outside good” into my model of plan choice. Other studies of Covered California have done so (Tebaldi 2017; Saltzman 2017); however, the data source they used to identify the uninsured – the American Community Survey – is not granular enough to assign the uninsured to three-digit zip codes, nor has it been released for 2017. This makes the network breadth of the plan choices facing the insured infeasible. Regardless, these first two limitations are of limited concern for focus of this study, which is to understand how network breadth affects plan choice *within* Covered California.

Third, my network measure does not distinguish which characteristics of broad network plans are more valuable to consumers. Consumers may value them for their coverage of certain types of providers, quality, and/or covering a preferred provider. While the data do contain information on in-network providers other than primary care providers, I find that separating network breadth into various specialties (e.g., internal medicine subspecialists, surgeons) resulted in collinearities exceeding 0.95. I thus cannot distinguish between tastes for different types of providers within networks.

7. Conclusion

The availability of granular network and enrollment data from Covered California provides an opportunity to analyze consumers’ sensitivity to health plans’ network breadth and premiums. I use a household-level discrete choice model combined with geographic measures of network breadth to estimate network breadth and premium sensitivity parameters. I contribute to the literature by providing an estimate of network breadth sensitivity in the Marketplaces and developing a provider-centric measure of network breadth based on consumers’ geospatial proximity to providers. This measure, unlike the network value measure sometimes used in the literature (Capps, Dranove, and Satterthwaite 2003), is easily calculated with respect to physicians (as opposed to just hospitals) and does not require the estimation of a separate demand system.

I have three main results. First, households' enrollment decisions are sensitive to network breadth. Covered California households, at least on average, have sufficient information to consider network breadth as they choose a health plan. Second, a selection mechanism exists in which single, lower-income households with older members tend to select into broader network plans. Unobserved household characteristics also play a large role in determining tastes for network breadth. Third, Covered California plan standardization appears to have made consumers highly sensitive to premiums, causing the premium sensitivities of Covered California households to more closely resemble those observed in Medicare Part D than the rest of the individual health insurance market.

These results raise questions for future research. First, it will be important to learn which particular network characteristics – existing relationships to providers, high-quality providers, distance – drive consumers' sensitivity to network breadth. Second, how do household characteristics influence tastes for network breadth? Previous experience with providers, knowledge of health insurance benefits, and previous enrollment in Covered California all may influence plan choices. Third, do costs, access to the healthcare system, and quality of care improve for households that enroll in broad network plans, particularly in rural areas? Previous work in the group insurance market has shown that consumers who switched from broad to narrow network plans became less costly to insure and started to see fewer specialists (Atwood and LoSasso 2016; Gruber and McKnight 2016), but this subject remains unstudied in the individual market. Lastly, how does plan standardization affect tastes for networks? Plan standardization increases premium sensitivity (Schmitz and Ziebarth 2017), but it is unclear whether tastes for remaining non-standardized characteristics like network breadth are altered as well. Continued efforts to make network directories, individual-enrollment data, and all-payer claims databases will be necessary to address these timely questions.

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Appendix Table 1: Standardized Cost-Sharing in Covered California by Metal Level

Metal Level	Primary Care Copay ($)	Medical Deductible ($)		Max Out-of-Pocket ($)	
		Individual	Family	Individual	Family
Catastrophic[1]	*	7,150	**	7,150	**
Bronze	75	6,300	12,600	6,800	13,600
Silver	35	2,500	5,000	6,800	13,600
Silver CSR 73[2]	30	2,200	4,400	5,700	11,400
Silver CSR 87[2]	10	650	1,300	2,350	4,700
Silver CSR 94[2]	5	75	150	2,350	4,700
Gold	30	0	0	6,750	13,500
Platinum	15	0	0	4,000	8,000

Source: https://www.coveredca.com/PDFs/2017-Health-Benefits-table.pdf

[1] Catastrophic "minimum coverage" plans may only be purchased by those under age 30. They are not eligible for premium tax credits.

[2] Cost-sharing reduction (CSR) plans are available to premium tax credit-eligible enrollees with incomes at or below 250 percent of the Federal Poverty Level.

* Full cost until out-of-pocket is met.

** Only subject to federal limits.

Appendix Table 2: Insurer Market Shares in Covered California by Rating Area

Rating Area	Anthem	BCBS	Chinese Community	HealthNet	Kaiser	LA Care	Molina	Oscar	Sharp	Valley	Western
	Market Share (%)										
1	75.89	23.14		0.02	0.94						
2	7.2	15.75		0.68	60.84						15.53
3	16.18	13.74		0.31	63.57						6.19
4	6.41	24.56	21.83	0.71	46.06			0.44			
5	2.53	27.36		1.16	68.95						
6	4.59	30.59			64.82						
7	31.17	9.45		1.52	44.61					13.26	
8	10.56	14.4	7.03	2.26	65.76						
9	35.6	44.27		2.18	17.94						
10	66.31	5.42		0.46	27.81						
11	26.03	44.18		0.13	29.67						
12	34.48	50.74			14.78						
13	20.32	8.95			0.19		70.54				
14	27.27	36.98		16.52	19.23						
15	6.65	35.88		18.36	15.96	7.32	15.83				
16	13.02	20.21		13.56	21.61	6.4	23.25	1.95			
17	4.96	24.15		22.55	20.77		27.58				
18	15.08	32.48		21.18	16.09		13.59	1.58			
19	3.51	15.81		15.99	23.9		19.76		21.04		

Note: Market shares are calculated as the percentage of households that are enrolled in an insurer's plans in a rating area.

Appendix Table 3: Means and Standard Deviations of Own-Premium and Own-Network Breadth Elasticities across Demographic Groups

Maximum Age	Own-Premium Semi-Elasticity		Own-Network Semi-Elasticity	
	Mean	Standard Deviation	Mean	Standard Deviation
		Overall		
All	-5.16	3.88	0.30	0.35
		Single Households with Premium Tax Credits		
18-29	-5.05	3.17	0.09	0.22
30-39	-4.24	2.93	0.17	0.25
40-49	-3.96	2.93	0.22	0.28
50-59	-4.47	3.65	0.34	0.34
60+	-4.63	3.99	0.44	0.39
		Non-Single Households with Premium Tax Credits		
18-29	-7.55	5.15	0.22	0.31
30-39	-5.76	4.44	0.3	0.36
40-49	-5.02	4.1	0.32	0.36
50-59	-4.79	4.38	0.39	0.36
60+	-4.39	4.42	0.44	0.37
		Single Households without Premium Tax Credits		
18-29	-7.4	2.95	0.23	0.29
30-39	-6.34	2.53	0.3	0.31
40-49	-6.03	2.67	0.36	0.36
50-59	-7.68	4.01	0.46	0.43
60+	-8.3	4.66	0.54	0.45
		Non-Single Households without Premium Tax Credits		
18-29	-9.06	4.38	0.4	0.41
30-39	-7.93	4.66	0.45	0.42
40-49	-6.87	4.77	0.44	0.41
50-59	-7.22	5.66	0.48	0.41
60+	-8.19	6.18	0.45	0.37

Notes: Own-premium elasticity is calculated as $\alpha_i P_{ijr}(1 - \Pr(J_r = j_{jr})$. Own-network breadth elasticity is calculated as $\beta_i N_{lzr}(1 - \Pr(J_r = j_{ir}))$. Household-specific sensitivity parameters α_i and β_i are estimated as described in Revelt and Train (2003).