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Keywords

insurance, health reform, individual mandate, adverse selection

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Demand for Health Insurance: Evidence from the California and Washington ACA Marketplaces

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Abstract

I estimate demand for health insurance using consumer-level data from the California and Washington ACA marketplaces. I use the demand estimates to simulate the impact of policies targeting adverse selection, including subsidies and the individual mandate. I find (1) high own-premium elasticities of -6.9 to -7.8, but low insurance coverage elasticities of -0.5 to -0.6; (2) minimal response to the mandate penalty *amount*, but significant response to the penalty's *existence*, suggesting consumers have a "taste for compliance"; (3) mandate repeal has minimal effect on consumer surplus because ACA subsidies already mitigate adverse selection by shielding most consumers from premium increases; and (4) mandate repeal reduces average annual consumer surplus by up to $\$1,500$ if consumers were exposed to premium increases under voucher-type systems, instead of ACA subsidies. The economic rationale for the mandate depends on the extent of adverse selection and the presence of other policies targeting selection.

Keywords: Insurance; Health reform; Individual mandate; Adverse selection

Introduction

Design of viable health insurance markets remains a key focus of public policy debates following the 2016 presidential election. One of the principal challenges in achieving efficient health insurance markets is the presence of adverse selection (Arrow, 1963). Strategies adopted under the Patient Protection and Affordable Care Act (ACA) for mitigating adverse selection include both policy "carrots," such as subsidies for purchasing health insurance, and policy "sticks," such as penalties for not having insurance. In order to understand the efficacy of these strategies, policymakers need to better understand how consumers respond to financial incentives when choosing health insurance plans.

In this paper, I analyze insurance choice behavior in the ACA marketplaces. The ACA marketplaces provide an appealing context for analyzing how consumers choose plans. First, the ACA contains both policy carrots and sticks that incentivize enrollment. Second, analysis of the ACA setting helps to address many of the data shortcomings and generalizability concerns of prior analyses in other settings, including the pre-ACA individual market, employer market, and Medicare. Studies of the pre-ACA individual market suffer from measurement error of key variables such as premiums, plan benefit structure, and choice sets due to the absence of a centralized, regulated market for collecting data (Auerbach and Ohri, 2006). Employer coverage studies often have minimal consumer heterogeneity, as well as limited product heterogeneity (83 percent of firms offer just one plan (Kaiser Family Foundation, 2016)). Medicare analyses are limited to the elderly (over age 65) and Medigap plan benefit structures are tightly regulated. In contrast, ACA consumers are highly diverse and have access to a wide range of plans.

My analysis uses consumer-level data that I obtained from the California and Washington state marketplaces. Across the 2014 and 2015 plan years, my data contain about 2.5 million records in California and $335,000$ records in Washington, accounting for approximately 15 to 20 percent of nationwide marketplace enrollment (Department of Health and Human Services, 2015). In addition to the consumer plan choice, I observe key demographic characteristics including age, income, gender, county of residence, smoking status, and race. Consumers purchasing coverage in 2015 had access to an average of 24 plans in California and 46 plans in Washington. Heterogeneous firm entry across county markets creates significant variation about these averages, helping to identify consumer substitution patterns between insurance plans.

Using these data, I estimate discrete choice models of consumer demand for health insurance in both states. My empirical findings suggest that marketplace consumers are highly premium sensitive on the intensive margin (i.e., between marketplace plans). In particular, I estimate mean plan own-premium

elasticities of demand from the insurer's perspective of -7.8 in California and -6.9 in Washington.[1] In contrast, I find that consumers are relatively inelastic on the extensive margin (i.e., between purchasing any marketplace plan or choosing to forgo insurance). I estimate marketplace coverage elasticities of -0.6 in California and -0.5 in Washington under the assumption that the subsidy does not adjust to premium changes (e.g., under a voucher system). However, marketplace coverage elasticities average -0.1 in California and -0.2 in Washington after accounting for ACA subsidies that shield most consumers from premium shocks. My data also allow me to compare premium sensitivity across demographic groups. I find that the "young invincible" population between ages 18 and 34, racial minorities, and smokers, are considerably more premium elastic.

My demand estimates also indicate that the mandate penalty *amount* has little impact on consumer choice, but the penalty's *existence* motivates some consumers to purchase insurance. Assessing alternative explanations for this result, I find evidence of a "taste for compliance" with the individual mandate that has been theorized in the ACA literature (Saltzman et al., 2015) (Frean et al., 2016). A taste for compliance is a consumer preference for being socially responsible and complying with the law, regardless of the penalty amount. Alternatively, the taste for compliance could be described as an aversion to paying a fine or experiencing a loss (Kahneman and Tversky, 1984).

After estimating demand, I use the estimates to simulate the impact of repealing the individual mandate. The mandate represents an economic tradeoff between mollifying the premium-increasing effects of adverse selection and forcing people to purchase insurance against their will. I find that repealing the individual mandate has minimal net effect on average consumer surplus because the ACA's subsidies are a potent policy counterweight to adverse selection (i.e., by shielding consumers from premium increases). In contrast, repealing the mandate under a voucher-type model that shifts the full burden of premium fluctuations to consumers would result in a sharp decline in average consumer surplus. Hence, the policy rationale for the individual mandate depends on the extent of adverse selection and the presence of other policies designed to curb adverse selection.

I make several contributions to the literature. First, my empirical work is the first to examine insurance choice in the ACA marketplaces across multiple years and states at the consumer level. My data allow me to make credible estimates of consumer premium elasticities in the ACA marketplaces. Second, I formalize the notion of a taste for compliance with the mandate in terms of compensating variation and find empirical evidence to support the hypothesized taste for compliance. This result has important implications for the efficacy of policy sticks relative to policy carrots in incentivizing the purchase of health insurance. Third, my counterfactual analysis reveals an important interaction between policies

[1] Because most consumers are subsidized, insurers receive more than consumers pay, resulting in higher premium elasticity estimates from the insurer's perspective.

targeting adverse selection that deserves deliberate discussion in the health reform debate.

This paper is organized as follows. Section 1 surveys the relevant literature. Section 2 provides a brief overview of the ACA. Section 3 describes the empirical methods used in the study. Results on premium sensitivity and consumer response to the individual mandate are presented in Sections 4 and 5, respectively. Section 6 considers the impact of repealing the mandate, followed by a discussion in Section 7.

1 Previous Literature

Previous work considering insurance plan choice has largely focused on the employer (group) market or Medicare. The literature on the pre-ACA individual market is far less extensive because of significant data limitations. In particular, pre-ACA individual market studies largely rely on national survey data in which the relevant sample is very small, limiting the potential for focused studies or natural experiments (Auerbach and Ohri, 2006). Accurate measurement of key variables, such as premiums, plan characteristics, and consumer choice sets, is difficult because a centralized exchange for purchasing insurance did not exist. Table 1 summarizes estimates from several prominent studies that have estimated the premium elasticity of demand for individual market coverage. Most studies have found that demand for pre-ACA individual market insurance is relatively inelastic, estimating an elasticity for coverage of approximately -0.5 (Glied et al., 2002).

Several recent studies have considered the experience of the 2006 health reform law in Massachusetts, which established a health insurance marketplace. There are several important differences with the ACA marketplaces that limit analysis of policies influencing consumer incentives. First, individuals with incomes below 300 percent of the federal poverty level (FPL) were assigned a cost sharing level based on their income level, greatly restricting their choice sets relative to the ACA marketplaces. Second, consumers with incomes above 300 percent of FPL were ineligible for financial assistance. Table 1 indicates elasticity estimates for coverage in Massachusetts were quite low, similar to the pre-ACA individual market.

There are two working papers analyzing plan choice in the ACA marketplaces. Tebaldi (2016) uses 2014 plan-level data from California. Data at the plan-level suffer from measurement error of key variables such as the premium and choice sets, which are determined at the consumer level. Frean et al. (2016) use data from the 2012-2014 American Community Survey (ACS) to study take-up of marketplace coverage, estimating a premium elasticity of demand for marketplace coverage of -0.05 to -0.09. They also find that the individual mandate penalty had little impact on consumer decision-making. The ACS

Table 1: Elasticity Estimates from Previous Studies

			Coverage		Own-Premium	
	Population	Type of Data	Elast.	Semi-Elast.	Elast.	Semi-Elast.
Pre-ACA Individual Market						
Gruber and Poterba (1994)	Self-employed	Survey data	-0.5 to -1.0			
Marquis and Long (1995)	Working families	Survey data	-0.3 to -0.6			
Marquis et al. (2004)	California	Survey data	-0.2 to -0.4			
Auerbach and Ohri (2006)	Single workers	Survey data	-0.59			
Massachusetts Connector						
Chan and Gruber (2010)	Low-Income	Individual-level admin. data			-0.65 to -0.72	-0.85 to -1.54
Ericson and Starc (2015)	High-Income	Transaction-level admin. data				-1 to -3
Jaffe and Shepard (2016)	Low-Income	Individual-level admin. data		-1.09 to -1.29	-1.07	-2.27 to -2.55
ACA Marketplaces						
Tebaldi (2016)	California	Plan-level admin. data		-1.09 to -12.89	-1.0 to -3.1	
Frean et al. (2016)	National	Survey data	-0.05 to -0.09			

does not directly ask participants whether they have marketplace coverage. Hence, data limitations have hampered previous analyses of the ACA marketplaces. In this paper, I overcome many of these data challenges by using consumer-level data that contain the precise demographic information used in rating policies and in determining financial assistance and penalties.

2 Institutional Background on the ACA Marketplaces

One of the key ACA mechanisms for expanding health insurance is the creation of state insurance marketplaces, where eligible nonelderly individuals under age 65 can receive subsidies to purchase individual insurance.[2] The ACA implements community rating in the marketplaces, restricting insurer premium variation to the enrollee's age, smoking status, and geographic residence. Insurers can charge a 64-year old up to 3 times as much as a 21-year old according to the default age rating curve (Centers for Medicare and Medicaid Services, 2013). Furthermore, smokers can be charged 50 percent more than non-smokers, although some states including California prohibit tobacco rating. Each state also

[2]Certain individuals over the age of 65 who are ineligible for Medicare may also be eligible for subsidies.

defines geographic rating areas, usually composed of counties, in which an insurer's premiums must be the same for consumers of the same age and smoking status. Insurers can opt to enter only a subset of counties within a rating area. Therefore, consumer choice sets vary across rating areas and within rating areas, providing a useful source of identifying variation. Individuals purchasing coverage can pick from one of the four metal tiers: bronze, silver, gold, and platinum. Bronze has an actuarial value of 60 percent, while silver, gold, and platinum have actuarial values of 70, 80, and 90 percent, respectively. Select individuals, including those under age 30, can buy a more basic catastrophic plan.

Financial assistance is available to consumers who have household income[3] between 100 percent and 400 percent of FPL, do not have access to an "affordable" employer plan offer as either an employee of dependent,[4] are ineligible for public insurance such as Medicaid or the Children's Health Insurance Program (CHIP), and are citizens or have legal resident status. ACA premium subsidies limit a household's premium contribution to the benchmark plan (defined as the second-lowest cost silver plan available to the consumer) to a certain percentage of income, where the percentage increases with income. In 2014, the benchmark premium contribution limit was 2 percent of income for households with income between 100 and 138 percent of the federal poverty level (FPL) and 9.5 percent for households with income between 300 and 400 percent of FPL. Consumers can apply the subsidy to the purchase of any metal plan.[5] Consumers with incomes less than or equal to 250 percent of poverty can access cost sharing subsidies by purchasing a silver plan. Cost sharing subsidies increase the actuarial value of the base silver plan from 70 percent to 94, 87, and 73 percent for individuals with incomes below 150 percent of FPL, 150 and 200 percent of FPL, and 200 and 250 percent of FPL, respectively. Silver is the most commonly selected metal tier because of the requirement to purchase a silver plan to access cost sharing subsidies.

Another key provision of the ACA is the individual mandate which requires most individuals to purchase insurance or pay a penalty. Exemptions from the individual mandate are made for certain groups, most notably for (1) those with income below the tax filing threshold and (2) individuals who lack access to a health insurance plan that is less than 8 percent of their income.[6] Both exemption groups involve sharp income thresholds, providing useful sources of variation. The penalty amount was phased in between 2014 and 2016. In 2014, the penalty for a single individual equaled the greater of $95 and 1 percent of income. By 2016, the penalty had increased to the greater of $695 and 2.5 percent of income.

[3] More precisely, modified adjusted gross income (MAGI) as reported on Form 1040 of the federal income tax return

[4] An "affordable" employer plan is defined as one for which the employee's contribution to the employer's single coverage plan is less than 9.5 percent in 2014 and 9.56 percent in 2015 of the employee's household income. Note that the employee contribution for family coverage does not play a role in determining affordability for dependents. Health policymakers have termed this affordability definition as the "family glitch" (Brooks, 2014)

[5] That is, any bronze, silver, gold or platinum plan, but not a catastrophic plan.

[6] This percentage is subject to increase. It was 8 percent in 2014, 8.05 percent in 2015, 8.13 percent in 2016, and 8.16 percent in 2017.

3 Methods

3.1 Study Data

One of the distinguishing features of this study is the use of detailed consumer-level administrative data to estimate demand for health insurance. In particular, I obtain enrollee data from Covered California and the Washington Health Benefit Exchange (WAHBE), the ACA marketplaces in California and Washington, respectively. The data indicate each enrollee's selected plan for the 2014 and 2015 plan years and key demographic information, including age, income, gender, county of residence, and subsidy eligibility. Additional demographic variables that are available for Washington include race, smoking status, and coverage start and end dates. Individual and household identifiers allow consumers to be grouped into household units and tracked across time. There are approximately 2.5 million unique records in the California data and $335,000$ unique records in the Washington data across the two plan years.

Estimation of demand for marketplace coverage also requires data on those who chose not to purchase insurance. I use data from the 2014 and 2015 American Community Survey (ACS) for this purpose (Ruggles et al., 2016). I apply several criteria to select the ACS sample. First, I do not include any individuals enrolled in or eligible for another source of coverage, such as Medicaid, the Children's Health Insurance Program (CHIP), and employer-sponsored insurance. Second, I exclude undocumented immigrants who are ineligible to purchase marketplace insurance. I merge the remaining California and Washington ACS survey records with the administrative data from California and Washington, respectively, to form the universe of potential consumers. There are approximately $23,000$ California and $3,500$ Washington ACS survey records in the final sample, representing about 2.8 million people in California and $440,000$ people in Washington when survey weights are applied.[7]

I also collect plan characteristic data from Covered California (California Health Benefit Exchange, 2016) and WAHBE (Office of the Insurance Commissioner Washington State, 2016a), as well as rate filings from both states (Department of Managed Health Care, 2016) (Office of the Insurance Commissioner Washington State, 2016b). Key plan characteristics include the premium, plan metal tier, plan cost sharing requirements (e.g., deductible, coinsurance, and maximum out-of-pocket limit), and network type (e.g., HMO, PPO). I can precisely map the plan data to each consumer's menu of choices in the marketplaces using the three permitted ACA rating criteria age, smoking status, and county of residence.

[7]Note that administrative data from the marketplaces are unweighted, while the ACS requires survey weights to be representative of the population.

Table 2 displays summary statistics for California and Washington consumers. The silver tier is the most commonly selected option because consumers eligible for cost sharing reductions (CSRs) must choose a silver plan to receive CSRs. Approximately 68 percent of California enrollees and 61 percent of Washington enrollees are eligible for CSRs, while 91 percent of California enrollees and 85 percent of Washington enrollees are eligible for premium subsidies. The proportion of consumers exempt from the individual mandate is small, but is notably higher among those who are uninsured. The uninsured rate is substantially higher among young adults and males in both states. Smokers and certain minority groups in Washingto are also more likely to be uninsured. Individuals with incomes between 250 and 400 percent of FPL, who receive relatively small subsidies, and those with incomes above 400 percent of FPL, who are ineligible for subsidies, make up a large share of the uninsured sample.[8]

Variation in consumer choice sets is considerable, as shown in Table 3. The average California consumer could select from about 5 insurers offering a total of 25 plans in both plan years. In 2014, the average Washington consumer had access to 5.5 insurers offering a total of 26.2 plans; by 2015, Washington consumers could select from 6.8 insurers offering a total of 45.8 plans. Plan premiums vary considerably by geography and time even within a single metal tier, particularly in California. The benchmark silver plan premium was about 65 percent more expensive in Monterrey County, CA than in Los Angeles County, CA. Geographic premium variation is less in Washington because state regulation prohibits premium variation of more than 15 percent across rating areas. This variation in choice sets and premiums is particularly useful for estimating demand for health insurance.

3.2 Empirical Strategy

I now develop an empirical model for estimating demand for health insurance in the ACA marketplaces. I estimate demand at the household level rather than the consumer level for several reasons: (1) insurance decisions are likely to account for the health and financial needs of all household members, (2) decisions between household members are likely to be highly correlated (e.g., a 5-year old child is unlikely to be making independent insurance decisions), and (3) subsidies and penalties are calculated at the household level. Normalize the utility of the outside option $U_{i0} \equiv 0$ for all households $i \in I$ and define the indirect utility U_{ij} of household $i \in I$ for marketplace plan $j \in J$ as

$$U_{ij} \equiv \alpha p_{ij} + x_j'\beta + d_i'\varphi + p_{ij}d_i'\gamma + \xi_{ij} + \epsilon_{ij} \tag{1}$$

[8] Another reason middle- to higher-income people make up a large share of the ACS sample is that many of the low-income uninsured do not meet the sample inclusion criteria (i.e., many are eligible for Medicaid or CHIP and/or could be undocumented immigrants).

Table 2: Choice and Demographic Distribution by State

	California		Washington	
	Marketplace	Uninsured	Marketplace	Uninsured
Metals				
Catastrophic	0.7		0.4	
Bronze	24.0		36.6	
Silver	64.9		55.1	
Gold	5.5		7.7	
Platinum	4.8		0.2	
Network Type				
HMO	45.7		38.5	
PPO	45.1		61.4	
EPO	9.2		0.0	
Income				
0% to 138% of FPL	2.9	2.8	5.0	4.3
138% to 150% of FPL	15.0	5.4	8.5	4.6
150% to 200% of FPL	33.8	20.5	30.3	18.0
200% to 250% of FPL	17.4	16.2	18.7	17.3
250% to 400% of FPL	22.7	29.6	25.0	30.9
400%+ of FPL	8.2	25.4	12.5	25.0
Subsidy Eligibility				
Premium tax credits	90.7	74.6	85.5	75.0
Cost sharing reduction subsidies	68.5	44.9	61.4	44.2
Penalty Status				
Exempt	3.8	6.3	5.3	9.5
Subject	96.2	93.7	94.7	90.5
Age				
0-17	4.8	3.2	0.3	2.9
18-25	10.4	20.9	8.5	19.1
26-34	15.7	25.5	17.5	25.2
35-44	15.6	17.0	17.4	19.9
45-54	24.4	17.8	22.6	16.6
55-64	29.0	15.4	33.8	16.3
Gender				
Female	52.3	43.1	54.1	40.8
Male	47.7	56.9	45.9	59.2
Race				
Asian			14.9	8.8
Black/African American			2.9	3.6
Other Race			5.4	12.1
White			76.8	75.5
Smoking Status				
Non-Smoker			91.1	70.2
Smoker			8.9	29.8
Year				
2014	48.9	58.9	48.0	56.5
2015	51.1	41.1	52.0	43.5
Average Annual Population	1,239,268	1,407,430	168,785	218,797

NOTES: Columns 2 and 4 indicate the distribution of enrollment in Covered California and WAHBE, respectively, based on 2014 and 2015 administrative data from the two marketplaces. Columns 3 and 5 summarize the distribution of enrollment of the uninsured who meet the inclusion criteria described in the text, based on 2014 and 2015 survey data from the ACS.

Table 3: Insurers, Plans, and Premiums by State and Year

	California		Washington	
	2014	2015	2014	2015
Insurers Available				
Minimum	1.0	2.0	2.0	3.0
Median	5.0	5.0	6.0	7.0
Average	4.8	4.7	5.5	6.8
Maximum	6.0	6.0	7.0	8.0
Plans Available				
Minimum	5.0	10.0	16.0	21.0
Median	25.0	25.0	28.0	47.0
Average	24.6	24.5	26.2	45.8
Maximum	35.0	35.0	31.0	61.0
Silver Plan Premiums				
County Average	\$309.70	\$320.25	\$306.00	\$303.46
Minimum	\$221.56	\$230.31	\$234.72	\$218.55
Maximum	\$480.59	\$554.26	\$369.11	\$363.24
Minimum second-lowest	\$253.27	\$257.19	\$260.01	\$252.67
Maximum second-lowest	\$422.58	\$423.67	\$312.61	\$297.00

NOTES: The first two panels provide summary statistics on the number of insurers and plans available to consumers. The third panel shows variation in silver plan premiums for a 40-year old nonsmoker.

where p_{ij} is household i's premium contribution for plan j relative to the outside option (i.e., after deducting the household's premium subsidy and penalty), x_j is a vector of observed product characteristics, d_i is a vector of demographic characteristics, ξ_{ij} is a vector of unobserved product characteristics which may vary over households, and ϵ_{ij} is an error term with distribution function $F(\cdot)$. The utility function parameters α, β, φ, and γ correspond to the variables p_{ij}, x_j, d_i, and the interaction term $p_{ij}d_i$ respectively. The demographic intercepts d_i' indicate each demographic's taste for marketplace insurance, all else equal, and are identified because they do not appear in the utility of the outside option. The interaction term $p_{ij}d_i$ indicates how premium sensitivity varies by demographic.

In the vector x_j of product characteristics, I include the plan actuarial value and an indicator for an HMO plan. I capture the considerable variation in benefit structure within metal tiers in Washington by including the ratio of each plan's deductible and maximum out-of-pocket limit to the maximum value of these parameters in the plan's metal tier.[9] A potentially important product characteristic that is omitted from the demand model is the breadth or quality of the plan provider network. I incorporate firm fixed effects, which are likely to be highly correlated with the provider network, to address this

[9]Recall that plan benefit structures are standardized within metal tiers in California.

concern. In the vector of demographics d_i, I include age group, income group, gender, household size, rating area, and year, as well as race and smoking status for Washington only.[10] The vector d_i also contains an indicator m_i of whether the household is subject to the individual mandate.

In my empirical analysis, I model (1) as a nested logit such that the vector of error terms $\epsilon_i = \{\epsilon_{ij}\}_{j \in J}$ has the generalized extreme value distribution. I create two nests: 1) a nest containing all marketplace plans and 2) a nest containing only the outside option. This two-nest structure addresses the potential concern that a simple logit model would overestimate substitution to the outside option (which represents over 50 percent of both state samples) due to a premium change because of its proportional substitution assumption.[11]

Several issues complicate estimation of (1). First, the premium variable may be endogenous as it might be correlated with unobserved product characteristics such as customer service. I adopt the control function approach of Petrin and Train (2010) to address potential premium endogeneity. Full details of the approach are given in Appendix A. Second, I do not observe health status or a measure of ex-post health risk, leading to potential bias of the demographic variable and interaction term coefficients. Significant variation in choice sets, both within and across rating areas, help to enhance identification of the model coefficients. In addition, the complexity of the ACA's market reforms generates substantial variation in choice sets and premiums that consumers face. For example, there is a sharp income threshold at 400 percent of FPL for premium subsidy eligibility and at 250 percent of FPL for cost sharing subsidy eligibility (and the actuarial value of the cost sharing subsidy plans also changes abruptly at 150 and 200 percent of FPL). Age breakpoints create choice set and premium variation; consumers are no longer able to purchase a catastrophic plan upon turning age 30, while young adults face a 57 percent increase in premiums upon turning age 21 according to the default CMS age rating curve (Centers for Medicare and Medicaid Services, 2013).

I also estimate the taste for compliance with the individual mandate using the demand estimates of (1). I define the taste for compliance formally in terms of compensating variation as follows. Consider the general utility function $U_{ij}(p_{ij}, m_i)$, where p_{ij} is the premium relative to the outside option (i.e., after deducting the premium subsidy and penalty) and m_i indicates whether household i is subject to the penalty as above. Suppose household i purchases plan j and define the premiums p''_{ij} and p'_{ij} such that $U_{ij}(p''_{ij}, 0) = U_{ij}(p'_{ij}, 1)$. That is, p''_{ij} is the premium relative to the outside option that provides the household with the same utility in a setting where it is exempt from the mandate as in a setting

[10] I aggregate individual-level demographic variables by calculating the percentage of household members with the specific individual-level characteristic (e.g., for gender, I calculate the percentage of household members that are male).

[11] A natural nest structure alternative would be to define each of five plan metal tiers (including catastrophic) as a separate nest and the outside option as a sixth nest. However, such a partition would be more computationally intensive and problematic to implement given the ACA's preferential treatment of certain metal tiers (e.g., cost sharing subsidies are only available for silver plans).

where it is subject to the mandate. I define the taste for compliance as the compensating variation $\tau_i = p'_{ij} - p''_{ij}$. No taste for compliance exists if $\tau_i = 0$, in which case a subsidy equal to the amount of the penalty provides household i with the same utility in both settings. A taste for compliance exists if $\tau_i > 0$ and represents the additional premium reduction beyond the amount of the penalty required to restore the consumer's utility to its level under the mandate.

If utility takes the linearly separable form in (1), then the taste for compliance is given by $\tau_i = \varphi_{m_i}/\overline{\alpha}_i$, where $\overline{\alpha}_i = \alpha_i + d'_i\gamma_i$ and φ_{m_i} is the coefficient of the variable m_i in (1). One potential empirical challenge with estimating φ_{m_i} is collinearity of the penalty and income. The sharp income-based exemption thresholds, including the filing threshold and affordability criterion, help to address this concern. Another challenge in estimating φ_{m_i} is the potential for omitted variable bias. For this reason, I include all available demographic characteristics in the demographic intercept variable vector d_i. A potentially important variable that I am unable to control for is health status.

4 Premium Sensitivity Results

I analyze consumer premium sensitivity by calculating premium elasticities of demand because regression coefficients in a discrete choice model are difficult to interpret. Appendix B presents full regression results, Appendix C provides semi-elasticities of demand, and Appendix D contains formulas for computing elasticities and semi-elasticities in the ACA setting.

Table 4 displays mean own-premium elasticities of demand (i.e., intensive margin elasticities). California consumers have a mean own-premium elasticity of -2.9 from the consumer's perspective and -7.8 from the insurer's perspective.[12] Washington consumers have a mean own-premium elasticity of -2.9 from the consumer's perspective and -6.9 from the insurer's perspective. These elasticity estimates are substantially higher than previous studies of individual market insurance because ACA consumers have (1) a much larger choice set of plans and (2) a centralized marketplace for readily comparing alternative plans. The elasticity estimates also suggest that California consumers are more premium elastic than Washington consumers, possibly due to plan standardization in California.[13] California consumers might place greater weight on the premium because there are fewer non-premium attributes to discriminate between alternative plan. Variation in premium sensitivity across demographic groups is consistent with theory. In particular, low-income individuals, young adults (between the ages of 18 and 34), males, non-whites, and smokers are more elastic.

[12] Recall that consumer perspective elasticities are lower than insurer perspective elasticities because consumers receive subsidies.

[13] A larger proportion of California consumers are subsidy-eligible, which explains why the mean consumer-perspective elasticities are about the same in both states, while the insurer-perspective elasticities are higher in California.

Table 4: Estimated Mean Own-Premium Elasticities

	California		Washington	
	Consumer-Perspective	Insurer-Perspective	Consumer-Perspective	Insurer-Perspective
Overall	-2.9	-7.8	-2.9	-6.9
Income (% of FPL)				
0-138	-3.8	-9.7	-6.7	-15.2
138-250	-3.3	-8.4	-3.0	-6.5
250-400	-2.7	-6.8	-2.7	-5.9
400+	-2.7	-6.8	-2.6	-5.7
Gender				
Female	-2.7	-6.8	-2.8	-6.6
Male	-3.0	-8.1	-3.0	-7.1
Age				
18-34	-3.5	-9.5	-3.6	-8.8
35-54	-3.3	-8.8	-2.9	-7.1
55+	-2.2	-5.9	-2.1	-5.2
Smoking Status				
Smoker			-3.4	-8.2
Non-Smoker			-2.7	-6.6
Race				
Asian			-3.1	-7.4
Black			-4.7	-11.1
White			-2.8	-6.5
Household Size				
Single	-4.2	-11.4	-3.9	-9.2
Family	-2.0	-5.7	-2.4	-5.8
Mandate Status				
Exempt	-2.3	-6.1	-2.5	-6.0
Subject	-3.0	-7.9	-2.9	-6.9
Year				
2014	-2.9	-7.7	-3.1	-7.4
2015	-3.0	-7.9	-2.8	-6.6

Notes: Table shows mean own-premium elasticities by demographic group and by state that are computed using formulas (4) and (5) in Appendix D.

Table 5 presents estimated elasticities for marketplace coverage (i.e., extensive margin elasticities). I find that consumers are inelastic on the extensive margin, consistent with the previous literature. California and Washington consumers have elasticities for marketplace coverage of -0.6 and -0.5, respectively, if subsidies do not adjust to the premium change (e.g., vouchers). Premium elasticities are

-0.1 and -0.2 in California and Washington, respectively, under the ACA subsidy formula that largely shields consumers from premium fluctuations. Advantages of limiting consumer premium sensitivity on the extensive margin include reducing market volatility and the potential for adverse selection. Insurers could, however, exploit consumer premium insensitivity by raising premiums, knowing that subsidies will largely offset the increase.

I conducted two sensitivity analyses to assess the robustness of my findings. First, I ran additional regressions where I included indicators for the cheapest plan and cheapest silver plan in each household's choice set. These tests assess whether consumers gravitate to plans carrying the "cheapest" designation. Table 11 shows both cheapest plan indicators are positive and statistically significant, but the coefficient for the cheapest silver plan is substantially larger. This result suggests that CSR-eligible consumers strategically select the cheapest plan eligible for CSRs. Second, I account for the possibility of inertia by incorporating an indicator in the vector d_i for a household renewing marketplace coverage in 2015. Table 11 in Appendix B indicates that the results are robust to the inclusion of the renewal indicator.

Assessing the relative importance of non-premium plan characteristics is also important to paint a complete picture of demand for health insurance. Table 6 displays the estimated non-premium plan characteristics parameters of (1). The actuarial value (or metal tier) of the plan has a strong positive impact on household plan selection in both states. Consumers may view the metal tier of the plan as a convenient signal for plan quality that involves little search effort. The effect of the plan actuarial value is substantially greater in California than in Washington. Plan standardization may make the actuarial value a more prominent plan attribute for California consumers. Coefficients for the other plan characteristics are far smaller in magnitude, suggesting that the plan metal tier represents the critical non-premium plan characteristic in consumer decision-making.

5 Consumer Response to the Individual Mandate

Contrary to standard economic theory, consumers appear to be relatively insensitive to the amount of the penalty, but quite sensitive to the existence of a penalty. Table 7 presents estimates of the individual mandate parameters for several different functional forms of (1) in addition to the base model functional form. I find that the mandate compliance variable is positive and statistically significant. In contrast, the coefficient on the penalty amount in sensitivity runs is either statistically insignificant or has the wrong (positive) sign, similar to what Frean et al. (2016) found. The estimates imply that the taste for compliance in Washington is \$67 per month, which means that consumers place as much value in complying with the mandate as a \$67 subsidy. The estimated taste for compliance is considerably

Table 5: Estimated Elasticities for Marketplace Coverage

	California		Washington	
	Vouchers	ACA Subsidies	Vouchers	ACA Subsidies
Overall	-0.6	-0.1	-0.5	-0.2
Income (% of FPL)				
0-138	-0.7	-0.2	-1.2	-0.4
138-250	-0.6	-0.1	-0.6	-0.2
250-400	-0.5	-0.1	-0.5	-0.2
400+	-0.5	-0.1	-0.5	-0.2
Gender				
Female	-0.5	-0.1	-0.5	-0.2
Male	-0.6	-0.1	-0.6	-0.2
Age				
18-34	-0.7	-0.1	-0.7	-0.2
35-54	-0.6	-0.1	-0.5	-0.2
55+	-0.4	-0.1	-0.4	-0.1
Smoking Status				
Smoker			-0.6	-0.2
Non-Smoker			-0.5	-0.1
Race				
Asian			-0.6	-0.2
Black			-0.8	-0.2
White			-0.5	-0.1
Household Size				
Single	-0.7	-0.2	-0.7	-0.2
Family	-0.4	-0.1	-0.4	-0.1
Mandate Status				
Exempt	-0.4	-0.1	-0.5	-0.1
Subject	-0.5	-0.1	-0.5	-0.2
Year				
2014	-0.6	-0.1	-0.6	-0.2
2015	-0.6	-0.1	-0.5	-0.1

Notes: Table shows elasticities for marketplace coverage by demographic group and by state that are computed using formula (7) in Appendix D. In the "Vouchers" columns, the cross-partial $\partial p_{ij}/\partial \overline{p}_{ib}$ is set equal to 0 for all plans $j \in J \setminus \{b\}$ for all consumers such that the consumer's subsidized premium does not respond to changes in the benchmark premium. In the "ACA subsidies" column, $\partial p_{ij}/\partial \overline{p}_{ib} = 1$ for all subsidized consumers and all plans $j \in J \setminus \{b\}$.

higher in California, but my sensitivity analyses indicate that lack of data on smokers could be a source of upward bias. As noted above, the taste for compliance estimates could be subject to omitted variable bias due to lack of data on health status. Table 7 also suggests the presence of potential collinearity

Table 6: Estimated Parameters of Non-Premium Plan Characteristics

	California	Washington
Actuarial Value (AV)	2.208***	1.614**
	(0.715)	(0.642)
HMO	−0.116***	0.287**
	(0.037)	(0.131)
Deductible Ratio		−0.051**
		(0.022)
Max. OOP Ratio		−0.011
		(0.014)
Anthem	0.225***	
	(0.078)	
Blue Shield CA	0.264***	
	(0.092)	
BridgeSpan		0.091**
		(0.045)
Centene/Health Net	0.233***	0.029
	(0.083)	(0.018)
Chinese Community	0.235***	
	(0.083)	
CHPW		0.207**
		(0.087)
Group Health/Kaiser	0.420***	0.099**
	(0.142)	(0.044)
LA Care	0.075***	
	(0.028)	
Moda		0.151**
		(0.071)
Molina	−0.123***	
	(0.042)	
Premera/Lifewise		0.378**
		(0.166)
Sharp	0.245***	
	(0.083)	
Valley	−0.003	
	(0.012)	
Western Health	0.117***	
	(0.039)	

Notes: ***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level. Table shows parameter estimates for the non-premium plan characteristics. Robust standard errors that correct for potential misspecification are shown in parentheses (see p.503 of Wooldridge (2010)).

between the penalty and income.

Table 7: Estimated Individual Mandate Parameters

	Base	Separate Penalty	No Mandate Intercept, Separate Penalty	Income Interaction	Exclude Smoker Variables
California					
Penalty		0.002	0.000		
		(0.002)	(0.001)		
Mandate	0.663***	0.997***		1.014***	
	(0.137)	(0.122)		(0.155)	
Mandate × > 400%				−0.911***	
				(0.212)	
Washington					
Penalty		0.003***	0.002***		
		(0.001)	(0.000)		
Mandate	0.181***	0.668***		1.080***	0.503***
	(0.053)	(0.076)		(0.109)	(0.061)
Mandate × > 400%				−1.500***	
				(0.161)	

Notes: ***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level. Robust standard errors that correct for potential misspecification are shown in parentheses (see p.503 of Wooldridge (2010)). Table shows parameter estimates for the individual mandate sensitivity runs. Column 2 includes a mandate intercept, column 3 includes both a mandate intercept and separate penalty, and column 4 includes a separate penalty. Column 5 adds an interaction between the mandate intercept and an intercept for those earning above 400 percent of FPL, while column 6 excludes the smoker variables in the Washington analysis.

An alternative hypothesis may hold that cognitive difficulty understanding the complex details of the mandate, rather than a taste for compliance, explains the response to the existence rather than the amount of the penalty. I designed a test to assess this hypothesis that distinguishes between the two primary mandate exemptions: (1) the household has income below the filing threshold and (2) the household lacks an affordable offer. Ascertaining whether an offer is affordable is a complex cognitive task, whereas determining whether income is below the filing threshold is a more straightforward exercise that long pre-dates the ACA. I distinguish between these two mandate exemptions by adding an interaction of the mandate intercept and the intercept for income above 400 percent of FPL to (1), as nearly all households with an affordable offer exemption have income just above the 400 percent

of FPL threshold for receiving subsidies. The fifth column of Table 7 indicates that individuals with income above 400 percent of FPL are not sensitive to the existence of the mandate, compared to those with income below 400 percent of FPL. Therefore, those who have a greater challenge in determining their exemption status are less responsive to the penalty's existence, indicating that cognitive difficulty does not drive the sensitivity of consumers to the penalty's existence.

Another method for evaluating consumer response to the individual mandate is to compare the behavior of those who started coverage at the beginning of the 2014 open enrollment period to those who waited until just before the deadline for complying with the individual mandate.[14] The earliest possible date to begin coverage during the 2015 open enrollment period was January 1, 2014 and latest possible date to begin coverage was May 1, 2014. Table 8 provides summary statistics comparing early enrollees to late enrollees. Late enrollees were less likely to choose a gold or platinum plan and more likely to select a bronze plan. I also find that late enrollees are more likely to be young adults (i.e., age 26-34), male, and racial minorities. Table 9 indicates that late enrollees are more premium elastic. Washington consumers beginning coverage in January 2014 had a mean own-premium elasticity of -6.1 from the insurer's perspective. In contrast, those beginning coverage in May 2014 had a mean own-premium elasticity of -7.3 from the insurer's perspective. Premium sensitivity is also monotonically increasing in the coverage start date. These findings suggest that the mandate incentivized lower-risk individuals to enroll, reducing adverse selection. In contrast, Table 9 indicates a substantially smaller increase in consumer premium sensitivity during the course of the 2015 open enrollment period when the mandate had already been in effect for a year.

6 Repealing the Individual Mandate

In this section, I simulate repeal of the individual mandate using the base demand estimates of demand model (1). A possible empirical strategy for determining the new market equilibrium under mandate repeal is to combine the demand estimates with firms' profit functions, and then inverting the first order conditions of the firms' profit functions to estimate cost. This empirical strategy depends on the assumption that the market is currently in equilibrium, which appears to be tenuous given recent upheaval in the ACA marketplaces. I avoid making this assumption and instead simulate mandate repeal under a range of firm responses from the microsimulation literature,[15] which suggests mandate repeal would increase premiums by roughly 10 to 25 percent (Eibner and Price, 2012). Most recently, the Congressional Budget Office estimated individual market premiums would rise by 20 to 25 percent

[14] Note that I do not observe the coverage term for Covered California consumers, and hence I limit this analysis to Washington.

[15] These include analyses by the Congressional Budget Office, Lewin Group, RAND Corporation, Urban Institute, and Jonathan Gruber.

Table 8: Choice and Demographic Distribution by Coverage Start Date (WAHBE)

	Jan. 2014	Feb. 2014	Mar. 2014	Apr. 2014	May 2014
Metal Tier Choice					
Catastrophic	0.1	0.1	0.1	0.1	0.2
Bronze	32.5	40.1	40.8	36.9	41.7
Silver	57.3	50.3	51.4	56.5	52.9
Gold	10.1	9.6	7.8	6.5	5.2
Platinum	0.0	0.0	0.0	0.0	0.0
Network Type Choice					
HMO	31.6	34.5	38.0	41.1	41.4
PPO	68.4	65.5	62.0	58.9	58.6
Income					
0% to 138% of FPL	3.6	6.8	7.0	6.4	4.6
138% to 150% of FPL	7.8	9.4	10.2	9.3	8.2
150% to 200% of FPL	27.0	30.8	33.1	33.2	32.7
200% to 250% of FPL	17.5	18.0	18.3	18.6	19.3
250% to 400% of FPL	27.2	23.4	21.9	22.4	22.2
400%+ of FPL	16.9	11.6	9.5	10.1	13.0
Subsidy Eligibility					
Premium tax credits	82.1	87.6	89.8	89.4	86.2
Cost sharing reduction subsidies	55.3	64.4	68.2	67.2	64.3
Penalty Status					
Exempt	6.8	5.8	5.1	4.8	3.9
Subject	93.2	94.2	94.9	95.2	96.1
Age					
0-17	0.3	0.4	0.2	0.1	0.0
18-25	7.5	10.5	9.8	9.6	9.5
26-34	13.3	16.8	18.3	19.1	23.4
35-44	15.2	17.8	18.3	18.6	20.2
45-54	21.9	23.2	24.0	24.0	23.4
55-64	41.4	30.6	28.8	28.0	23.0
65+	0.4	0.6	0.7	0.7	0.5
Gender					
Female	55.7	54.5	55.0	53.7	49.7
Male	44.3	45.5	45.0	46.3	50.3
Race					
Asian	11.4	16.8	19.9	18.8	14.1
Black/African American	1.9	2.8	3.6	4.1	4.7
Other Race	3.5	5.7	6.5	6.6	7.1
White	83.2	74.7	70.0	70.5	74.0
Smoking Status					
Non-Smoker	92.6	91.3	90.6	89.9	88.8
Smoker	7.4	8.7	9.4	10.1	11.2
Total population	54,664	24,260	17,536	24,652	27,678

Notes: Table compares Washington marketplace enrollee choices and demographic characteristics by their coverage initiation dates.

if the individual mandate were repealed (Congressional Budget Office, 2017).

Table 10 shows how repealing the individual mandate would affect marketplace enrollment and con-

Table 9: Estimated Mean Own-Premium Elasticities by Coverage Start Date (Washington)

Coverage Start Month	Consumer-Perspective	Insurer-Perspective
January 2014	-2.6	-6.1
February 2014	-2.8	-6.7
March 2014	-2.9	-6.9
April 2014	-2.9	-7.0
May 2014	-3.1	-7.3
January 2015	-2.5	-6.0
February 2015	-2.7	-6.3
March 2015	-2.7	-6.5

Notes: Table shows estimated mean own-premium elasticities for Washington marketplace consumers by the coverage initiation month from the consumer's and insurer's perspectives using formulas (4) and (5), respectively.

sumer welfare under two firm response scenarios: a low percentage premium increase (10 percent) and a high percentage premium increase (25 percent). I find that marketplace enrollment would decline by 25.5 to 26.3 percent in California and 15.7 to 17.0 percent in Washington, which is on the lower end of the ACA micro-simulation literature. Repealing the mandate would cause sharper coverage declines of 30.1 to 37.7 percent in California and 23.4 to 35.9 percent in Washington if vouchers were to replace ACA subsidies. Mandate repeal has minimal effect on average annual consumer surplus, which increases by \$130 to \$230 in California and \$117 to \$140 in Washington.[16] A voucher-type system that exposes consumers to premium shocks reverses this conclusion; average annual consumer surplus falls by \$361 to \$1,211 in California and \$575 to \$1,507 in Washington. These divergent outcomes illustrate the important interaction between the mandate and other policies targeting adverse selection. ACA subsidies serve as a strong counterweight to adverse selection by shielding subsidized consumers from premium increases that could result from mandate repeal, making the mandate somewhat superfluous in the ACA setting. Exposing consumers to premium increases in a setting with vouchers gives the mandate a central role in curbing adverse selection. Note that these estimates of consumer welfare are averages and do not reflect the individual experience of a consumer. They also do not account for other social welfare impacts of repealing the mandate, such as changes in producer surplus and federal government spending.

[16] McFadden (1983) shows that expected consumer surplus can be calculated as $CW_i = \frac{\lambda}{\overline{\alpha}_i} \ln N_{iEX}$, where λ is the nesting parameter and $N_{iEX} = \sum_j \exp(U_{ij}/\lambda)$.

Table 10: Impact of Repealing the Individual Mandate

	Percent Change in Marketplace Enrollment		Change in Average Annual Consumer Surplus	
	Vouchers	ACA Subsidies	Vouchers	ACA Subsidies
California				
10% Premium Increase	-30.1%	-25.5%	-$361	$203
25% Premium Increase	-37.7%	-26.3%	-$1,211	$130
Washington				
10% Premium Increase	-23.4%	-15.7%	-$575	$140
25% Premium Increase	-35.9%	-17.0%	-$1,507	$117

Notes: Table shows the impact on enrollment and average annual consumer surplus of repealing the individual mandate under a voucher subsidy and under ACA subsidies. Two alternative supply response scenarios are considered: a 10% premium increase and a 25% premium increase.

7 Conclusion

I estimate demand for health insurance using consumer-level data from two ACA marketplaces. I find that marketplace consumers in California and Washington are highly premium elastic on the intensive margin, but premium inelastic on the extensive margin. There is considerable variation in premium sensitivity across demographic groups, particularly by age. Standardization of plan benefits appears to make consumers more premium elastic. My results also indicate that the plan metal tier is an important discriminator in plan choice, as it may be a convenient proxy for plan quality. In addition, I find evidence that consumers respond to the existence of the mandate penalty, rather than the amount of the penalty. My analysis indicates that a taste for compliance offers a plausible explanation for this result, which has important implications for the effectiveness of policy sticks relative to policy carrots.

After estimating demand for health insurance in the ACA marketplaces, I use the demand estimates to simulate the interaction between alternative subsidy approaches and the individual mandate in mitigating adverse selection. My simulations indicate that mandate repeal would have minimal impact on consumer welfare because ACA subsidies are already a strong policy instrument for reducing adverse selection. If a voucher-based system that exposes consumers to premium increases were to replace ACA subsidies, mandate repeal would significantly reduce consumer welfare. Hence, repealing the individual mandate involves an intricate set of policy interactions that warrant deliberate discussion.

Several caveats should be attached to my empirical results. First, I am unable to control for health status or ex-post health risk, which could be a source of bias. Second, collinearity between the penalty amount and income could lead to imprecision in measuring the taste for compliance. Finally, I do not

have enrollment data for individual market plans offered outside of the marketplaces. Substitution between on- and off-marketplace individual market plans is likely to be minimal because off-marketplace plans are ineligible for subsidies and subject to ACA rating rules and risk adjustment. However, it is conceivable that some of the uninsured in my sample who are ineligible for subsidies might consider an off-marketplace plan.

Future studies of demand for health insurance can use data from the ACA marketplaces to further understand how consumers choose plans. In particular, my analysis does not consider the importance of provider networks, which vary considerably between marketplace firms, in consumer decision-making. Data in the ACA setting is sufficiently rich to answer key supply-side questions such as which geographic markets insurers decide to enter and how they set premiums. A stronger understanding of both the demand-side and supply-side will help researchers characterize the competitive dynamics in the ACA marketplaces and identify which policy regimes could improve social welfare.

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Appendix A: Description of the Control Function Approach

A key challenge in estimating (1) is identification of the premium parameter α_i and interaction term parameters γ_i. Premiums are likely to be correlated with unobserved (to the econometrician) product characteristics ξ_{ij}, such as speed of processing claims and overall customer service. Failure to account for these correlations would tend to bias the parameter estimates downwards in magnitude towards zero. The most common approach to correct for premium endogeneity in a discrete choice model was developed by Berry et al. (1995) and extended to individual-level data in Berry et al. (2004a). For consistent parameter estimates, the approach requires that there be more than just zero or a small number of observed purchases per plan (Berry et al., 2004b), which is violated in my data for some plans sold by small insurers. In addition, the procedure works by absorbing the premium endogeneity into product-level constants, which is somewhat problematic in this setting because premiums vary across households in addition to products.

As an alternative, I use the control function approach of Petrin and Train (2010). To implement the control function approach, I first regress the insurer's premium $\overline{p}_{ij}$ against instruments z_t. I then compute the predicted household premiums $\widehat{p}_{ij} = \overline{p}_{ij} - ps_i - \tau_i$ (where ps_i is the household's premium subsidy and $\overline{\tau}_i$ is the household's individual mandate penalty) and obtain the residuals $\mu_{ij} = p_{ij} - \widehat{p}_{ij}$. Following the second approach in Petrin and Train (2010), suppose that the error terms (μ_{ij}, ξ_{ij}) are jointly normal and set $\xi_{ij} = E[\xi_{ij}|\mu_{ij}] + \widetilde{\xi}_{ij}$ to "control" for potential correlations between μ_{ij} and ξ_{ij}. By properties of normal distributions, it follows that the conditional distribution $\xi_{ij}|\mu_{ij}$ is also normal with mean $\upsilon\mu_{ij}$ and variance ψ^2 (υ and ψ are parameters to be estimated). Now the model (1) can be written as

$$\begin{aligned} U_{ij} &= V_{ij} + E[\xi_{ij}|\mu_{ij}] + \widetilde{\xi}_{ij} + \epsilon_{ij} \\ &= V_{ij} + \upsilon\mu_{ij} + \psi\eta_{ij} + \epsilon_{ij} \end{aligned} \tag{2}$$

where $V_{ij} = \alpha p_{ij} + x_j'\beta + d_i'\varphi + p_{ij}d_i'\gamma$ and $\eta_{ij} \sim N(0,1)$. Note that model (2 has two more parameters to estimate (υ and ψ), but controls for the endogeneity of premiums. The household choice probabilities can be computed as

$$s_{ij} = \int \left[\frac{e^{V_{ij}'/\lambda} \left(\sum_{j \in J} e^{V_{ij}'/\lambda} \right)^{\lambda - 1}}{1 + \left(\sum_{j \in J} e^{V_{ij}'/\lambda} \right)^{\lambda}} \right] dG(\cdot) \tag{3}$$

where $V_{ij}' \equiv V_{ij} + \upsilon\mu_{ij} + \psi\eta_{ij}$ and $G(\cdot)$ is the normal cumulative distribution function for $\xi_{ij}|\mu_{ij}$. Because

the integral in (3) does not have an analytical solution, I estimate it using simulation. To estimate the demand model parameters θ in (1), I use maximum simulated likelihood with log-likelihood function

$$LL(\theta) = \sum_{i,j} w_i c_{ij} \ln s_{ij}(\theta)$$

where w_i is the household's weight and c_{ij} takes 1 if household i chose plan j and 0 otherwise.

To construct the instrument vector, I include all non-premium attributes, which are assumed to be exogenous. From the California and Washington insurer rate filings, I obtain geographic cost factors, which reflect each insurer's cost relative to its cost in other rating areas in which it participates. For example, in 2014, Kaiser had a geographic cost factor of 1.00 in Washington's rating area 3 and 1.05 in rating area 2, implying that it expects its cost to be 5 percent greater in rating area 2. In its rate filing, Kaiser indicates that its provider contracts are more favorable in rating area 3 than in rating area 2. Because the geographic cost factors are indicative of an insurer's bargaining leverage with providers in a given rating area, they should make good instruments in this setting (i.e., they are likely to be correlated with the premium, but uncorrelated with demand). Note also that many insurers have larger disparities in cost across geographic regions (e.g., Group Health's cost factor in rating area 2 was 46 percent greater than its cost factor in rating area 4).

In addition, I include the instruments suggested by Berry et al. (1995). Applied to this setting, these instruments are for each plan $j \in J$ 1) the average value for each plan characteristic $k \in K_1$ of all plans $j' \in J, j' \neq j$ offered by the firm offering plan j in a given rating area $n \in N$ and year $t \in \{2004, 2005\}$ and 2) the average value for each plan characteristic $k \in K_1$ of all plans $j' \in J, j' \neq j$ *not* offered by the firm offering plan j in a given rating area $n \in N$ and year $t \in \{2004, 2005\}$. The idea is to measure each plan's isolation in the characteristic space K_1, with more "isolated" or less substitutable products potentially having higher margins. These instruments should be strong in the Washington model, where products are highly differentiated; however, they might be weak in the California setting, where plans are standardized. Because of these potential limitations, I also instrument for a plan $j \in J$ being offered in rating area n in year t by calculating the average premium that the insurer charges for j in other rating areas in the same year. Proposed by Hausman (1997), this instrument reflects the idea that the unobserved characteristics of a plan j offered in rating area n are correlated with the premium in rating area n, but not correlated with the premiums in other rating areas.

Appendix B: Full Regression Results

Table 11: Full Regression Results

	California			Washington		
	Base	Inertia	Cheapest Plans	Base	Inertia	Cheapest Plans
Monthly Premium ($100)	-0.304^{***}	-0.293^{***}	-0.276^{***}	-0.530^{***}	-0.450^{***}	-0.421^{***}
	(0.087)	(0.020)	(0.067)	(0.179)	(0.037)	(0.147)
Cheapest Plan			0.026^{***}			0.085^{**}
			(0.008)			(0.036)
Cheapest Silver Plan			0.253^{***}			0.232^{**}
			(0.082)			(0.097)
Actuarial Value (AV)	2.208^{***}	2.090^{***}	2.281^{***}	1.614^{**}	1.329^{***}	1.693^{**}
	(0.715)	(0.114)	(0.647)	(0.642)	(0.110)	(0.715)
HMO	-0.116^{***}	-0.110^{***}	-0.140^{***}	0.287^{**}	0.229^{***}	0.267^{**}
	(0.037)	(0.009)	(0.040)	(0.131)	(0.075)	(0.114)
Deductible Ratio				-0.051^{**}	-0.043^{***}	-0.102^{**}
				(0.022)	(0.009)	(0.047)
Max. OOP Ratio				-0.011	-0.005	-0.020
				(0.014)	(0.010)	(0.022)
Anthem	0.225^{***}	0.214^{***}	0.226^{***}			
	(0.078)	(0.080)	(0.073)			
Blue Shield CA	0.264^{***}	0.250^{***}	0.276^{***}			
	(0.092)	(0.080)	(0.088)			
BridgeSpan				0.091^{**}	0.071	0.023^{***}
				(0.045)	(0.073)	(0.007)
Centene/Health Net	0.233^{***}	0.221^{***}	0.178^{***}	0.029	0.023^{**}	-0.025^{***}
	(0.083)	(0.080)	(0.060)	(0.018)	(0.010)	(0.001)
Chinese Community	0.235^{***}	0.224^{***}	0.161^{***}			
	(0.083)	(0.081)	(0.053)			
CHPW				0.207^{**}	0.167^{**}	0.161^{***}
				(0.087)	(0.074)	(0.051)
Group Health/Kaiser	0.420^{***}	0.398^{***}	0.485^{***}	0.099^{**}	0.082^{***}	0.126^{**}
	(0.142)	(0.082)	(0.149)	(0.044)	(0.011)	(0.060)
LA Care	0.075^{***}	0.072	0.079^{***}			
	(0.028)	(0.080)	(0.029)			
Moda				0.151^{**}	0.121^{*}	0.096^{***}
				(0.071)	(0.073)	(0.033)
Molina	-0.123^{***}	-0.115	-0.184^{***}			
	(0.042)	(0.080)	(0.057)			
Premera/Lifewise				0.378^{**}	0.306^{***}	0.389^{**}
				(0.166)	(0.077)	(0.165)

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Table 11 – *Continued from previous page*

	California			Washington		
	Base	Inertia	Cheapest Plans	Base	Inertia	Cheapest Plans
Sharp	0.245^{***}	0.233^{***}	0.270^{***}			
	(0.083)	(0.081)	(0.084)			
Valley	-0.003	-0.001	0.002			
	(0.012)	(0.086)	(0.014)			
Western Health	0.117^{***}	0.113	0.130^{***}			
	(0.039)	(0.082)	(0.040)			
Premium ($100) ×						
138-250	0.045^{***}	0.037^{***}	0.027^{***}	0.304^{***}	0.247^{***}	0.221^{**}
	(0.013)	(0.014)	(0.010)	(0.111)	(0.026)	(0.092)
250-400	0.095^{***}	0.085^{***}	0.060^{***}	0.325^{***}	0.262^{***}	0.222^{**}
	(0.027)	(0.015)	(0.017)	(0.122)	(0.027)	(0.097)
400+	0.096^{***}	0.091^{***}	0.063^{***}	0.332^{***}	0.272^{***}	0.226^{**}
	(0.026)	(0.014)	(0.016)	(0.124)	(0.027)	(0.100)
Male	-0.018^{***}	-0.015^{***}	-0.020^{***}	-0.017	-0.010^{*}	-0.024
	(0.006)	(0.005)	(0.005)	(0.016)	(0.005)	(0.023)
0-17	0.024	0.021^{***}	0.033^{*}			
	(0.017)	(0.006)	(0.020)			
18-34	-0.115^{***}	-0.111^{***}	-0.122^{***}	-0.124^{***}	-0.101^{***}	-0.130^{***}
	(0.036)	(0.008)	(0.033)	(0.041)	(0.009)	(0.040)
35-54	-0.094^{***}	-0.087^{***}	-0.103^{***}	-0.065^{***}	-0.054^{***}	-0.075^{**}
	(0.030)	(0.006)	(0.029)	(0.025)	(0.006)	(0.030)
Smoker				-0.055	-0.040^{***}	-0.076
				(0.034)	(0.008)	(0.048)
Black				-0.143^{*}	-0.110^{***}	-0.173
				(0.081)	(0.020)	(0.108)
Asian				-0.017^{***}	-0.018^{***}	-0.014^{***}
				(0.005)	(0.006)	(0.003)
White				0.015^{***}	0.014^{***}	0.015^{***}
				(0.001)	(0.003)	(0.002)
Family	0.186^{***}	0.174^{***}	0.196^{***}	0.118^{***}	0.101^{***}	0.122^{***}
	(0.060)	(0.010)	(0.055)	(0.038)	(0.008)	(0.039)
Year 2015	-0.005^{***}	-0.016^{***}	-0.007^{***}	0.027^{*}	0.004	0.023^{*}
	(0.002)	(0.003)	(0.002)	(0.014)	(0.004)	(0.014)
Renewal		0.018^{***}			0.022^{***}	
		(0.004)			(0.004)	
Mandate	-0.060^{**}	-0.046^{***}	-0.068^{**}	-0.033	-0.012^{*}	-0.051
	(0.027)	(0.006)	(0.031)	(0.025)	(0.007)	(0.038)
Intercept						

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Table 11 – *Continued from previous page*

	California			Washington		
	Base	Inertia	Cheapest Plans	Base	Inertia	Cheapest Plans
Base	−2.639***	−2.532***	−2.876***	0.500	0.926***	0.212
	(0.724)	(0.180)	(0.815)	(0.962)	(0.210)	(1.317)
138-250				−0.672***	−0.885***	−0.634***
				(0.147)	(0.115)	(0.242)
250-400				−1.057***	−1.418***	−0.915*
				(0.285)	(0.128)	(0.468)
400+	−1.046***	−1.164***	−0.981***	−1.751***	−2.135***	−1.592***
	(0.193)	(0.058)	(0.194)	(0.319)	(0.127)	(0.508)
Male	0.049	0.146***	0.056	−0.275***	−0.340***	−0.260***
	(0.041)	(0.041)	(0.038)	(0.056)	(0.043)	(0.067)
0-17	−2.765***	−2.877***	−2.717***			
	(0.150)	(0.111)	(0.119)			
18-34	−1.461***	−1.501***	−1.458***	−2.027***	−1.874***	−2.024***
	(0.054)	(0.053)	(0.046)	(0.046)	(0.050)	(0.031)
35-54	−1.135***	−1.219***	−1.127***	−0.676***	−0.619***	−0.652***
	(0.060)	(0.051)	(0.045)	(0.062)	(0.048)	(0.065)
Smoker				−1.916***	−1.922***	−1.866***
				(0.116)	(0.058)	(0.135)
Black				−1.796***	−2.155***	−1.722***
				(0.238)	(0.102)	(0.288)
Asian				−0.677***	−0.950***	−0.676***
				(0.086)	(0.077)	(0.075)
White				−1.366***	−1.417***	−1.352***
				(0.070)	(0.046)	(0.066)
Family	1.850***	1.893***	1.845***	0.489***	0.495***	0.504***
	(0.070)	(0.040)	(0.033)	(0.059)	(0.036)	(0.076)
Year 2015	0.417***	−0.416***	0.419***	0.396***	−0.390***	0.408***
	(0.043)	(0.036)	(0.036)	(0.064)	(0.036)	(0.058)
Renewal		28.334			4.921***	
					(0.155)	
		(17,334.230)				
Mandate	0.663***	0.451***	0.720***	0.181***	0.284***	0.236**
	(0.137)	(0.082)	(0.199)	(0.053)	(0.087)	(0.093)
Rating Areas						
WA1				1.123***	1.309***	1.118***
				(0.045)	(0.055)	(0.040)
CA/WA2	2.322***	2.656***	2.323***	0.869***	0.931***	0.864***

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Table 11 – *Continued from previous page*

	California			Washington		
	Base	Inertia	Cheapest Plans	Base	Inertia	Cheapest Plans
	(0.231)	(0.140)	(0.195)	(0.039)	(0.049)	(0.036)
CA/WA3	0.810***	1.043***	0.795***	0.840***	0.939***	0.830***
	(0.121)	(0.102)	(0.099)	(0.085)	(0.076)	(0.090)
WA4				0.277***	0.162**	0.279***
				(0.075)	(0.067)	(0.075)
CA4/8	2.330***	2.473***	2.334***			
	(0.186)	(0.121)	(0.150)			
CA5	2.228***	2.833***	2.197***			
	(0.292)	(0.163)	(0.246)			
CA6	2.034***	2.269***	2.034***			
	(0.149)	(0.119)	(0.127)			
CA7	2.024***	2.314***	2.040***			
	(0.177)	(0.122)	(0.149)			
CA9	1.227***	1.440***	1.243***			
	(0.145)	(0.126)	(0.123)			
CA10	−0.260	0.057	−0.331**			
	(0.165)	(0.107)	(0.164)			
CA11	−1.210***	−1.156***	−1.247***			
	(0.124)	(0.123)	(0.110)			
CA12	1.509***	1.764***	1.500***			
	(0.143)	(0.112)	(0.117)			
CA14	−1.499***	−1.329***	−1.474***			
	(0.117)	(0.127)	(0.098)			
CA15	−0.036	0.249***	−0.038			
	(0.114)	(0.086)	(0.097)			
CA16	0.573***	0.777***	0.574***			
	(0.100)	(0.083)	(0.078)			
CA17	−0.893***	−0.512***	−0.865***			
	(0.097)	(0.088)	(0.080)			
CA18	0.573***	0.872***	0.567***			
	(0.134)	(0.090)	(0.112)			
CA19	0.595***	0.662***	0.584***			
	(0.134)	(0.088)	(0.112)			
Nesting Parameter	0.184***	0.173***	0.220***	0.176**	0.143***	0.209**
	(0.063)	(0.010)	(0.069)	(0.076)	(0.012)	(0.098)

Notes: ***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level. Robust standard errors that correct for potential misspecification are shown in parentheses (see p.503 of Wooldridge (2010)). Table shows full regression results for the base case, as well as the inertia and cheapest plan sensitivity runs.

Table 12: Control Function Regression Results

	California		Washington	
	Base	Control Function	Base	Control Function
Monthly Premium ($100)	-0.304^{***}	-0.283^{***}	-0.530^{***}	-0.532^{**}
	(0.087)	(0.103)	(0.179)	(0.257)
Actuarial Value (AV)	2.208^{***}	2.147^{**}	1.614^{**}	1.642^{*}
	(0.715)	(0.960)	(0.642)	(0.927)
HMO	-0.116^{***}	-0.114^{**}	0.287^{**}	0.287
	(0.037)	(0.047)	(0.131)	(0.187)
Deductible Ratio			-0.051^{**}	-0.051
			(0.022)	(0.031)
Max. OOP Ratio			-0.011	-0.006
			(0.014)	(0.016)
Anthem	0.225^{***}	0.225^{**}		
	(0.078)	(0.109)		
Blue Shield CA	0.264^{***}	0.264^{**}		
	(0.092)	(0.126)		
BridgeSpan			0.091^{**}	0.090
			(0.045)	(0.064)
Centene/Health Net	0.233^{***}	0.233^{**}	0.029	0.028
	(0.083)	(0.110)	(0.018)	(0.025)
Chinese Community	0.235^{***}	0.239^{**}		
	(0.083)	(0.112)		
CHPW			0.207^{**}	0.209^{*}
			(0.087)	(0.127)
Group Health/Kaiser	0.420^{***}	0.420^{**}	0.099^{**}	0.100
	(0.142)	(0.193)	(0.044)	(0.062)
LA Care	0.075^{***}	0.074^{**}		
	(0.028)	(0.035)		
Moda			0.151^{**}	0.152
			(0.071)	(0.102)
Molina	-0.123^{***}	-0.147^{*}		
	(0.042)	(0.079)		
Premera/Lifewise			0.378^{**}	0.379
			(0.166)	(0.239)
Sharp	0.245^{***}	0.246^{**}		
	(0.083)	(0.111)		
Valley	-0.003	-0.012		
	(0.012)	(0.018)		
Western Health	0.117^{***}	0.106^{**}		
	(0.039)	(0.041)		

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Table 12 – *Continued from previous page*

	California		Washington	
	Base	Control Function	Base	Control Function
Premium ($100) ×				
138-250	0.045^{***}	0.040^{***}	0.304^{***}	0.302^{**}
	(0.013)	(0.012)	(0.111)	(0.151)
250-400	0.095^{***}	0.093^{***}	0.325^{***}	0.324^{*}
	(0.027)	(0.031)	(0.122)	(0.166)
400+	0.096^{***}	0.096^{***}	0.332^{***}	0.331^{*}
	(0.026)	(0.031)	(0.124)	(0.177)
Male	-0.018^{***}	-0.024^{*}	-0.017	-0.017
	(0.006)	(0.013)	(0.016)	(0.024)
0-17	0.024	0.030		
	(0.017)	(0.028)		
18-34	-0.115^{***}	-0.118^{**}	-0.124^{***}	-0.125^{**}
	(0.036)	(0.052)	(0.041)	(0.062)
35-54	-0.094^{***}	-0.098^{**}	-0.065^{***}	-0.065^{*}
	(0.030)	(0.045)	(0.025)	(0.035)
Smoker			-0.055	-0.056
			(0.034)	(0.039)
Black			-0.143^{*}	-0.144
			(0.081)	(0.116)
Asian			-0.017^{***}	-0.017^{***}
			(0.005)	(0.006)
White			0.015^{***}	0.015^{***}
			(0.001)	(0.001)
Family	0.186^{***}	0.189^{**}	0.118^{***}	0.118^{**}
	(0.060)	(0.087)	(0.038)	(0.056)
Year 2015	-0.005^{***}	-0.006^{**}	0.027^{*}	0.027
	(0.002)	(0.002)	(0.014)	(0.019)
Mandate	-0.060^{**}	-0.060	-0.033	-0.033
	(0.027)	(0.038)	(0.025)	(0.029)
Intercept				
Base	-2.639^{***}	-2.671^{**}	0.500	0.487
	(0.724)	(1.116)	(0.962)	(1.397)
138-250			-0.672^{***}	-0.678^{***}
			(0.147)	(0.131)
250-400			-1.057^{***}	-1.057^{***}
			(0.285)	(0.316)
400+	-1.046^{***}	-1.059^{***}	-1.751^{***}	-1.749^{***}

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Table 12 – *Continued from previous page*

	California		Washington	
	Base	Control Function	Base	Control Function
	(0.193)	(0.231)	(0.319)	(0.405)
Male	0.049	0.049	-0.275^{***}	-0.274^{***}
	(0.041)	(0.052)	(0.056)	(0.075)
0-17	-2.765^{***}	-2.769^{***}		
	(0.150)	(0.135)		
18-34	-1.461^{***}	-1.456^{***}	-2.027^{***}	-2.031^{***}
	(0.054)	(0.049)	(0.046)	(0.081)
35-54	-1.135^{***}	-1.132^{***}	-0.676^{***}	-0.677^{***}
	(0.060)	(0.059)	(0.062)	(0.102)
Smoker			-1.916^{***}	-1.915^{***}
			(0.116)	(0.277)
Black			-1.796^{***}	-1.794^{***}
			(0.238)	(0.176)
Asian			-0.677^{***}	-0.680^{***}
			(0.086)	(0.106)
White			-1.366^{***}	-1.365^{***}
			(0.070)	(0.092)
Family	1.850^{***}	1.828^{***}	0.489^{***}	0.493^{***}
	(0.070)	(0.082)	(0.059)	(0.057)
Year 2015	0.417^{***}	0.414^{***}	0.396^{***}	0.396^{***}
	(0.043)	(0.041)	(0.064)	(0.124)
Mandate	0.663^{***}	0.654^{***}	0.181^{***}	0.176^{*}
	(0.137)	(0.212)	(0.053)	(0.103)
Rating Areas				
WA1			1.123^{***}	1.120^{***}
			(0.045)	(0.085)
CA/WA2	2.322^{***}	2.344^{***}	0.869^{***}	0.867^{***}
	(0.231)	(0.201)	(0.039)	(0.059)
CA/WA3	0.810^{***}	0.812^{***}	0.840^{***}	0.839^{***}
	(0.121)	(0.106)	(0.085)	(0.146)
WA4			0.277^{***}	0.276^{**}
			(0.075)	(0.121)
CA4/8	2.330^{***}	2.349^{***}		
	(0.186)	(0.130)		
CA5	2.228^{***}	2.256^{***}		
	(0.292)	(0.256)		
CA6	2.034^{***}	2.050^{***}		
	(0.149)	(0.133)		

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Table 12 – *Continued from previous page*

	California		Washington	
	Base	Control Function	Base	Control Function
CA7	2.024^{***}	2.047^{***}		
	(0.177)	(0.154)		
CA9	1.227^{***}	1.254^{***}		
	(0.145)	(0.124)		
CA10	-0.260	-0.242^{*}		
	(0.165)	(0.147)		
CA11	-1.210^{***}	-1.187^{***}		
	(0.124)	(0.118)		
CA12	1.509^{***}	1.536^{***}		
	(0.143)	(0.090)		
CA14	-1.499^{***}	-1.478^{***}		
	(0.117)	(0.104)		
CA15	-0.036	-0.024		
	(0.114)	(0.068)		
CA16	0.573^{***}	0.573^{***}		
	(0.100)	(0.063)		
CA17	-0.893^{***}	-0.884^{***}		
	(0.097)	(0.059)		
CA18	0.573^{***}	0.579^{***}		
	(0.134)	(0.076)		
CA19	0.595^{***}	0.598^{***}		
	(0.134)	(0.090)		
Residual		-0.000		0.000
		(0.000)		(0.000)
eta		0.005		-0.012^{***}
		(0.012)		(0.004)
Nesting Parameter	0.184^{***}	0.200^{**}	0.176^{**}	0.176
	(0.063)	(0.100)	(0.076)	(0.108)

Notes: ***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level. Robust standard errors that correct for potential misspecification are shown in parentheses (see p.503 of Wooldridge (2010)). Table shows full regression results for the base case and the control function approach of Petrin and Train (2010)

Table 13: California Regression Results - Mandate Regressions

	Base	No Mandate Intercept	Separate Penalty	No Mandate Intercept, Separate Penalty	Income Interaction
Monthly Premium ($100)	-0.304^{***}	-0.300^{**}	-0.275^{***}	-0.273^{**}	-0.303^{***}
	(0.087)	(0.117)	(0.106)	(0.138)	(0.080)
Penalty ($100)			0.179	0.027	
			(0.177)	(0.148)	
Actuarial Value (AV)	2.208^{***}	1.949^{**}	2.024^{**}	1.782^{*}	2.240^{***}
	(0.715)	(0.792)	(0.903)	(0.948)	(0.684)
HMO	-0.116^{***}	-0.102^{**}	-0.107^{**}	-0.094^{*}	-0.118^{***}
	(0.037)	(0.041)	(0.047)	(0.049)	(0.035)
Anthem	0.225^{***}	0.200^{**}	0.207^{**}	0.184^{*}	0.228^{***}
	(0.078)	(0.086)	(0.098)	(0.103)	(0.075)
Blue Shield CA	0.264^{***}	0.235^{**}	0.243^{**}	0.216^{*}	0.267^{***}
	(0.092)	(0.101)	(0.115)	(0.120)	(0.088)
Centene/Health Net	0.233^{***}	0.207^{**}	0.215^{**}	0.190^{*}	0.236^{***}
	(0.083)	(0.091)	(0.103)	(0.108)	(0.079)
Chinese Community	0.235^{***}	0.209^{**}	0.217^{**}	0.192^{*}	0.238^{***}
	(0.083)	(0.091)	(0.103)	(0.108)	(0.079)
Group Health/Kaiser	0.420^{***}	0.372^{**}	0.386^{**}	0.341^{*}	0.425^{***}
	(0.142)	(0.156)	(0.178)	(0.186)	(0.135)
LA Care	0.075^{***}	0.067^{**}	0.070^{**}	0.062^{*}	0.075^{***}
	(0.028)	(0.030)	(0.034)	(0.036)	(0.027)
Molina	-0.123^{***}	-0.108^{**}	-0.111^{**}	-0.098^{*}	-0.125^{***}
	(0.042)	(0.046)	(0.051)	(0.053)	(0.040)
Sharp	0.245^{***}	0.217^{**}	0.225^{**}	0.199^{*}	0.248^{***}
	(0.083)	(0.091)	(0.104)	(0.109)	(0.079)
Valley	-0.003	-0.002	-0.001	-0.001	-0.003
	(0.012)	(0.010)	(0.011)	(0.009)	(0.012)
Western Health	0.117^{***}	0.104^{**}	0.109^{**}	0.096^{*}	0.119^{***}
	(0.039)	(0.043)	(0.050)	(0.052)	(0.038)
Premium ($100) ×					
138-250	0.045^{***}	0.016^{*}	0.039^{***}	0.017^{*}	0.033^{***}
	(0.013)	(0.010)	(0.014)	(0.009)	(0.009)
250-400	0.095^{***}	0.060^{***}	0.084^{***}	0.056^{**}	0.084^{***}
	(0.027)	(0.020)	(0.032)	(0.023)	(0.018)
400+	0.096^{***}	0.092^{***}	0.082^{***}	0.082^{**}	0.087^{***}
	(0.026)	(0.034)	(0.027)	(0.037)	(0.019)

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Table 13 – *Continued from previous page*

	Base	No Mandate Intercept	Separate Penalty	No Mandate Intercept, Separate Penalty	Income Interaction
Male	-0.018^{***}	-0.018^{**}	-0.016^{**}	-0.016^{*}	-0.018^{***}
	(0.006)	(0.008)	(0.007)	(0.009)	(0.006)
0-17	0.024	0.020	0.026	0.022	0.026
	(0.017)	(0.017)	(0.024)	(0.024)	(0.017)
18-34	-0.115^{***}	-0.102^{**}	-0.106^{**}	-0.094^{*}	-0.116^{***}
	(0.036)	(0.040)	(0.046)	(0.049)	(0.034)
35-54	-0.094^{***}	-0.085^{**}	-0.088^{**}	-0.079^{*}	-0.096^{***}
	(0.030)	(0.035)	(0.041)	(0.044)	(0.029)
Family	0.186^{***}	0.169^{**}	0.168^{**}	0.152^{*}	0.189^{***}
	(0.060)	(0.070)	(0.074)	(0.081)	(0.058)
Year 2015	-0.005^{***}	-0.005^{***}	-0.005^{**}	-0.005^{*}	-0.006^{***}
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Mandate	-0.060^{**}		-0.054		-0.054^{**}
	(0.027)		(0.035)		(0.021)
Intercept					
Base	-2.639^{***}	-1.776^{***}	-2.850^{***}	-1.645^{**}	-3.016^{***}
	(0.724)	(0.682)	(0.841)	(0.806)	(0.714)
400+	-1.046^{***}	-1.246^{***}	-0.679^{***}	-1.094^{***}	-0.215
	(0.193)	(0.177)	(0.216)	(0.201)	(0.323)
Male	0.049	0.067	0.037	0.067	0.037
	(0.041)	(0.050)	(0.049)	(0.058)	(0.040)
0-17	-2.765^{***}	-2.751^{***}	-2.815^{***}	-2.789^{***}	-2.732^{***}
	(0.150)	(0.170)	(0.158)	(0.178)	(0.150)
18-34	-1.461^{***}	-1.426^{***}	-1.416^{***}	-1.381^{***}	-1.435^{***}
	(0.054)	(0.059)	(0.059)	(0.066)	(0.054)
35-54	-1.135^{***}	-1.132^{***}	-1.068^{***}	-1.086^{***}	-1.081^{***}
	(0.060)	(0.065)	(0.067)	(0.074)	(0.063)
Family	1.850^{***}	1.836^{***}	1.903^{***}	1.842^{***}	1.825^{***}
	(0.070)	(0.082)	(0.114)	(0.118)	(0.070)
Year 2015	0.417^{***}	0.391^{***}	0.586^{***}	0.474^{***}	0.426^{***}
	(0.043)	(0.050)	(0.064)	(0.062)	(0.042)
Mandate	0.663^{***}		0.997^{***}		1.014^{***}
	(0.137)		(0.122)		(0.155)
Mandate x gt400					-0.911^{***}
					(0.212)
Rating Areas					

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Table 13 – *Continued from previous page*

	Base	No Mandate Intercept	Separate Penalty	No Mandate Intercept, Separate Penalty	Income Interaction
CA2	2.322***	2.284***	2.352***	2.280***	2.299***
	(0.231)	(0.258)	(0.251)	(0.280)	(0.229)
CA3	0.810***	0.821***	0.834***	0.828***	0.778***
	(0.121)	(0.133)	(0.132)	(0.145)	(0.120)
CA4/8	2.330***	2.341***	2.364***	2.359***	2.319***
	(0.186)	(0.208)	(0.199)	(0.225)	(0.186)
CA5	2.228***	2.301***	2.465***	2.459***	2.218***
	(0.292)	(0.324)	(0.341)	(0.369)	(0.289)
CA6	2.034***	1.960***	1.997***	1.901***	1.959***
	(0.149)	(0.164)	(0.159)	(0.178)	(0.150)
CA7	2.024***	1.994***	2.084***	2.007***	2.006***
	(0.177)	(0.197)	(0.194)	(0.215)	(0.175)
CA9	1.227***	1.215***	1.236***	1.207***	1.200***
	(0.145)	(0.161)	(0.156)	(0.175)	(0.144)
CA10	−0.260	−0.207	−0.224	−0.178	−0.271*
	(0.165)	(0.178)	(0.186)	(0.199)	(0.161)
CA11	−1.210***	−1.184***	−1.188***	−1.165***	−1.217***
	(0.124)	(0.137)	(0.134)	(0.148)	(0.122)
CA12	1.509***	1.543***	1.512***	1.553***	1.506***
	(0.143)	(0.158)	(0.152)	(0.170)	(0.143)
CA14	−1.499***	−1.530***	−1.517***	−1.564***	−1.584***
	(0.117)	(0.130)	(0.127)	(0.144)	(0.118)
CA15	−0.036	−0.005	−0.023	0.007	−0.050
	(0.114)	(0.123)	(0.125)	(0.135)	(0.112)
CA16	0.573***	0.570***	0.620***	0.586***	0.564***
	(0.100)	(0.110)	(0.113)	(0.123)	(0.099)
CA17	−0.893***	−0.930***	−0.864***	−0.930***	−0.879***
	(0.097)	(0.107)	(0.105)	(0.116)	(0.096)
CA18	0.573***	0.606***	0.708***	0.668***	0.553***
	(0.134)	(0.145)	(0.175)	(0.182)	(0.132)
CA19	0.595***	0.623***	0.648***	0.652***	0.574***
	(0.134)	(0.143)	(0.149)	(0.157)	(0.132)
Nesting Parameter	0.184***	0.162**	0.168**	0.148*	0.186***
	(0.063)	(0.069)	(0.078)	(0.082)	(0.060)

Notes: ***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level. Robust standard errors that correct for potential misspecification are shown in parentheses (see p.503 of Wooldridge (2010)). Table shows full regression results for the base and the individual mandate sensitivity runs for California.

Table 14: Washington Regression Results - Mandate Regressions

	Base	No Mandate Intercept	Separate Penalty	No Mandate Intercept, Separate Penalty	Income Interaction	Exclude Smoker Variables
Monthly Premium ($100)	-0.530^{***}	-0.523^{***}	-0.616^{***}	-0.613^{***}	-0.558^{***}	-0.638^{***}
	(0.179)	(0.197)	(0.139)	(0.156)	(0.172)	(0.110)
Penalty ($100)			0.297^{***}	0.153^{***}		
			(0.055)	(0.038)		
Actuarial Value (AV)	1.614^{**}	1.534^{**}	1.897^{***}	1.812^{***}	1.684^{***}	2.031^{***}
	(0.642)	(0.652)	(0.507)	(0.526)	(0.599)	(0.431)
HMO	0.287^{**}	0.271^{**}	0.342^{***}	0.325^{***}	0.300^{**}	0.370^{***}
	(0.131)	(0.131)	(0.109)	(0.111)	(0.124)	(0.098)
Deductible Ratio	-0.051^{**}	-0.049^{**}	-0.059^{***}	-0.056^{***}	-0.054^{**}	-0.063^{***}
	(0.022)	(0.022)	(0.018)	(0.018)	(0.021)	(0.016)
Max. OOP Ratio	−0.011	−0.010	−0.014	−0.013	−0.011	−0.017
	(0.014)	(0.013)	(0.012)	(0.012)	(0.013)	(0.013)
BridgeSpan	0.091^{**}	0.086^{*}	0.110^{***}	0.104^{***}	0.096^{**}	0.119^{***}
	(0.045)	(0.045)	(0.039)	(0.039)	(0.043)	(0.036)
Centene/Health Net	0.029	0.028	0.035^{**}	0.033^{**}	0.031^{*}	0.039^{**}
	(0.018)	(0.018)	(0.015)	(0.015)	(0.017)	(0.016)
CHPW	0.207^{**}	0.196^{**}	0.246^{***}	0.234^{***}	0.216^{***}	0.264^{***}
	(0.087)	(0.088)	(0.072)	(0.074)	(0.082)	(0.062)
Group Health/Kaiser	0.099^{**}	0.094^{**}	0.116^{***}	0.111^{***}	0.103^{**}	0.126^{***}
	(0.044)	(0.043)	(0.035)	(0.035)	(0.041)	(0.031)
Moda	0.151^{**}	0.143^{**}	0.181^{***}	0.171^{***}	0.159^{**}	0.195^{***}
	(0.071)	(0.070)	(0.060)	(0.060)	(0.067)	(0.054)
Premera/Lifewise	0.378^{**}	0.358^{**}	0.448^{***}	0.426^{***}	0.395^{**}	0.483^{***}
	(0.166)	(0.167)	(0.136)	(0.139)	(0.157)	(0.121)
Premium ($100) ×						
138-250	0.304^{***}	0.275^{***}	0.357^{***}	0.321^{***}	0.303^{***}	0.378^{***}
	(0.111)	(0.102)	(0.088)	(0.079)	(0.094)	(0.073)
250-400	0.325^{***}	0.295^{***}	0.384^{***}	0.346^{***}	0.326^{***}	0.407^{***}
	(0.122)	(0.112)	(0.097)	(0.088)	(0.104)	(0.080)
400+	0.332^{***}	0.315^{**}	0.383^{***}	0.362^{***}	0.339^{***}	0.415^{***}
	(0.124)	(0.125)	(0.095)	(0.094)	(0.111)	(0.085)
Male	−0.017	−0.015	−0.014	−0.015	−0.020	-0.021^{*}
	(0.016)	(0.015)	(0.010)	(0.011)	(0.017)	(0.011)
18-34	-0.124^{***}	-0.122^{***}	-0.153^{***}	-0.149^{***}	-0.129^{***}	-0.145^{***}
	(0.041)	(0.045)	(0.037)	(0.040)	(0.038)	(0.022)

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Table 14 – *Continued from previous page*

	Base	No Mandate Intercept	Separate Penalty	No Mandate Intercept, Separate Penalty	Income Interaction	Exclude Smoker Variables
35-54	-0.065^{***}	-0.065^{**}	-0.073^{***}	-0.073^{***}	-0.069^{***}	-0.089^{***}
	(0.025)	(0.028)	(0.018)	(0.021)	(0.024)	(0.020)
Smoker	-0.055	-0.051	-0.073^{**}	-0.065^{**}	-0.060^{*}	
	(0.034)	(0.033)	(0.030)	(0.029)	(0.033)	
Black	-0.143^{*}	-0.133^{*}	-0.165^{***}	-0.155^{**}	-0.151^{**}	-0.219^{***}
	(0.081)	(0.079)	(0.061)	(0.062)	(0.077)	(0.072)
Asian	-0.017^{***}	-0.016^{***}	-0.016^{***}	-0.015^{***}	-0.017^{***}	-0.015^{***}
	(0.005)	(0.005)	(0.002)	(0.003)	(0.004)	(0.002)
White	0.015^{***}	0.015^{***}	0.013^{***}	0.014^{***}	0.015^{***}	0.008^{*}
	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)	(0.005)
Family	0.118^{***}	0.115^{***}	0.135^{***}	0.132^{***}	0.124^{***}	0.142^{***}
	(0.038)	(0.041)	(0.028)	(0.031)	(0.036)	(0.022)
Year 2015	0.027^{*}	0.026^{*}	0.036^{***}	0.035^{**}	0.029^{**}	0.040^{***}
	(0.014)	(0.015)	(0.014)	(0.015)	(0.014)	(0.012)
Mandate	-0.033		-0.046^{**}		-0.016^{*}	-0.067^{***}
	(0.025)		(0.023)		(0.009)	(0.025)
Intercept						
Base	0.500	0.690	-0.052	0.318	0.035	-0.462
	(0.962)	(0.960)	(0.797)	(0.791)	(0.902)	(0.683)
138-250	-0.672^{***}	-0.580^{***}	-0.814^{***}	-0.473^{***}	-1.196^{***}	-0.759^{***}
	(0.147)	(0.149)	(0.116)	(0.134)	(0.168)	(0.095)
250-400	-1.057^{***}	-0.977^{***}	-1.050^{***}	-0.733^{***}	-1.565^{***}	-1.286^{***}
	(0.285)	(0.290)	(0.218)	(0.259)	(0.286)	(0.180)
400+	-1.751^{***}	-1.728^{***}	-1.275^{***}	-1.210^{***}	-0.863^{**}	-1.675^{***}
	(0.319)	(0.317)	(0.291)	(0.333)	(0.383)	(0.189)
Male	-0.275^{***}	-0.278^{***}	-0.299^{***}	-0.295^{***}	-0.313^{***}	-0.312^{***}
	(0.056)	(0.060)	(0.044)	(0.048)	(0.053)	(0.036)
18-34	-2.027^{***}	-2.017^{***}	-1.939^{***}	-1.909^{***}	-1.964^{***}	-1.818^{***}
	(0.046)	(0.045)	(0.054)	(0.056)	(0.046)	(0.028)
35-54	-0.676^{***}	-0.671^{***}	-0.629^{***}	-0.609^{***}	-0.607^{***}	-0.722^{***}
	(0.062)	(0.062)	(0.053)	(0.055)	(0.063)	(0.052)
Smoker	-1.916^{***}	-1.939^{***}	-1.853^{***}	-1.899^{***}	-1.847^{***}	
	(0.116)	(0.115)	(0.110)	(0.103)	(0.113)	
Black	-1.796^{***}	-1.828^{***}	-1.792^{***}	-1.806^{***}	-1.825^{***}	-1.810^{***}
	(0.238)	(0.236)	(0.192)	(0.190)	(0.221)	(0.192)
Asian	-0.677^{***}	-0.685^{***}	-0.697^{***}	-0.700^{***}	-0.691^{***}	-0.721^{***}
	(0.086)	(0.089)	(0.074)	(0.076)	(0.082)	(0.057)

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Table 14 – *Continued from previous page*

	Base	No Mandate Intercept	Separate Penalty	No Mandate Intercept, Separate Penalty	Income Interaction	Exclude Smoker Variables
White	-1.366^{***}	-1.378^{***}	-1.448^{***}	-1.440^{***}	-1.386^{***}	-1.526^{***}
	(0.070)	(0.068)	(0.057)	(0.053)	(0.064)	(0.056)
Family	0.489^{***}	0.480^{***}	0.523^{***}	0.505^{***}	0.470^{***}	0.646^{***}
	(0.059)	(0.054)	(0.047)	(0.047)	(0.052)	(0.043)
Year 2015	0.396^{***}	0.402^{***}	0.494^{***}	0.462^{***}	0.404^{***}	0.404^{***}
	(0.064)	(0.064)	(0.051)	(0.047)	(0.059)	(0.051)
Mandate	0.181^{***}		0.668^{***}		1.080^{***}	0.503^{***}
	(0.053)		(0.076)		(0.109)	(0.061)
Mandate x gt400					-1.500^{***}	
					(0.161)	
Rating Areas						
WA1	1.123^{***}	1.125^{***}	1.091^{***}	1.117^{***}	1.129^{***}	1.163^{***}
	(0.045)	(0.050)	(0.039)	(0.042)	(0.043)	(0.033)
WA2	0.869^{***}	0.870^{***}	0.904^{***}	0.907^{***}	0.872^{***}	0.747^{***}
	(0.039)	(0.040)	(0.036)	(0.038)	(0.039)	(0.033)
WA3	0.840^{***}	0.817^{***}	0.910^{***}	0.846^{***}	0.909^{***}	0.556^{***}
	(0.085)	(0.087)	(0.074)	(0.072)	(0.085)	(0.070)
WA4	0.277^{***}	0.259^{***}	0.325^{***}	0.311^{***}	0.303^{***}	0.475^{***}
	(0.075)	(0.063)	(0.062)	(0.057)	(0.067)	(0.054)
Nesting Parameter	0.176^{**}	0.166^{**}	0.207^{***}	0.197^{***}	0.183^{***}	0.224^{***}
	(0.076)	(0.076)	(0.062)	(0.063)	(0.071)	(0.055)

Notes: ***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level. Robust standard errors that correct for potential misspecification are shown in parentheses (see p.503 of Wooldridge (2010)). Table shows full regression results for the base and the individual mandate sensitivity runs for Washington state.

Appendix C: Semi-Elasticities

Table 15: Estimated Own-Premium Semi-Elasticities

	California	Washington
Overall	-19.8	-23.9
Income (% of FPL)		
0-138	-24.5	-51.3
138-250	-21.1	-22.4
250-400	-17.3	-20.3
400+	-17.2	-19.6
Gender		
Female	-17.2	-23.2
Male	-20.5	-24.8
Age		
18-34	-22.9	-28.7
35-54	-21.3	-23.1
55+	-14.1	-16.9
Smoking Status		
Smoker		-28.4
Non-Smoker		-23.1
Race		
Asian		-25.8
Black		-37.8
White		-22.7
Household Size		
Single	-29.2	-32.5
Family	-15.0	-21.3
Renewal Status		
Active		
Renewal		
Mandate Status		
Exempt	-15.6	-20.9
Subject	-20.1	-24.1
Year		
2014	-19.6	-25.8
2015	-20.0	-23.2

Notes: Table shows mean own-premium semi-elasticities by demographic group and by state that are computed using formula (6) in the text.

Table 16: Estimated Marketplace Coverage Semi-Elasticities

	California		Washington	
	Voucher/ No Subsidy	ACA Subsidies	Voucher/ No Subsidy	ACA Subsidies
Overall	-1.8	-0.4	-2.0	-0.8
Income (% of FPL)				
0-138	-2.2	-0.6	-4.4	-1.7
138-250	-1.9	-0.5	-2.0	-0.8
250-400	-1.6	-0.4	-1.9	-0.8
400+	-1.6	-0.4	-1.8	-0.7
Gender				
Female	-1.6	-0.4	-1.9	-0.7
Male	-1.8	-0.4	-2.1	-0.8
Age				
18-34	-2.0	-0.5	-2.4	-0.9
35-54	-1.9	-0.4	-1.9	-0.7
55+	-1.3	-0.3	-1.4	-0.5
Smoking Status				
Smoker			-2.1	-0.7
Non-Smoker			-1.7	-0.6
Race				
Asian			-2.0	-0.7
Black			-2.8	-1.0
White			-1.7	-0.6
Household Size				
Single	-2.4	-0.6	-2.6	-1.0
Family	-1.2	-0.3	-1.7	-0.6
Mandate Status				
Exempt	-1.2	-0.3	-1.7	-0.7
Subject	-1.6	-0.4	-2.0	-0.8
Year				
2014	-1.8	-0.4	-2.1	-0.8
2015	-1.8	-0.4	-1.9	-0.7

Notes: Table shows marketplace coverage semi-elasticities by demographic group and by state that are computed using formula (8) in the text. In the "voucher/no subsidy" columns, the partial $\frac{\partial p_{ij}}{\partial \overline{p}_{ib}}$ is set equal to 0 for all consumers such that the consumer's subsidized premium does not respond to changes in the benchmark premium. In the "ACA subsidies" column, $\frac{\partial p_{ij}}{\partial \overline{p}_{ib}} = 1$ for all subsidized consumers and all plans $j \in J \setminus \{b\}$.

Appendix D: Computing Elasticities

In this appendix, I derive the formulas used to compute the elasticities and semi-elasticities estimates in the main text. Because consumers pay $p_{ij} \leq \overline{p}_{ij}$ for insurance (relative to the outside option), it

is important to distinguish between elasticities from the consumer's and insurer's perspective. Own-premium elasticities ε_{ij}^{C} and ε_{ij}^{I} from the consumer's and insurer's perspective, respectively, for the nested logit model are given by

$$\varepsilon_{ij}^{C} \equiv \frac{\partial \ln s_{ij}}{\partial \ln p_{ij}} = \overline{\alpha}_i p_{ij} \left(\frac{1}{\lambda} + \left(\frac{\lambda - 1}{\lambda} \right) s_{ij|EX} - s_{ij} \right) \tag{4}$$

$$\varepsilon_{ij}^{I} \equiv \frac{\partial \ln s_{ij}}{\partial \ln \overline{p}_{ij}} = \left(\overline{p}_{ij} \frac{\partial \ln s_{ij}}{\partial p_{ij}} \right) \frac{\partial p_{ij}}{\partial \overline{p}_{ij}} = \overline{\alpha}_i \overline{p}_{ij} \left(\frac{1}{\lambda} + \left(\frac{\lambda - 1}{\lambda} \right) s_{ij|EX} - s_{ij} \right) \tag{5}$$

for $j \in J \setminus \{b\}$, where λ is the nesting parameter and $s_{ij|EX}$ is the probability that household i chooses plan j, conditional on purchasing an exchange plan. Note that the partial $\frac{\partial p_{ij}}{\partial \overline{p}_{ij}}$, which represents how the consumer's premium changes with respect to the full premium, equals 1 for all plans except for the benchmark plan. That is, if the premium for plan $j \in J \setminus \{b\}$ increases, even subsidized consumers face the full burden of the increase, provided there is no change in the benchmark plan premium. An increase in the benchmark premium has no impact on a subsidized consumer's out-of-pocket premium (i.e., $\frac{\partial p_{ij}}{\partial \overline{p}_{ij}} = 0$) because the subsidy will adjust to keep the consumer's premium constant.

Furthermore, I also compute own-premium semi-elasticities ς_{ij}, which provide the percentage change in demand for an absolute change in the premium. Consistent with the literature, I set the absolute change equal to \$100 per year.[17] For $j \in J \setminus \{b\}$, own-premium semi-elasticities ς_{ij} are computed as

$$\varsigma_{ij} \equiv \frac{\partial \ln s_{ij}}{\partial p_{ij}} = \overline{\alpha}_i \left(\frac{1}{\lambda} + \left(\frac{\lambda - 1}{\lambda} \right) s_{ij|EX} - s_{ij} \right) \times (100/12) \tag{6}$$

Observe that because subsidized consumers are responsible for any absolute increase in the premium of plan $j \in J \setminus \{b\}$, there is no distinction between the consumer's and insurer's perspective when computing own-premium semi-elasticities. For the benchmark plan, $\varsigma_{ib} = 0$.

In addition to own-premium demand, I also calculate marketplace coverage elasticities to assess consumer demand on the extensive margin. I define market coverage elasticities as the percentage change in demand for marketplace coverage for a percentage change in all marketplace plan premiums, including the premium of the benchmark plan. Marketplace coverage elasticities ϱ_i are computed as

[17] Note that I use monthly premiums in estimating the nested logit model.

$$\begin{aligned}\varrho_i &= \sum_j \left[s_{ij|EX} \frac{\partial \ln s_{iEX}}{\partial \ln \overline{p}_{ij}} \left(\frac{\partial p_{ij}}{\partial \overline{p}_{ij}} - \varpi_{ij} \frac{\partial p_{ij}}{\partial \overline{p}_{ib}} \right) \right] \\ &= \sum_j \left[s_{ij|EX} \overline{\alpha}_i \overline{p}_{ij} \left(1 - s_{iEX}\right) \left(\frac{\partial p_{ij}}{\partial \overline{p}_{ij}} - \varpi_{ij} \frac{\partial p_{ij}}{\partial \overline{p}_{ib}} \right) \right] \end{aligned} \tag{7}$$

where s_{iEX} is the probability that household i selects a marketplace plan and $\varpi_{ij} = p_{ib}/p_{ij}$ is the ratio of benchmark premium to the premium of plan j for household i. As before, the partial $\partial p_{ij}/\partial \overline{p}_{ij} = 1$ for all plans $j \in J \setminus \{b\}$ and $\partial p_{ij}/\partial \overline{p}_{ij} = 0$ for $j = b$. For subsidized consumers, the partial $\partial p_{ij}/\partial \overline{p}_{ib}$, which represents rate of change of the consumer's out-of-pocket premium with respect to a change in the benchmark premium, equals 1 for all plans $j \in J \setminus \{b\}$ (i.e., for every dollar that the benchmark premium increases, the subsidy increases by a dollar) and equals 0 for $j = b$. By contrast, $\partial p_{ij}/\partial \overline{p}_{ib} = 0$ for consumers ineligible for subsidies.

Observe that the ratio ϖ_{ij} is greater than 1 for plans that are cheaper than the benchmark plan (e.g., for a bronze plan), but less than 1 for plans that are more costly than the benchmark plan. As a result, subsidized consumers pay *less* for plans that have a smaller premium than the benchmark plan if all marketplace premiums increase by the same percentage. To illustrate this point with a simple example, suppose that a consumer receives a subsidy of \$100 and can purchase a bronze plan for \$200 or the benchmark silver plan for \$250 (and hence the consumer pays \$100 for the bronze plan and \$150 for the benchmark plan). If all marketplace premiums increase by 10 percent, then the subsidy will increase to \$125 and the consumer still pays \$150 for the benchmark plan. Although the bronze plan premium has increased to \$220, the consumer's \$125 subsidy reduces the out-of-pocket premium to \$95, less than the \$100 out-of-pocket premium before the market-wide premium increase. By the same logic, plans that cost more than the benchmark plan would be more expensive from the perspective of a subsidized consumer if all marketplace premiums increase by the same percentage. Hence, while the ACA's subsidy formula largely shields subsidized consumers from premium shocks, it may encourage substitution to less generous plans if there are common market shocks affecting plan premiums proportionally.

This peculiar result may argue for considering marketplace coverage semi-elasticities, which are computed as

$$\vartheta_i = \sum_j \left[s_{ij|EX} \overline{\alpha}_i \left(1 - s_{iEX}\right) \left(\frac{\partial p_{ij}}{\partial \overline{p}_{ij}} - \frac{\partial p_{ij}}{\partial \overline{p}_{ib}} \right) \right] \times (100/12) \tag{8}$$

For all subsidized consumers, the marketplace coverage semi-elasticity $\vartheta_i = 0$ because $\partial p_{ij}/\partial \overline{p}_{ij} = \partial p_{ij}/\partial \overline{p}_{ib}$ (i.e., the subsidy increases by one dollar for every dollar increase in the benchmark pre-

mium). That is, if all marketplace plans increase by the same absolute amount, subsidized consumers observe no change in any of their out-of-pocket premiums. Therefore, subsidized consumers are completely shielded from premium shocks if all marketplace premiums increase by the same amount.