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

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Abstract

I estimate demand for health insurance using consumer-level data from the California and Washington ACA exchanges. I use the demand estimates to simulate the impact of policies targeting adverse selection, including subsidies and the individual mandate. I find (1) own-premium elasticities of -7.2 to -10.6 and insurance coverage elasticities of -1.1 to -1.2; (2) limited response to the mandate penalty *amount*, but significant response to the penalty's *existence*, suggesting consumers have a "taste for compliance"; (3) mandate repeal slightly increases consumer surplus because the ACA's price-linked subsidies shield most consumers from premium increases resulting from repeal and some consumers are not compelled to purchase insurance against their will; and (4) mandate repeal decreases consumer surplus if ACA subsidies are replaced with vouchers that expose consumers to premium increases. 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

Promoting equitable and efficient access to health insurance is a key objective of government intervention in insurance markets. Common regulations for promoting equitable access to insurance include limitations on insurer price discrimination and requirements to offer insurance to all consumers, including those with preexisting conditions. These regulations can exacerbate adverse selection, reducing the economic efficiency of health insurance provision (Handel et al., 2015). Strategies adopted under the Patient Protection and Affordable Care Act (ACA) for mitigating the effects of adverse selection include both policy "carrots," such as subsidies for purchasing health insurance, and policy "sticks," such as penalties for not having insurance. Understanding how consumers respond to these financial incentives is critical in assessing the efficacy of these alternative strategies.

In this paper, I analyze demand for health insurance by studying consumer behavior in the ACA exchanges. The ACA exchanges provide an appealing context for analyzing health insurance demand. First, the setting provides an opportunity to assess how consumers respond to both policy carrots and sticks that incentivize enrollment. Second, analysis of the ACA setting helps to address some of the data shortcomings of examining the pre-ACA individual market, such as measurement error of premiums, choice sets, and other key variables (Auerbach and Ohri, 2006).

I estimate demand for health insurance using consumer-level data from the California and Washington ACA exchanges. My data contain about 2.5 million records in California and $335,000$ records in Washington across the 2014 and 2015 plan years, accounting for approximately 15 percent of nationwide enrollment in the ACA exchanges (Department of Health and Human Services, 2015). Detailed demographic information on income, age, smoking status, and geographic residence enables me to precisely calculate (1) the premium that consumers face for each plan in their choice sets; (2) the consumer-specific subsidy received for each plan; and (3) the consumer-specific penalty imposed for forgoing coverage. I combine the consumer-level demand data from the exchanges with data on the uninsured from the American Community Survey (ACS) to form the universe of potential exchange consumers.

Using these data, I estimate nested logit discrete choice models of demand for health insurance at the consumer level for both California and Washington. To address potential endogeneity of the premium, I exploit consumer-level variation in premiums created by exogenous ACA regulations, including subsidy eligibility thresholds, exemptions from the individual mandate, and the phase-in of the mandate between 2014 and 2016. I also estimate the model with the control function approach of Petrin and Train (2010).

My empirical findings suggest that exchange consumers are highly premium sensitive. I estimate that the mean own-premium elasticity of demand ranges from -9.1 to -10.6 in California and from -7.2 to -8.1 in Washington. The mean premium elasticity for exchange coverage is -1.2 in California and -1.1 in Washington. I also find that young adults are considerably more premium sensitive; in California, the mean own-premium elasticity of demand ranges from -13.1 to -14.7 for adults between the ages of 18 and 34 and from -5.6 to -7.2 for adults over the age of 55. Low-income individuals, smokers, racial minorities, and males also have more premium-elastic demand.

My demand estimates also indicate that the mandate penalty *amount* has a relatively small impact on consumer choice, but the penalty's *existence* motivates some consumers to purchase insurance. 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., 2017). A taste for compliance is a consumer preference for being socially responsible and complying with the law, regardless of the penalty amount. The taste for compliance could also be described as an aversion to paying a fine or experiencing a loss (Kahneman and Tversky, 1984).

I then use the demand estimates to simulate the impact of policies targeting adverse selection, including the individual mandate and premium subsidies. The mandate represents an economic tradeoff between addressing underenrollment of low-risk consumers that may result from adverse selection and compelling consumers to purchase insurance against their will. Another potential impact of the mandate is a higher rate of underinsurance, which I investigate in concurrent work (Saltzman, 2018). I find that repealing the individual mandate modestly increases consumer surplus because the ACA's price-linked subsidies protect most consumers from premium increases that may result from repeal and some consumers are not compelled to purchase insurance against their will. In contrast, repealing the mandate when fixed subsidies or vouchers replace the ACA's price-linked subsidies would result in a sharp decline in consumer surplus because vouchers expose consumers to premium increases. Hence, the policy rationale for the individual mandate depends on the extent of adverse selection and the presence of other policies such as price-linked subsidies that are designed to mitigate the effects of adverse selection.

I make several contributions to the literature. First, my empirical work uses consumer-level data with exogenous variation in premiums to estimate consumer premium elasticities in two state ACA exchanges. 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 targeting adverse selection that warrants discussion in the health reform debate.

This paper proceeds as follows. Section 1 surveys the relevant literature. Section 2 provides a brief overview of the ACA. Section 3 develops a model of health insurance demand. Section 4 describes the data I use in my analysis. Section 5 discusses how I use the data to estimate the model. Sections 6 and 7 present results on consumers' response to premiums and the individual mandate, respectively. Section 8 considers the impact of repealing the mandate. Section 9 concludes.

1 Related Literature

My work contributes to the literature examining consumer premium sensitivity for individual market insurance. Table 1 summarizes premium elasticity of demand estimates for several prominent studies. 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. More recently, researchers have been able to address many of these data shortcomings by analyzing data from the Massachusetts Connector. These studies generally find greater premium sensitivity (Chan and Gruber, 2010; Jaffe and Shepard, 2017; Finkelstein et al., 2017). It is unclear how well these estimates generalize to the ACA exchanges because they usually focus on the Massachusetts Commonwealth Care program, which served consumers with incomes below 300 of the poverty level and assigned enrollees to a cost sharing level based on their income.

Several recent studies consider the early experience of the ACA exchanges. Frean et al. (2017) use data from the American Community Survey (ACS) and Sacks (2017) uses data from the Current Population Survey (CPS) to study take-up of exchange coverage. Abraham et al. (2017) estimate a discrete choice model using plan-level data from the states using the healthcare.gov platform. These studies find significantly smaller estimates of consumer premium sensitivity compared to studies of the Massachusetts Connector. A limitation of these studies is that they cannot match consumers to the menu of plans or premiums that they face, potentially resulting in measurement error in the premium and penalty variables. Tebaldi (2017) overcomes many of these issues by analyzing consumer-level data from the 2014 plan year of the California ACA exchange, finding somewhat higher sensitivity to premiums. I build on his analysis by (1) using data from the Washington exchange and an additional year of data from the California exchange and (2) estimating demand at the household level using maximum likelihood. Recent studies by Domurat (2017) and Drake (2018) also estimate consumer premium sensitivity using data from the California exchange; their estimates of own-premium elasticity are higher than the estimates of Tebaldi (2017).

Table 1: Elasticity Estimates from Previous Studies of the Individual Market

	Coverage		Own-Premium	
	Elasticity	Semi-Elasticity	Elasticity	Semi-Elasticity
Pre-ACA Individual Market				
Gruber and Poterba (1994)	-0.5 to -1.0			
Marquis and Long (1995)	-0.3 to -0.6			
Marquis et al. (2004)	-0.2 to -0.4			
CBO (2005)	-0.57			
Auerbach and Ohri (2006)	-0.59			
Massachusetts Connector				
Chan and Gruber (2010)			-0.65 to -0.72	-10.0 to -18.5
Ericson and Starc (2015)				-12 to -36
Jaffe and Shepard (2017)		-13.1 to -15.5		-27.2 to -30.6
Finkelstein et al. (2017)		-5.2		
ACA Exchanges				
Frean et al. (2017)	-0.05 to -0.09			
Abraham et al. (2017)			-1.7	
Sacks (2017)		-1.4		
Tebaldi (2017)		-1.5 to -4.0		-2.3 to -12.0
Domurat (2017)				-25.0 to -41.7
Drake (2018)			-5.2	-13.5

NOTES: Table reports premium elasticity and semi-elasticity of demand estimate from the individual market literature. Studied settings include the pre-ACA individual market, the Massachusetts Connector, and the ACA exchange. Coverage elasticity estimates refer to impact of an increase in all premiums on total demand. Own-premium elasticity estimates refer to the impact of an increase in a plan's premium on its own demand. Elasticities measure the percentage change in demand for a one percent increase in premiums. Semi-elasticities measure the percentage change in demand for a $100 increase in annual premiums.

Previous studies have generally found that consumers' response to the individual mandate is small or negligible. Frean et al. (2017) find that the ACA's individual mandate penalty had little impact on consumer decision-making, while Sacks (2017) estimates that the mandate increased welfare by $45 per capita per year. Hackmann et al. (2015) study the impact of the individual mandate in the Massachusetts Connector and find an annual welfare gain of 4.1 percent per person. These studies model the penalty amount either as a price change or as a separate variable. I extend this work by allowing for the possibility of a taste for compliance with the mandate.

My analysis also contributes to a recent literature studying the economic tradeoffs between "price-linked" subsidies that adjust to premium changes and "fixed" subsidies or vouchers that are set independently of premiums. Jaffe and Shepard (2017) find that price-linked subsidies can result in higher premiums and lower social welfare relative to vouchers, but price-linked subsidies have advantages when insurance costs are uncertain. Tebaldi (2017) finds that replacing the ACA price-linked subsidy with a voucher of the same amount would reduce average markups by 11 percent. In concurrent work, I study the interaction of the subsidy design with risk adjustment in an imperfectly competitive market; I find that price-linked subsidies can prevent the loss of low-risk consumers that may result from risk adjustment (Saltzman, 2017). I contribute to the subsidy design literature in this paper by simulating the interaction of the ACA's individual mandate and subsidy design. My results shows that there are important caveats associated with the implementation of vouchers, potentially offsetting the welfare benefits that Jaffe and Shepard (2017) and Tebaldi (2017) find.

2 Institutional Background on the ACA Exchanges

One of the key mechanisms for expanding health insurance under the ACA is the creation of regulated state insurance exchanges, where insurers sell insurance plans directly to consumers. Plans sold on the exchange are classified by their actuarial value (AV), i.e., the expected percentage of health care costs that the insurance plan will cover. The four actuarial value or "metal" tiers are bronze (60 percent AV), silver (70 percent AV), gold (80 percent AV), and platinum (90 percent AV). Select individuals, mostly those under age 30, can buy a more basic catastrophic plan. In most states, insurers can design their plans with different cost sharing parameters (e.g., deductibles, coinsurance rates, copays, etc.), as long as the plans have the advertised AV. One notable exception is California, where plans within a metal tier are standardized to have the cost sharing design specified by the California exchange. The standard benefit designs for the 2014 plan year are shown in Table 11 in Appendix A.

The ACA restricts the ability of insurers to price discriminate to a consumer'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). Smokers can be charged 50 percent more than non-smokers. Some states, including California but not Washington, prohibit tobacco rating. Each state also 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. Appendix A shows the rating areas in California and Washington. Insurers can opt to serve only part of a rating area.

Limitations on price discrimination can exacerbate adverse selection (Handel et al., 2015). One ACA policy designed to mitigate the effects of adverse selection 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 in 2014 and 8.05 percent of their income in 2015. Exemptions are also made for those who would have been eligible for Medicaid but reside in a state that did not expand Medicaid. The individual mandate penalty amount was phased in between 2014 and 2016. The penalty for a single individual equaled the greater of $95 and 1 percent of income exceeding the filing threshold in 2014 and the greater of $325 and 2 percent of income exceeding the filing threshold in 2015. For the 2016 through 2018 plan years, the penalty for a single individual is the greater of $695 and 2.5 percent of income. The Tax Cuts and Jobs Act of 2017 sets the individual penalty amount to zero starting in the 2019 plan year.

Another important policy that targets adverse selection is the ACA's premium subsidy design. In contrast to vouchers or fixed subsidies that do not adjust to premium changes, the ACA's premium subsidies are price-linked and adjust to premium changes. The amount of the subsidy equals the difference between the premium of the benchmark plan and the consumer's income contribution cap. The benchmark plan is the second-cheapest silver plan available to the consumer and may vary between consumers because of heterogeneous entry into markets within a state marketplace. The consumer's income contribution cap ranged from 2 percent of annual income for a consumer earning 100 percent of the federal poverty level (FPL) and 9.5 percent of annual income for a consumer earning 400 percent of FPL in the 2014 plan year. Consumers can apply the premium subsidy towards the premium of any metal plan.

Premium subsidies are available to consumers who meet the following criteria: (1) have income between 100 percent and 400 percent of the federal poverty level (FPL), (2) have citizenship or legal resident status, (3) are ineligible for public insurance such as Medicare, Medicaid, or the Children's Health Insurance Program (CHIP) and (4) lack access to an "affordable plan offer" through employer-sponsored insurance either as an employee or as a dependent. A plan is defined as affordable if the employee's contribution to the employer's single coverage plan is less than 9.5 percent of the employee's household income in 2014 and 9.56 percent of income in 2015.

Consumers with incomes less than or equal to 250 percent of poverty can also receive cost sharing subsidies by purchasing a silver plan. As a consequence, silver is the most commonly selected metal tier. Cost sharing subsidies increase the actuarial value of the 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.

3 Model

In this section, I develop a model of demand for health insurance in the ACA exchanges that I take to the data. I model consumers as household units rather than individuals for three 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. Household i chooses the plan j that maximizes the utility function

$$U_{ij} \equiv \alpha_i p_{ij} + x_j'\beta + d_i'\varphi + \xi_j + \epsilon_{ij} \tag{1}$$

where p_{ij} is the average premium per household member (i.e., the household's total premium divided by the number of household members), x_j is a vector of observed product characteristics, ξ_j is a vector of unobserved product characteristics, d_i is a vector of demographic characteristics, and ϵ_{ij} is an error term with cumulative distribution function $F(\cdot)$. The utility U_{i0} of the outside option equals

$$U_{i0} = \alpha_i \rho_i + \epsilon_{i0} \tag{2}$$

where ρ_i is the average penalty per household member for being uninsured.

Utility equations (1) and (2) capture potential heterogeneity in preferences across demographic groups. I allow household i's premium parameter α_i to vary with household characteristics such that $\alpha_i = \alpha + d_i'\gamma$. The demographic parameters φ indicate each demographic's taste for exchange insurance, all else equal, and are identified because they do not appear in equation (2). The interaction term parameters γ indicate how premium sensitivity varies by demographic group.

The premium p_{ij} that household i pays for plan j equals

$$p_{ij} = \max\left\{ \underbrace{r_i p_j}_{\substack{\text{full}\\\text{premium}}} - \underbrace{\max\{r_i p_b - cap_i, 0\}}_{\text{subsidy}}, 0 \right\} \Big/ N_i \tag{3}$$

where the household's rating factor r_i accounts for the age, smoking status, and geographic residence of the household's members, p_j is the insurer's premium for plan j, p_b is the premium of the benchmark plan, cap_i is the household's contribution cap, and N_i is the number of household members.

The individual mandate may elicit a behavioral response from consumers. For instance, consumers may respond differently to the penalty than to the premium. I allow for this possibility by considering an alternative specification where I replace the premium parameter α_i in utility equation (2) with the penalty parameter α_i' such that

$$U_{i0} = \alpha_i' \rho_i + \epsilon_{i0} \tag{4}$$

If $\alpha_i = \alpha_i'$, then consumers are equally sensitive to changes in the *amount* of the premium and the penalty. In my empirical analysis, I test whether $\alpha_i = \alpha_i'$.

Another possible behavioral response is that consumers could be sensitive to the *existence* of the penalty. For example, consumers might have a taste for complying with the mandate or a distaste for paying a fine. To define the taste for compliance with the individual mandate, let the vector of demographic variables d_i in utility equation (1) contain a variable d_{mi} with coefficient φ_m that indicates whether household i is subject to the individual mandate. Denote U_i^m as household i's utility when it is subject to the mandate and U_i^n as its utility when it is exempt or the mandate is repealed.[1] I define the taste for compliance τ_i as the compensating variation that restores household i's utility from U_i^n to U_i^m when the individual mandate is repealed. A taste for compliance exists if $U_i^m > U_i^n$, which implies the mandate parameter $\varphi_m > 0$. Under utility equation (1), the taste for compliance can be computed in dollars as

$$\tau_i = \frac{U_i^m - U_i^n}{\alpha_i} = \frac{\varphi_m}{\alpha_i} \tag{5}$$

In my empirical analysis, I test whether the mandate parameter $\varphi_m > 0$.

4 Data

One of the distinguishing features of my empirical analysis is the use of detailed consumer-level administrative data to estimate demand for health insurance. I obtain data from Covered California and the Washington Health Benefit Exchange (WAHBE), the ACA exchanges 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, county of residence, subsidy eligibility, and household composition. These demographic characteristics and rating factors from the insurer rate filings

[1] I drop the j subscript because the taste for compliance does not depend on the chosen exchange plan.

(Department of Managed Health Care, 2016; Office of the Insurance Commissioner Washington State, 2016b) enable me to (1) define the household's complete menu of plan choices and (2) precisely calculate the household-specific premium p_{ij} from the insurer's base premium p_j for all plans. 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.

To form the universe of potential exchange consumers, I use data from the 2014 and 2015 American Community Survey (ACS) (Ruggles et al., 2016). I apply several criteria to select the ACS sample: (1) I exclude 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 and (2) I exclude undocumented immigrants who are ineligible to purchase exchange insurance. I merge the remaining California and Washington ACS survey records with the administrative data from California and Washington, respectively.

The ACS has several limitations. Although the ACS samples 3.5 million households or 1 percent of the U.S. population each year, surveys such as the ACS are susceptible to nonresponse bias and inaccurate measurement of key variables. The smallest geographic identifier available in the ACS is public use microdata area (PUMA). Using the PUMA definitions from the U.S. Census Bureau (U.S. Census Bureau, 2010), I am able to match all but 1 PUMA in California (representing 0.5 percent of California ACS households) and 2 PUMAs in Washington (representing 3.0 percent of Washington ACS households) to a single rating region. The ACS is also missing information on smoking and immigration status. I use the Behavioral Risk Factor Surveillance System (BRFSS) (Centers for Disease Control and Prevention, 2016) to impute smoking status and the Survey of Income and Program Participation (SIPP) to impute immigration status (U.S. Census Bureau, 2016) following the imputation methods presented in Hall et al. (2010) and Van Hook et al. (2015). I verify that the imputed number of undocumented immigrants and legal permanent residents matches state-level targets from the Department of Homeland Security (Department of Homeland Security, 2013a,b).

I also collect plan characteristic data from California (California Health Benefit Exchange, 2016) and Washington (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).

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 Washington 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 relatively large share of the uninsured population.

Variation in consumer choice sets is considerable, as shown in Table 3. The average California consumer could choose from 25 plans offered by 5 different insurers. 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 year 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.

5 Estimation

To estimate demand, I model equations (1) and (2) as a nested logit at the consumer level, where the vector of error terms ϵ_i has the generalized extreme value distribution. I create two nests: 1) a nest containing all exchange plans and 2) a nest containing only the outside option. This two-nest structure addresses the potential concern that a logit model might overestimate substitution to the outside option because of its proportional substitution assumption. A natural alternative would be to model each metal tier as a nest, along with the outside option nest. I use the two-nest structure because the primary observed substitution pattern is between the silver tier and the outside option due to the ACA's linkage of cost sharing subsidies to the purchase of silver plans. The household choice probabilities are computed as

$$q_{ij}(\mathbf{p};\boldsymbol{\theta}) = \frac{e^{V_{ij}/\lambda}\left(\sum_j e^{V_{ij}/\lambda}\right)^{\lambda-1}}{1+\left(\sum_j e^{V_{ij}/\lambda}\right)^{\lambda}} \tag{6}$$

Table 2: Choice and Demographic Distribution by State

	California		Washington	
	Exchange	Uninsured	Exchange	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%	
Access to free plan	45.4%	19.3%	33.0%	13.6%
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: Table provides summary statistics on consumers in the California and Washington exchange markets for the 2014 and 2015 plan years. Data on exchange consumers come from Covered California and the Washington Health Benefit Exchange. Data on the uninsured come 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 $\boldsymbol{\theta}$ is the vector of parameters in equation (1), $V_{ij} = \alpha_i p_{ij} + x_j'\beta + d_i'\varphi + \xi_j$, and λ is the nesting parameter for the exchange nest. I use maximum likelihood to estimate the value of $\boldsymbol{\theta}$ that maximizes the log-likelihood function

$$LL(\boldsymbol{\theta}) = \sum_{i,j} w_i c_{ij} \ln q_{ij}(\mathbf{p}; \boldsymbol{\theta})$$

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

5.1 Estimating the Premium Parameter

The main empirical challenge with estimating equation (1) is that the premium may be endogenous. Premiums vary across insurers, markets, and households. Unobserved product characteristics that vary at the insurer-market level, including insurer entry decisions, customer service, provider networks, formularies, and advertising, could be correlated with premiums. Including insurer-market fixed effects in equation (1) can control for these unobservables. Ho and Pakes (2014) and Tebaldi (2017) follow a similar approach. The inclusion of fixed effects still permits estimation of the premium parameter in utility equation (1) because premiums also vary across households and I estimate demand at the household-level.

ACA regulations create exogenous variation in premiums across households that I can exploit to identify the effect of the premium on the household's choice. Examples of this variation include: (1) the upper income limit for subsidy eligibility that creates a discontinuity in household premiums at 400 percent of FPL; (2) the 57 percent increase in the age rating curve that creates a discontinuity in premiums between ages 20 and 21 (Centers for Medicare and Medicaid Services, 2013); (3) the individual mandate exemption for having income below the tax filing threshold; (4) the individual mandate exemption for not having access to an affordable offer; and (5) the increase in penalty assessments between 2014 and 2015. Figures 2-5 in Appendix F provide reduced-form evidence of how these exogenous shocks affect demand for exchange coverage. Exchange enrollment is particularly responsive to the upper income limit for subsidy eligibility and the tax filing threshold exemption from the individual mandate.

Consumer-level variation in premiums is a nonlinear function of age, tobacco usage, geographic residence, and household income. I include controls in the utility function for these characteristics. Identification of the premium could be problematic if consumers can manipulate these characteristics. Age is not manipulable and it is unlikely that consumers will relocate simply to find lower exchange premiums. In recent work, Friedman et al. (2016) find that the ACA's smoking surcharges reduced takeup among smokers, but did not affect smoking rates. Income is the characteristic that consumers are most likely to manipulate. For instance, households might try to keep their income below the 400 percent of poverty threshold for subsidy eligibility. Figure 6 in Appendix F does not reveal any sharp discontinuities in enrollment at the 400 percent of poverty threshold, suggesting that income manipulation might be minimal.

As a robustness check, I also estimate the parameters of equation (1) with the control function approach of Petrin and Train (2010) to address potential endogeneity of the premium. Appendix B describes how I implement the approach in this setting.

5.2 Estimating the Mandate Intercept

Collinearity between the mandate intercept and income intercepts is a potential concern because exemptions from the mandate depend on income. To address this concern, I exploit two sharp exemption thresholds: (1) the tax filing threshold and (2) the affordability threshold. Importantly, neither of these thresholds coincide with the subsidy eligibility thresholds. Figure 4 in Appendix F indicates that enrollment is responsive to the tax filing threshold exemption, but Figure 5 indicates less responsiveness to the affordability threshold exemption, particularly in California.

Another challenge in estimating φ_m is potential omitted variable bias. I include all observable demographic characteristics in the intercept vector d_i. A potentially important variable that I do not observe is health status. My estimates of the taste for compliance could be upward-biased if health status, rather than a taste for compliance, explains lower enrollment rates in certain sub-populations. Including intercepts for variables such as age and income that are likely to be correlated with health status may reduce the extent of the bias.

6 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 C presents full regression results and Appendix E contains formulas for computing elasticities and semi-elasticities in the ACA setting.

Table 4 summarizes the mean own-premium elasticities and semi-elasticities of demand by demographic group for California and Washington. The mean own-premium elasticity of demand is the percentage change in a plan's enrollment associated with a one percent increase in its premium. The mean own-premium semi-elasticity of demand is the percentage change in a plan's enrollment associated with a \$100 increase in its annual premium. California consumers have a mean own-premium elasticity of -9.1 and mean own-premium semi-elasticity of -21.8. These estimates are higher than those of Tebaldi (2017) and Drake (2018), but lower than Domurat (2017)'s estimates. Washington consumers have a lower mean own-premium elasticity of -7.2 and mean own-premium semi-elasticity of -19.9. California consumers may view the premium as a more important discriminator because there are fewer non-premium characteristics to discriminate between plans in California due to plan standardization. Variation in premium sensitivity across demographic groups is consistent with theory. In particular, low-income individuals, males, and young adults between the ages of 18 and 34 are more premium sensitive.

Table 5 presents estimated premium elasticities and semi-elasticities for exchange coverage. The premium elasticity for exchange coverage is the percentage change in exchange enrollment associated with a one percent increase in the base premium of all exchange plans. The premium semi-elasticity for exchange coverage is the percentage change in exchange enrollment associated with a \$100 annual increase in all exchange premiums. California consumers have an elasticity for exchange coverage of -1.2 and a semi-elasticity for exchange coverage of -3.3. These estimates are similar to those of Tebaldi (2017). Washington consumers have an elasticity for exchange coverage of -1.1 and a semi-elasticity for exchange coverage of -3.7. Variation in premium sensitivity across demographic groups is similar

Table 4: Estimated Mean Own-Premium Elasticities and Semi-Elasticities

	California		Washington	
	Elasticity	Semi-Elasticity	Elasticity	Semi-Elasticity
Overall	-9.1	-21.8	-7.2	-19.9
Income (% of FPL)				
0-138	-8.8	-21.3	-10.7	-28.6
138-250	-9.7	-23.1	-7.3	-20.3
250-400	-8.2	-20.0	-6.6	-18.5
400+	-7.8	-19.1	-5.3	-15.3
Gender				
Female	-8.8	-21.0	-6.8	-18.9
Male	-9.5	-22.6	-7.6	-20.9
Age				
18-34	-13.1	-27.9	-10.0	-24.9
35-54	-9.3	-19.9	-7.5	-18.7
55+	-5.6	-12.0	-4.9	-12.4
Smoking Status				
Smoker			-10.3	-27.6
Non-Smoker			-6.6	-18.3
Race				
Asian			-8.2	-22.1
Black			-11.5	-30.3
White			-6.8	-18.7

Notes: Table shows mean own-premium elasticities and semi-elasticities by demographic group. A plan's own-premium elasticity indicates the percentage change in enrollment for a 1 percent increase in its premium and is computed using equation (9). A plan's own-premium semi-elasticity indicates the percentage change in enrollment for a $100 increase in its annual premium and is computed using equation (10). I use the plan market shares as weights to compute the mean elasticities and semi-elasticities.

to the variation in the own-premium elasticity estimates across demographic groups.

I conduct several sensitivity analyses to assess the robustness of my findings. First, I estimate equation (1) with the control function approach of Petrin and Train (2010). The results in Appendix D indicate a small downward bias in the premium sensitivity estimates in Tables 4 and 5. Table 16 shows that the mean own-premium elasticity changes from -9.1 to -10.6 in California and from -7.2 to -8.1 in Washington. Table 17 shows that the mean premium elasticity for exchange coverage changes from -1.1 to -1.2 in Washington, while the corresponding change in California is minimal. Second, I run additional regressions where I include indicators for the cheapest plan and cheapest silver plan in each household's choice set. These tests assess whether consumers gravitate to the cheapest plans. Ta-

Table 5: Estimated Mean Elasticities and Semi-Elasticities for Exchange Coverage

	California		Washington	
	Elasticity	Semi-Elasticity	Elasticity	Semi-Elasticity
Overall	-1.2	-3.3	-1.1	-3.7
Income (% of FPL)				
0-138	-1.2	-3.3	-1.6	-5.4
138-250	-1.3	-3.5	-1.2	-4.0
250-400	-1.1	-3.1	-1.1	-3.7
400+	-1.0	-2.9	-0.9	-3.1
Gender				
Female	-1.1	-3.2	-1.0	-3.5
Male	-1.2	-3.4	-1.1	-3.9
Age				
18-34	-1.6	-4.1	-1.4	-4.4
35-54	-1.1	-2.9	-1.0	-3.3
55+	-0.7	-1.7	-0.7	-2.2
Smoking Status				
Smoker			-1.5	-4.6
Non-Smoker			-1.0	-3.1
Race				
Asian			-1.2	-3.9
Black			-1.7	-5.2
White			-1.1	-3.3

Notes: Table shows mean elasticities and semi-elasticities for exchange coverage by demographic group. The mean elasticity for exchange coverage indicates the percentage change in exchange enrollment if all exchange premiums increase by 1 percent and is computed using equation (11). The mean semi-elasticity for exchange coverage indicates the percentage change in exchange enrollment if all annual exchange premiums increase by $100 and is computed using equation (12). I use the plan market shares as weights to compute the mean elasticities and semi-elasticities.

ble 12 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. Third, I account for the possibility of inertia by incorporating an indicator in the vector d_i for a household renewing exchange coverage in 2015. Table 12 in Appendix C indicates that the results are relatively robust to the inclusion of the renewal indicator.

Table 6 displays the estimated non-premium plan characteristics parameters of utility equation (1). The actuarial value 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.

Table 6: Estimated Parameters of Non-Premium Plan Characteristics

	California	Washington
Actuarial Value (AV)	4.125***	3.591***
	(0.240)	(0.159)
HMO	−0.275***	1.009***
	(0.016)	(0.085)
Deductible Ratio		−0.096***
		(0.008)
Max. OOP Ratio		0.010
		(0.009)

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, including the actuarial value, whether the plan is an HMO, the ratio of the plan's deductible to the maximum deductible in the plan's metal tier, and the ratio of the plan's out-of-pocket limit to the maximum out-of-pocket limit in the plan's metal tier. Parameters for the latter two variables cannot be estimated for California because of plan standardization. Robust standard errors that correct for potential misspecification are shown in parentheses (see p.503 of Wooldridge (2010)).

7 Consumer Response to the Individual Mandate

I examine how consumers respond to the individual along two dimensions. First, I assess whether the individual mandate elicits a behavioral response from consumers. Second, I determine whether consumers who enrolled just before the mandate took effect are more sensitive to premiums.

In Table 7, I compare three alternative specifications of utility equation (1): (1) including the mandate intercept in the vector of demographic variables; (2) modeling the premium and penalty variables with different coefficients; and (3) including a mandate intercept and modeling the premium and penalty variables with different coefficients. Table 7 indicates that the mandate intercept is positive and statistically significant across the specifications, suggesting consumers may have a taste for compliance with the individual mandate. In contrast, the penalty parameter is substantially smaller in magnitude than the premium parameter. The estimates imply that the taste for compliance in Washington is about \$13 per month using equation (5). The estimated taste for compliance is \$64 per month in California, but my sensitivity analyses indicate that lack of data on smokers could be a source of upward bias. The taste for compliance estimates could be subject to omitted variable bias due to lack of data on health status and imprecision due to collinearity between the penalty and income.

Table 7: Estimated Individual Mandate Parameters

	Mandate Intercept	Separate Penalty Parameter	Mandate Intercept and Separate Penalty Parameter	Income Interaction	Exclude Smoker Variables
California					
Penalty		-0.002^{***}	-0.008^{***}		
		(0.001)	(0.001)		
Mandate	0.479^{***}		1.218^{***}	1.467^{***}	
	(0.062)		(0.069)	(0.086)	
Mandate $\times > 400\%$				-2.272^{***}	
				(0.163)	
Washington					
Penalty		-0.002^{***}	-0.004^{***}		
		(0.000)	(0.000)		
Mandate	0.095^{***}		0.754^{***}	1.565^{***}	0.277^{***}
	(0.034)		(0.030)	(0.063)	(0.059)
Mandate $\times > 400\%$				-2.562^{***}	
				(0.075)	

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 1 includes a mandate intercept, column 2 includes a separate penalty parameter, and column 3 includes both a mandate intercept and separate penalty parameter. Column 4 adds an interaction between the mandate intercept and an intercept for those earning above 400 percent of FPL, while column 5 excludes the smoker variables in the Washington analysis.

It is also possible that cognitive difficulty in understanding the complex details of the ACA's individual mandate, not a taste for compliance, may explain the significant response to the existence of the penalty rather than the amount of the penalty. I design a test to distinguish 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 utility equation (1), as nearly all households with an affordable offer exemption have income just above the 400 percent of FPL threshold for receiving subsidies. The fourth 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.

I also assess whether consumers who enrolled just before the mandate took effect are more sensitive to premiums using data from Washington state. Consumers had to have coverage effective May 1, 2014 in order to comply with the mandate, but were allowed to begin exchange coverage as early as January 1, 2014. Table 8 provides summary statistics comparing early enrollees to late enrollees. Late enrollees are 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, male, and racial minorities. Table 9 indicates that late enrollees are more premium elastic. Consumers beginning coverage in January 2014 had a mean own-premium elasticity of -6.2, while those beginning coverage in May 2014 had a mean own-premium elasticity of -7.4. Premium sensitivity is also monotonically increasing in the coverage start date. These findings suggest that the mandate incentivizes 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.

8 Repealing the Individual Mandate

My demand estimates can be used to analyze a broad set of relevant policy counterfactuals. In this section, I simulate how repeal of the individual mandate affects exchange enrollment and consumer surplus, assuming a range of exogenous supply responses from the literature. Microsimulation studies suggest mandate repeal would increase premiums by roughly 10 to 25 percent (Eibner and Price, 2012).[2] Most recently, the Congressional Budget Office estimated individual market premiums would rise by 10 percent if the individual mandate were repealed (Congressional Budget Office, 2017). In concurrent work, I develop and estimate a structural model of the California exchange in which firms set premiums and consumers choose plans. I find that repealing the mandate in the California setting would lead to premium increases of less than 5 percent (Saltzman, 2018).

[2] 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 exchange enrollee choices and demographic characteristics by their coverage initiation dates.

Table 10 shows how repealing the mandate would affect exchange enrollment and consumer welfare under three supply response scenarios: a 5 percent, 10 percent, and 25 percent increase. Exchange

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

Coverage Start Month	Elasticity	Semi-Elasticity
January 2014	-6.2	-17.5
February 2014	-7.0	-19.4
March 2014	-7.2	-19.9
April 2014	-7.3	-20.2
May 2014	-7.4	-20.4
January 2015	-6.3	-17.6
February 2015	-6.7	-18.5
March 2015	-7.0	-19.3

Notes: Table shows mean own-premium elasticities and semi-elasticities for Washington exchange consumers by coverage initiation month. A plan's own-premium elasticity indicates the percentage change in enrollment for a 1 percent increase in its premium and is computed using equation (9). A plan's own-premium semi-elasticity indicates the percentage change in enrollment for a $100 increase in its annual premium and is computed using equation (10).

enrollment would decline by 18.6 to 19.7 percent in California and 13.4 to 16.1 percent in Washington. Repealing the mandate would result in sharper coverage declines of 20.5 to 29.3 percent in California and 17.2 to 35.7 percent in Washington if vouchers were to replace ACA subsidies. Mandate repeal slightly increases consumer surplus by 1.2 to 1.6 percent in California and 5.0 to 6.8 percent in Washington.[3] However, mandate repeal reduces consumer surplus by 2.8 to 20.1 percent in California and 3.5 to 40.3 percent in Washington when vouchers replace ACA subsidies. The ACA's price-linked subsidies shield subsidized consumers from premium increases that result from mandate repeal, while vouchers expose consumers to premium increases. Note that these estimates of consumer welfare are averages and do not account for other social welfare impacts such as changes in producer surplus and government spending.

9 Conclusion

I estimate demand for health insurance using consumer-level data from two ACA exchanges. I find that exchange consumers in California and Washington are highly premium elastic. There is considerable variation in premium sensitivity across demographic groups, particularly by age. California's 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. I also find evidence that consumers are more responsive to the *existence* of the mandate penalty, rather than the *amount* of the penalty. My analysis indicates that a taste for compliance offers

[3] McFadden (1983) shows that expected consumer surplus can be calculated as $CW_i = \frac{\lambda}{\alpha_i} \ln N_{iEX}$, 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 Exchange Enrollment		Percent Change in Consumer Surplus	
	ACA Subsidies	Vouchers	ACA Subsidies	Vouchers
California				
5% Premium Increase	-18.6%	-20.5%	1.6%	-2.8%
10% Premium Increase	-18.9%	-22.8%	1.5%	-7.4%
25% Premium Increase	-19.7%	-29.3%	1.2%	-20.1%
Washington				
5% Premium Increase	-13.4%	-17.2%	6.8%	-3.5%
10% Premium Increase	-14.3%	-21.9%	6.0%	-14.0%
25% Premium Increase	-16.1%	-35.7%	5.0%	-40.3%

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. Three alternative supply response scenarios are considered: a 5% premium increase, a 10% premium increase, and a 25% premium increase.

a plausible explanation for this result, which has important implications for the effectiveness of policy sticks relative to policy carrots.

I use the demand estimates to simulate the interaction between alternative subsidy approaches and the individual mandate in mitigating the effects of adverse selection. My simulations indicate that mandate repeal would slightly increase consumer surplus because the ACA's price-linked subsidies shield most consumers from premium increases and some consumers are not compelled to purchase insurance against their will. If vouchers were to replace ACA subsidies, mandate repeal would significantly reduce consumer surplus because consumers would be exposed to premium increases resulting from repeal. Repealing the individual mandate therefore involves an intricate set of policy interactions that warrant discussion.

Several caveats should be attached to my 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 exchanges. Substitution between on- and off-exchange individual market plans is likely to be minimal because off-exchange 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-exchange plan.

Future studies of demand for health insurance can use data from the ACA exchanges to further understand how consumers choose plans. My analysis does not consider the importance of provider networks, which can vary considerably between 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 exchanges and identify which policy regimes could improve social welfare.

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Appendix A: ACA Institutional Detail

Table 11: California Exchange Standard Plan Benefit Designs (2014)

	Bronze	Silver	Gold	Plat-inum	Silver 73	Silver 87	Silver 94
Actuarial value	60%	70%	80%	90%	73%	87%	94%
Deductible	$5,000	$2,000	$0	$0	$1,500	$500	$0
Coinsurance	30%	20%	20%	10%	20%	15%	10%
PCP copay	$60	$45	$30	$20	$40	$15	$3
Specialist copay	$70	$65	$50	$40	$50	$20	$5
Out-of-pocket limit	$6,350	$6,350	$6,350	$4,000	$5,200	$2,250	$2,250

Notes: Table summarizes the standard plan benefit designs in the California exchange for the 2014 plan year. The silver 73, silver 87, and silver 94 plans are the enhanced versions of the basic silver plan and reduce cost sharing for consumers who qualify for cost sharing subsidies.

Figure 1: Premium Rating Regions in California and Washington

Notes: Figure shows the premium rating regions in the California and Washington state exchanges (Department of Managed Health Care, 2016; Office of the Insurance Commissioner Washington State, 2016b). There are 19 rating areas in California and 5 rating areas in Washington.

Appendix B: Description of the Control Function Approach

As a robustness check, I estimate demand as a nested logit discrete choice model with the control function approach of Petrin and Train (2010) to control for potential endogeneity of the premium. Although the approach of Berry et al. (1995) is more commonly used for addressing price endogeneity in discrete choice models, significant household-level variation in premiums for the same product and in penalty assessments precludes applying the key insight of Berry et al. (1995): absorbing the premium endogeneity into product-level constants. I estimate the first stage by regressing the premium p_{ij} on instruments z_{ij}. I calculate each household's predicted premium from the first stage and then compute the residuals μ_{ij}. I make the assumption that (μ_{ij}, ξ_{ij}) are jointly normal, which implies that $\xi_{ij}|\mu_{ij}$ is also normal with mean $\upsilon\mu_{ij}$ and variance ψ^2 (υ and ψ are parameters to be estimated). Setting the unobservables $\xi_{ij} = E[\xi_{ij}|\mu_{ij}] + \widetilde{\xi}_{ij}$ to "control" for potential correlations between μ_{ij} and ξ_{ij}, I rewrite demand equation (1) as

$$\begin{aligned} U_{ij} &= \alpha_i p_{ij} + x_j'\beta + d_i'\varphi + E[\xi_{ij}|\mu_{ij}] + \widetilde{\xi}_{ij} + \epsilon_{ij} \\ &= \alpha_i p_{ij} + x_j'\beta + d_i'\varphi + \upsilon\mu_{ij} + \psi\eta_{ij} + \epsilon_{ij} \end{aligned} \tag{7}$$

where $\eta_{ij} \sim N(0,1)$. The household choice probabilities can be computed as

$$q_{ij}(\mathbf{p};\boldsymbol{\theta}) = \int \left[\frac{e^{V_{ij}/\lambda}\left(\sum_j e^{V_{ij}/\lambda}\right)^{\lambda-1}}{1+\left(\sum_j e^{V_{ij}/\lambda}\right)^{\lambda}} \right] dG(\cdot) \tag{8}$$

where $\boldsymbol{\theta}$ is the vector of parameters in (7), $V_{ij} = \alpha_i p_{ij} + x_j'\beta + d_i'\varphi + \upsilon\mu_{ij} + \psi\eta_{ij}$, and $G(\cdot)$ is the normal cumulative distribution function for $\xi_{ij}|\mu_{ij}$. I estimate the integral in equation (8) using simulation. I then use maximum simulated likelihood to estimate the value of $\boldsymbol{\theta}$ that maximizes the log-likelihood function.

In the instrument vector z_{ij}, I include all non-premium variables, which I assume are exogenous. I also include the geographic cost factors reported by each California and Washington insurer in their rate filings. The geographic cost factors measure each plan's cost relative to its cost in other rating areas in which it participates. The geographic variation in cost represents, in part, differences in firm's bargaining power with providers across markets. For example, in its rate filing in Washington, Kaiser justifies its higher rates in rating area 2 with the following statement: "Our provider contracts in area 2 are less favorable than in area 3." Hence, the geographic cost factors should be valid instruments in this setting because they are unrelated to demand, but likely to be highly correlated with premiums.

Appendix C: Full Regression Results

Table 12: Full Regression Results

	California			Washington		
	Base	Inertia	Cheapest Plans	Base	Inertia	Cheapest Plans
Monthly Premium (\$100)	-0.429^{***}	-0.473^{***}	-0.314^{***}	-0.827^{***}	-0.881^{***}	-0.503^{***}
	(0.027)	(0.025)	(0.019)	(0.025)	(0.016)	(0.011)
Cheapest Plan			0.076^{***}			0.169^{***}
			(0.004)			(0.009)
Cheapest Silver Plan			0.388^{***}			0.399^{***}
			(0.030)			(0.028)
Actuarial Value (AV)	4.125^{***}	4.734^{***}	4.028^{***}	3.591^{***}	4.666^{***}	3.604^{***}
	(0.240)	(0.195)	(0.225)	(0.159)	(0.135)	(0.164)
HMO	-0.275^{***}	-0.313^{***}	-0.284^{***}	1.009^{***}	1.788^{***}	1.017^{***}
	(0.016)	(0.013)	(0.017)	(0.085)	(0.153)	(0.103)
Deductible Ratio				-0.096^{***}	-0.219^{***}	-0.188^{***}
				(0.008)	(0.019)	(0.015)
Max. OOP Ratio				0.010	-0.094^{***}	-0.003
				(0.009)	(0.025)	(0.014)
Premium (\$100) ×						
138-250	-0.035^{**}	-0.078^{***}	-0.101^{***}	0.367^{***}	0.307^{***}	0.098^{***}
	(0.017)	(0.018)	(0.016)	(0.012)	(0.022)	(0.017)
250-400	0.070^{***}	0.053^{***}	-0.039^{***}	0.445^{***}	0.407^{***}	0.123^{***}
	(0.016)	(0.017)	(0.013)	(0.015)	(0.019)	(0.016)
400+	0.126^{***}	0.138^{***}	0.011	0.589^{***}	0.707^{***}	0.296^{***}
	(0.016)	(0.018)	(0.013)	(0.028)	(0.024)	(0.014)
Male	-0.059^{***}	-0.057^{***}	-0.054^{***}	-0.089^{***}	-0.153^{***}	-0.103^{***}
	(0.005)	(0.004)	(0.005)	(0.008)	(0.011)	(0.010)
0-17	-0.569^{***}	-0.600^{***}	-0.570^{***}	-0.336^{***}	-0.564^{***}	-0.353^{***}
	(0.027)	(0.021)	(0.026)	(0.050)	(0.103)	(0.059)
18-34	-0.616^{***}	-0.669^{***}	-0.611^{***}	-0.553^{***}	-0.505^{***}	-0.560^{***}
	(0.033)	(0.024)	(0.032)	(0.017)	(0.010)	(0.015)
35-54	-0.306^{***}	-0.325^{***}	-0.301^{***}	-0.276^{***}	-0.319^{***}	-0.296^{***}
	(0.016)	(0.011)	(0.015)	(0.012)	(0.007)	(0.014)
Smoker				-0.409^{***}	-0.515^{***}	-0.461^{***}
				(0.024)	(0.018)	(0.027)
Black				-0.456^{***}	-0.794^{***}	-0.506^{***}
				(0.034)	(0.049)	(0.040)
Asian				-0.093^{***}	-0.153^{***}	-0.087^{***}
				(0.004)	(0.006)	(0.004)

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Table 12 – *Continued from previous page*

	California			Washington		
	Base	Inertia	Cheapest Plans	Base	Inertia	Cheapest Plans
White				0.057***	0.030***	0.057***
				(0.002)	(0.005)	(0.002)
Family	−0.015***	−0.041***	−0.010***	−0.080***	−0.188***	−0.092***
	(0.003)	(0.005)	(0.003)	(0.009)	(0.016)	(0.011)
Year 2015	−0.019***	−0.200***	−0.022***	0.063***	−0.257***	0.046***
	(0.002)	(0.010)	(0.002)	(0.004)	(0.018)	(0.004)
Renewal		0.301***			0.584***	
		(0.019)			(0.039)	
Intercept						
Base	−3.866***	−4.424***	−4.045***	−3.187***	−5.560***	−3.609***
	(0.216)	(0.189)	(0.238)	(0.316)	(0.373)	(0.380)
138-250				−0.186**	0.107*	−0.044
				(0.078)	(0.058)	(0.087)
250-400				0.194	0.876***	0.502***
				(0.118)	(0.096)	(0.142)
400+	−0.676***	−0.523***	−0.609***	−0.802***	−0.511***	−0.574***
	(0.074)	(0.057)	(0.076)	(0.084)	(0.046)	(0.093)
Male	0.154***	0.186***	0.152***	−0.024	0.078***	0.004
	(0.026)	(0.024)	(0.026)	(0.024)	(0.022)	(0.027)
0-17	−2.350***	−2.448***	−2.246***	−9.661***	−10.15***	−9.653***
	(0.101)	(0.086)	(0.095)	(0.194)	(0.175)	(0.179)
18-34	−1.031***	−1.096***	−1.029***	−1.682***	−1.764***	−1.668***
	(0.048)	(0.041)	(0.046)	(0.025)	(0.021)	(0.023)
35-54	−1.099***	−1.192***	−1.103***	−0.531***	−0.398***	−0.477***
	(0.040)	(0.037)	(0.038)	(0.037)	(0.029)	(0.039)
Black				−1.016***	−0.447***	−0.894***
				(0.094)	(0.095)	(0.102)
Asian				−0.682***	−0.777***	−0.679***
				(0.039)	(0.030)	(0.036)
White				−1.412***	−1.401***	−1.403***
				(0.023)	(0.018)	(0.022)
Family	2.046***	2.119***	2.044***	1.090***	1.330***	1.105***
	(0.031)	(0.029)	(0.029)	(0.024)	(0.034)	(0.027)
Year 2015	0.327***	0.455***	0.333***	0.124***	0.254***	0.172***
	(0.029)	(0.025)	(0.028)	(0.020)	(0.013)	(0.017)
Mandate	0.479***	0.541***	0.504***	0.095***	0.044*	0.101***
	(0.062)	(0.059)	(0.056)	(0.034)	(0.024)	(0.028)
Insurers						

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Table 12 – *Continued from previous page*

	California			Washington		
	Base	Inertia	Cheapest Plans	Base	Inertia	Cheapest Plans
Anthem	0.199***	0.231***	0.241***			
	(0.030)	(0.033)	(0.034)			
Blue Shield CA	−0.276***	−0.336***	−0.146***			
	(0.031)	(0.035)	(0.029)			
BridgeSpan				0.479***	0.920***	0.413***
				(0.047)	(0.091)	(0.054)
Centene/Health Net	−0.438***	−0.524***	−0.495***	0.165***	0.276***	0.054***
	(0.038)	(0.040)	(0.043)	(0.014)	(0.024)	(0.012)
Chinese Community	−0.077***	−0.096***	−0.259***			
	(0.026)	(0.031)	(0.033)			
CHPW				0.944***	1.437***	0.867***
				(0.064)	(0.095)	(0.071)
Group Health/Kaiser	−1.210***	−1.431***	−1.380***	0.302***	0.436***	0.332***
	(0.089)	(0.085)	(0.099)	(0.019)	(0.025)	(0.023)
LA Care	0.515***	0.594***	0.429***			
	(0.054)	(0.057)	(0.051)			
Moda				0.715***	1.304***	0.669***
				(0.063)	(0.117)	(0.075)
Molina	−0.798***	−0.955***	−0.960***			
	(0.061)	(0.059)	(0.076)			
Premera/Lifewise				1.227***	2.065***	1.293***
				(0.091)	(0.155)	(0.112)
Sharp	−0.061**	−0.090***	−0.186***			
	(0.028)	(0.033)	(0.034)			
Valley	−0.277***	−0.341***	−0.305***			
	(0.035)	(0.039)	(0.038)			
Western Health	0.186***	0.211***	0.162***			
	(0.032)	(0.037)	(0.034)			
Rating Areas						
WA1				1.308***	1.360***	1.299***
				(0.025)	(0.023)	(0.024)
CA2/WA2	2.311***	2.331***	2.423***	1.205***	1.274***	1.218***
	(0.156)	(0.140)	(0.145)	(0.025)	(0.023)	(0.024)
CA3/WA3	0.627***	0.608***	0.747***	1.664***	2.247***	1.600***
	(0.087)	(0.081)	(0.081)	(0.067)	(0.101)	(0.072)
WA4				0.862***	0.939***	0.865***
				(0.033)	(0.031)	(0.032)

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Table 12 – *Continued from previous page*

	California			Washington		
	Base	Inertia	Cheapest Plans	Base	Inertia	Cheapest Plans
CA4/8	2.590***	2.614***	2.708***			
	(0.117)	(0.104)	(0.110)			
CA5	1.861***	1.734***	1.952***			
	(0.168)	(0.148)	(0.156)			
CA6	4.177***	4.673***	4.500***			
	(0.160)	(0.149)	(0.179)			
CA7	2.434***	2.586***	2.598***			
	(0.124)	(0.115)	(0.119)			
CA9	1.743***	1.862***	1.915***			
	(0.099)	(0.089)	(0.099)			
CA10	−0.300***	−0.418***	−0.220**			
	(0.101)	(0.098)	(0.103)			
CA11	0.399***	0.668***	0.721***			
	(0.137)	(0.125)	(0.151)			
CA12	3.029***	3.270***	3.330***			
	(0.118)	(0.107)	(0.131)			
CA14	−1.481***	−1.395***	−1.316***			
	(0.080)	(0.075)	(0.077)			
CA15	−0.755***	−0.883***	−0.562***			
	(0.096)	(0.088)	(0.083)			
CA16	0.765***	0.857***	1.018***			
	(0.062)	(0.056)	(0.062)			
CA17	−0.189**	0.006	−0.083			
	(0.080)	(0.074)	(0.079)			
CA18	1.102***	1.212***	1.103***			
	(0.067)	(0.062)	(0.064)			
CA19	0.764***	0.778***	1.006***			
	(0.067)	(0.061)	(0.062)			
Anthem ×						
CA2/WA2	0.086***	0.112***	0.056***			
	(0.019)	(0.022)	(0.019)			
CA3/WA3	0.082***	0.115***	−0.128***			
	(0.022)	(0.026)	(0.021)			
CA4/8	−0.452***	−0.534***	−0.513***			
	(0.034)	(0.032)	(0.040)			
CA5	−0.175***	−0.199***	−0.217***			
	(0.024)	(0.027)	(0.028)			
CA6	−1.945***	−2.282***	−2.183***			

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Table 12 – *Continued from previous page*

	California			Washington		
	Base	Inertia	Cheapest Plans	Base	Inertia	Cheapest Plans
	(0.134)	(0.121)	(0.150)			
CA7	−0.114***	−0.132***	−0.285***			
	(0.014)	(0.016)	(0.024)			
CA9	−0.161***	−0.192***	−0.228***			
	(0.017)	(0.018)	(0.022)			
CA10	−0.202***	−0.236***	−0.417***			
	(0.018)	(0.019)	(0.031)			
CA11	−1.727***	−2.035***	−2.059***			
	(0.120)	(0.109)	(0.141)			
CA12	−1.461***	−1.710***	−1.674***			
	(0.101)	(0.092)	(0.115)			
CA14	0.170***	0.204***	0.039			
	(0.027)	(0.030)	(0.026)			
CA15	0.396***	0.457***	0.272***			
	(0.041)	(0.044)	(0.037)			
CA16	−0.289***	−0.355***	−0.462***			
	(0.026)	(0.027)	(0.043)			
CA17	−0.915***	−1.087***	−0.948***			
	(0.068)	(0.063)	(0.073)			
CA18	−0.897***	−1.068***	−0.838***			
	(0.065)	(0.060)	(0.063)			
CA19	−0.458***	−0.545***	−0.638***			
	(0.035)	(0.033)	(0.051)			
Blue Shield ×						
CA2/WA2	0.366***	0.448***	0.062***			
	(0.034)	(0.034)	(0.020)			
CA3/WA3	0.611***	0.743***	0.506***			
	(0.053)	(0.053)	(0.049)			
CA4/8	0.276***	0.321***	0.138***			
	(0.022)	(0.021)	(0.015)			
CA5	0.629***	0.763***	0.386***			
	(0.051)	(0.051)	(0.038)			
CA6	−1.638***	−1.907***	−2.133***			
	(0.109)	(0.097)	(0.140)			
CA7	0.356***	0.417***	0.206***			
	(0.027)	(0.025)	(0.018)			
CA9	0.060***	0.078***	−0.253***			
	(0.015)	(0.017)	(0.019)			

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Table 12 – *Continued from previous page*

	California			Washington		
	Base	Inertia	Cheapest Plans	Base	Inertia	Cheapest Plans
CA10	0.062***	0.084***	−0.068***			
	(0.016)	(0.018)	(0.015)			
CA11	−1.315***	−1.534***	−1.773***			
	(0.090)	(0.082)	(0.119)			
CA12	−1.130***	−1.316***	−1.598***			
	(0.078)	(0.071)	(0.107)			
CA14	0.704***	0.844***	0.517***			
	(0.057)	(0.056)	(0.048)			
CA15	1.207***	1.428***	1.026***			
	(0.093)	(0.089)	(0.081)			
CA16	0.318***	0.369***	0.049***			
	(0.022)	(0.021)	(0.010)			
CA17	−0.214***	−0.247***	−0.307***			
	(0.014)	(0.012)	(0.021)			
CA19	0.298***	0.350***	0.040***			
	(0.025)	(0.025)	(0.014)			
BridgeSpan ×						
WA1				0.000	0.018	0.008
				(0.014)	(0.023)	(0.017)
CA2/WA2				0.117***	0.279***	0.104***
				(0.021)	(0.042)	(0.026)
WA4				−0.353***	−0.580***	−0.391***
				(0.030)	(0.048)	(0.036)
Centene/Health Net ×						
WA1				−0.093***	−0.061***	−0.068***
				(0.010)	(0.019)	(0.012)
CA2/WA2				−0.303***	−0.336***	−0.307***
				(0.014)	(0.018)	(0.013)
WA4				−0.236***	−0.314***	−0.238***
				(0.016)	(0.020)	(0.017)
CA15	1.278***	1.512***	1.095***			
	(0.098)	(0.093)	(0.086)			
CA16	0.363***	0.430***	0.114***			
	(0.028)	(0.026)	(0.011)			
CA19	0.381***	0.452***	0.152***			
	(0.031)	(0.031)	(0.017)			
CHPW ×						

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Table 12 – *Continued from previous page*

	California			Washington		
	Base	Inertia	Cheapest Plans	Base	Inertia	Cheapest Plans
WA1				0.122***	0.285***	0.161***
				(0.019)	(0.039)	(0.024)
CA2/WA2				−0.241***	−0.257***	−0.244***
				(0.017)	(0.024)	(0.018)
CA3/WA3				−0.532***	−0.777***	−0.368***
				(0.036)	(0.051)	(0.033)
WA4				−0.248***	−0.339***	−0.250***
				(0.022)	(0.030)	(0.024)
Group Health/Kaiser ×						
WA1				−0.113***	−0.110***	−0.101***
				(0.010)	(0.017)	(0.012)
CA2/WA2	2.091***	2.458***	2.297***	−0.159***	−0.122***	−0.169***
	(0.145)	(0.132)	(0.158)	(0.011)	(0.023)	(0.013)
CA3/WA3	1.982***	2.341***	2.195***	−0.727***	−1.239***	−0.635***
	(0.142)	(0.131)	(0.157)	(0.056)	(0.096)	(0.062)
WA4				−0.019*	0.000	0.005
				(0.012)	(0.020)	(0.013)
CA4/8	1.558***	1.823***	1.746***			
	(0.108)	(0.098)	(0.119)			
CA5	2.047***	2.414***	2.263***			
	(0.143)	(0.131)	(0.157)			
CA7	1.722***	2.015***	1.903***			
	(0.118)	(0.106)	(0.128)			
CA10	1.471***	1.730***	1.685***			
	(0.103)	(0.095)	(0.117)			
CA14	1.870***	2.194***	2.049***			
	(0.129)	(0.117)	(0.139)			
CA15	2.335***	2.730***	2.433***			
	(0.162)	(0.146)	(0.164)			
CA16	1.456***	1.693***	1.490***			
	(0.098)	(0.089)	(0.095)			
CA17	1.074***	1.250***	1.268***			
	(0.073)	(0.067)	(0.082)			
CA18	0.981***	1.132***	1.257***			
	(0.066)	(0.061)	(0.082)			
CA19	1.365***	1.598***	1.428***			
	(0.098)	(0.090)	(0.098)			

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Table 12 – *Continued from previous page*

	California			Washington		
	Base	Inertia	Cheapest Plans	Base	Inertia	Cheapest Plans
LA Care ×						
CA16	-0.791^{***}	-0.937^{***}	-0.846^{***}			
	(0.066)	(0.065)	(0.071)			
Moda ×						
WA1				-0.200^{***}	-0.330^{***}	-0.228^{***}
				(0.019)	(0.031)	(0.023)
CA2/WA2				0.046^{***}	0.170^{***}	0.034^{*}
				(0.015)	(0.033)	(0.018)
CA3/WA3				-0.478^{***}	-0.879^{***}	-0.420^{***}
				(0.044)	(0.080)	(0.051)
WA4				-0.361^{***}	-0.617^{***}	-0.393^{***}
				(0.032)	(0.053)	(0.037)
Premera/Lifewise ×						
WA1				0.040^{***}	0.097^{***}	0.034^{***}
				(0.011)	(0.020)	(0.013)
CA2/WA2				-0.087^{***}	-0.025	-0.107^{***}
				(0.011)	(0.024)	(0.013)
CA3/WA3				-0.583^{***}	-0.997^{***}	-0.564^{***}
				(0.046)	(0.079)	(0.053)
WA4				-0.118^{***}	-0.183^{***}	-0.142^{***}
				(0.014)	(0.020)	(0.016)
Nesting Parameter	0.308^{***}	0.363^{***}	0.328^{***}	0.356^{***}	0.564^{***}	0.405^{***}
	(0.022)	(0.020)	(0.023)	(0.023)	(0.036)	(0.029)

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 13: California Regression Results - Mandate Regressions

	Mandate Intercept	Separate Penalty Parameter	Mandate Intercept and Separate Penalty Parameter	No Mandate Intercept, Separate Penalty	Income Interaction
Monthly Premium ($100)	-0.429^{***}	-0.467^{***}	-0.403^{***}	-0.485^{***}	-0.378^{***}
	(0.027)	(0.031)	(0.026)	(0.033)	(0.017)
Penalty ($100)			-0.777^{***}	-0.157^{***}	
			(0.061)	(0.055)	
Actuarial Value (AV)	4.125^{***}	4.111^{***}	4.152^{***}	4.125^{***}	4.592^{***}
	(0.240)	(0.242)	(0.260)	(0.255)	(0.236)
HMO	-0.275^{***}	-0.273^{***}	-0.276^{***}	-0.274^{***}	-0.305^{***}
	(0.016)	(0.016)	(0.017)	(0.017)	(0.016)
Premium ($100) ×					
138-250	-0.035^{**}	0.006	-0.069^{***}	0.022	-0.137^{***}
	(0.017)	(0.017)	(0.018)	(0.017)	(0.024)
250-400	0.070^{***}	0.112^{***}	0.051^{***}	0.137^{***}	-0.010
	(0.016)	(0.018)	(0.015)	(0.019)	(0.017)
400+	0.126^{***}	0.159^{***}	0.087^{***}	0.164^{***}	0.022
	(0.016)	(0.018)	(0.015)	(0.018)	(0.019)
Male	-0.059^{***}	-0.061^{***}	-0.062^{***}	-0.066^{***}	-0.063^{***}
	(0.005)	(0.005)	(0.005)	(0.006)	(0.004)
0-17	-0.569^{***}	-0.567^{***}	-0.607^{***}	-0.587^{***}	-0.614^{***}
	(0.027)	(0.028)	(0.034)	(0.032)	(0.025)
18-34	-0.616^{***}	-0.613^{***}	-0.617^{***}	-0.612^{***}	-0.670^{***}
	(0.033)	(0.033)	(0.035)	(0.035)	(0.030)
35-54	-0.306^{***}	-0.299^{***}	-0.304^{***}	-0.292^{***}	-0.334^{***}
	(0.016)	(0.015)	(0.017)	(0.015)	(0.015)
Family	-0.015^{***}	-0.019^{***}	-0.020^{***}	-0.026^{***}	-0.033^{***}
	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)
Year 2015	-0.019^{***}	-0.018^{***}	-0.013^{***}	-0.014^{***}	-0.025^{***}
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Intercept					
Base	-3.866^{***}	-3.382^{***}	-4.589^{***}	-3.374^{***}	-5.221^{***}
	(0.216)	(0.213)	(0.229)	(0.223)	(0.266)
400+	-0.676^{***}	-0.718^{***}	0.222^{**}	-0.253^{***}	1.550^{***}
	(0.074)	(0.077)	(0.087)	(0.091)	(0.213)
Male	0.154^{***}	0.176^{***}	0.125^{***}	0.180^{***}	0.135^{***}

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Table 13 – *Continued from previous page*

	Mandate Intercept	Separate Penalty Parameter	Mandate Intercept and Separate Penalty Parameter	No Mandate Intercept, Separate Penalty	Income Interaction
	(0.026)	(0.026)	(0.027)	(0.027)	(0.024)
0-17	-2.350^{***}	-2.340^{***}	-2.402^{***}	-2.355^{***}	-2.268^{***}
	(0.101)	(0.100)	(0.105)	(0.101)	(0.091)
18-34	-1.031^{***}	-1.010^{***}	-1.065^{***}	-1.009^{***}	-0.957^{***}
	(0.048)	(0.047)	(0.048)	(0.047)	(0.044)
35-54	-1.099^{***}	-1.102^{***}	-1.087^{***}	-1.096^{***}	-0.977^{***}
	(0.040)	(0.040)	(0.040)	(0.040)	(0.040)
Family	2.046^{***}	2.034^{***}	2.032^{***}	2.014^{***}	2.020^{***}
	(0.031)	(0.031)	(0.031)	(0.030)	(0.029)
Year 2015	0.327^{***}	0.304^{***}	0.632^{***}	0.448^{***}	0.352^{***}
	(0.029)	(0.029)	(0.035)	(0.032)	(0.026)
Mandate	0.479^{***}		1.218^{***}		1.467^{***}
	(0.062)		(0.069)		(0.086)
Mandate x gt400					-2.272^{***}
					(0.163)
Insurers					
Anthem	0.199^{***}	0.199^{***}	0.208^{***}	0.205^{***}	0.219^{***}
	(0.030)	(0.030)	(0.031)	(0.031)	(0.032)
Blue Shield CA	-0.276^{***}	-0.275^{***}	-0.271^{***}	-0.272^{***}	-0.310^{***}
	(0.031)	(0.031)	(0.032)	(0.032)	(0.034)
Centene/Health Net	-0.438^{***}	-0.437^{***}	-0.436^{***}	-0.436^{***}	-0.491^{***}
	(0.038)	(0.039)	(0.040)	(0.040)	(0.040)
Chinese Community	-0.077^{***}	-0.076^{***}	-0.072^{***}	-0.074^{***}	-0.088^{***}
	(0.026)	(0.026)	(0.026)	(0.026)	(0.029)
Group Health/Kaiser	-1.210^{***}	-1.207^{***}	-1.212^{***}	-1.209^{***}	-1.349^{***}
	(0.089)	(0.090)	(0.094)	(0.093)	(0.091)
LA Care	0.515^{***}	0.514^{***}	0.525^{***}	0.520^{***}	0.572^{***}
	(0.054)	(0.054)	(0.057)	(0.056)	(0.057)
Molina	-0.798^{***}	-0.796^{***}	-0.798^{***}	-0.797^{***}	-0.893^{***}
	(0.061)	(0.062)	(0.065)	(0.064)	(0.063)
Sharp	-0.061^{**}	-0.061^{**}	-0.056^{**}	-0.058^{**}	-0.072^{**}
	(0.028)	(0.028)	(0.028)	(0.028)	(0.031)
Valley	-0.277^{***}	-0.277^{***}	-0.274^{***}	-0.276^{***}	-0.313^{***}
	(0.035)	(0.035)	(0.036)	(0.036)	(0.038)
Western Health	0.186^{***}	0.185^{***}	0.193^{***}	0.190^{***}	0.206^{***}
	(0.032)	(0.032)	(0.033)	(0.033)	(0.035)

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Table 13 – *Continued from previous page*

	Mandate Intercept	Separate Penalty Parameter	Mandate Intercept and Separate Penalty Parameter	No Mandate Intercept, Separate Penalty	Income Interaction
Rating Areas					
CA2	2.311***	2.273***	2.430***	2.304***	2.248***
	(0.156)	(0.155)	(0.159)	(0.156)	(0.146)
CA3	0.627***	0.624***	0.704***	0.657***	0.532***
	(0.087)	(0.087)	(0.087)	(0.086)	(0.084)
CA4/8	2.590***	2.572***	2.693***	2.613***	2.586***
	(0.117)	(0.118)	(0.116)	(0.117)	(0.111)
CA5	1.861***	1.852***	2.386***	2.115***	1.750***
	(0.168)	(0.168)	(0.198)	(0.184)	(0.158)
CA6	4.177***	4.080***	4.145***	3.991***	4.232***
	(0.160)	(0.161)	(0.167)	(0.166)	(0.150)
CA7	2.434***	2.412***	2.633***	2.496***	2.453***
	(0.124)	(0.124)	(0.128)	(0.125)	(0.115)
CA9	1.743***	1.714***	1.805***	1.720***	1.729***
	(0.099)	(0.099)	(0.097)	(0.097)	(0.093)
CA10	−0.300***	−0.294***	−0.274***	−0.279***	−0.355***
	(0.101)	(0.101)	(0.101)	(0.100)	(0.097)
CA11	0.399***	0.397***	0.488***	0.448***	0.558***
	(0.137)	(0.137)	(0.144)	(0.141)	(0.132)
CA12	3.029***	3.031***	3.077***	3.058***	3.181***
	(0.118)	(0.118)	(0.121)	(0.120)	(0.114)
CA14	−1.481***	−1.524***	−1.448***	−1.562***	−1.653***
	(0.080)	(0.079)	(0.078)	(0.077)	(0.075)
CA15	−0.755***	−0.753***	−0.689***	−0.722***	−0.885***
	(0.096)	(0.096)	(0.098)	(0.098)	(0.095)
CA16	0.765***	0.753***	0.898***	0.811***	0.770***
	(0.062)	(0.062)	(0.062)	(0.061)	(0.058)
CA17	−0.189**	−0.235***	−0.064	−0.208***	−0.070
	(0.080)	(0.080)	(0.081)	(0.080)	(0.076)
CA18	1.102***	1.096***	1.329***	1.209***	1.084***
	(0.067)	(0.067)	(0.068)	(0.067)	(0.062)
CA19	0.764***	0.752***	0.883***	0.803***	0.714***
	(0.067)	(0.067)	(0.066)	(0.066)	(0.063)
Anthem ×					
CA2	0.086***	0.086***	0.086***	0.086***	0.099***

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Table 13 – *Continued from previous page*

	Mandate Intercept	Separate Penalty Parameter	Mandate Intercept and Separate Penalty Parameter	No Mandate Intercept, Separate Penalty	Income Interaction
	(0.019)	(0.019)	(0.019)	(0.019)	(0.021)
CA3	0.082***	0.082***	0.082***	0.083***	0.093***
	(0.022)	(0.023)	(0.023)	(0.023)	(0.025)
CA4/8	−0.452***	−0.451***	−0.457***	−0.455***	−0.504***
	(0.034)	(0.034)	(0.037)	(0.036)	(0.035)
CA5	−0.175***	−0.175***	−0.180***	−0.178***	−0.194***
	(0.024)	(0.024)	(0.025)	(0.025)	(0.026)
CA6	−1.945***	−1.940***	−1.959***	−1.950***	−2.163***
	(0.134)	(0.135)	(0.144)	(0.142)	(0.134)
CA7	−0.114***	−0.114***	−0.117***	−0.116***	−0.128***
	(0.014)	(0.014)	(0.015)	(0.015)	(0.016)
CA9	−0.161***	−0.160***	−0.163***	−0.160***	−0.179***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)
CA10	−0.202***	−0.202***	−0.207***	−0.205***	−0.229***
	(0.018)	(0.018)	(0.019)	(0.018)	(0.019)
CA11	−1.727***	−1.724***	−1.739***	−1.733***	−1.924***
	(0.120)	(0.121)	(0.128)	(0.127)	(0.120)
CA12	−1.461***	−1.457***	−1.471***	−1.464***	−1.623***
	(0.101)	(0.102)	(0.108)	(0.107)	(0.101)
CA14	0.170***	0.171***	0.172***	0.173***	0.195***
	(0.027)	(0.027)	(0.027)	(0.027)	(0.030)
CA15	0.396***	0.394***	0.397***	0.395***	0.440***
	(0.041)	(0.041)	(0.043)	(0.042)	(0.044)
CA16	−0.289***	−0.288***	−0.294***	−0.292***	−0.325***
	(0.026)	(0.027)	(0.028)	(0.028)	(0.027)
CA17	−0.915***	−0.913***	−0.924***	−0.919***	−1.021***
	(0.068)	(0.069)	(0.073)	(0.072)	(0.068)
CA18	−0.897***	−0.895***	−0.904***	−0.900***	−1.000***
	(0.065)	(0.066)	(0.070)	(0.069)	(0.065)
CA19	−0.458***	−0.457***	−0.463***	−0.460***	−0.511***
	(0.035)	(0.035)	(0.037)	(0.037)	(0.035)
Blue Shield ×					
CA2	0.366***	0.365***	0.368***	0.366***	0.411***
	(0.034)	(0.034)	(0.035)	(0.035)	(0.035)
CA3	0.611***	0.610***	0.616***	0.613***	0.683***
	(0.053)	(0.053)	(0.056)	(0.056)	(0.054)

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Table 13 – *Continued from previous page*

	Mandate Intercept	Separate Penalty Parameter	Mandate Intercept and Separate Penalty Parameter	No Mandate Intercept, Separate Penalty	Income Interaction
CA4/8	0.276***	0.275***	0.276***	0.275***	0.305***
	(0.022)	(0.022)	(0.023)	(0.023)	(0.022)
CA5	0.629***	0.628***	0.629***	0.629***	0.703***
	(0.051)	(0.052)	(0.054)	(0.054)	(0.052)
CA6	−1.638***	−1.633***	−1.649***	−1.640***	−1.820***
	(0.109)	(0.110)	(0.117)	(0.115)	(0.108)
CA7	0.356***	0.354***	0.356***	0.355***	0.394***
	(0.027)	(0.027)	(0.028)	(0.028)	(0.027)
CA9	0.060***	0.060***	0.059***	0.061***	0.067***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)
CA10	0.062***	0.061***	0.061***	0.060***	0.068***
	(0.016)	(0.015)	(0.016)	(0.016)	(0.017)
CA11	−1.315***	−1.313***	−1.323***	−1.319***	−1.463***
	(0.090)	(0.091)	(0.096)	(0.095)	(0.090)
CA12	−1.130***	−1.127***	−1.138***	−1.133***	−1.255***
	(0.078)	(0.078)	(0.083)	(0.082)	(0.078)
CA14	0.704***	0.704***	0.711***	0.711***	0.793***
	(0.057)	(0.058)	(0.061)	(0.061)	(0.059)
CA15	1.207***	1.204***	1.214***	1.209***	1.345***
	(0.093)	(0.094)	(0.099)	(0.098)	(0.094)
CA16	0.318***	0.317***	0.318***	0.317***	0.351***
	(0.022)	(0.022)	(0.024)	(0.023)	(0.022)
CA17	−0.214***	−0.214***	−0.217***	−0.216***	−0.239***
	(0.014)	(0.014)	(0.015)	(0.015)	(0.014)
CA19	0.298***	0.297***	0.299***	0.298***	0.331***
	(0.025)	(0.025)	(0.026)	(0.026)	(0.025)
Centene/Health Net ×					
CA15	1.278***	1.275***	1.288***	1.282***	1.425***
	(0.098)	(0.099)	(0.105)	(0.104)	(0.099)
CA16	0.363***	0.363***	0.366***	0.365***	0.405***
	(0.028)	(0.028)	(0.029)	(0.029)	(0.028)
CA19	0.381***	0.380***	0.384***	0.382***	0.423***
	(0.031)	(0.031)	(0.033)	(0.033)	(0.032)
Group Health/Kaiser ×					
CA2	2.091***	2.086***	2.105***	2.096***	2.329***

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Table 13 – *Continued from previous page*

	Mandate Intercept	Separate Penalty Parameter	Mandate Intercept and Separate Penalty Parameter	No Mandate Intercept, Separate Penalty	Income Interaction
	(0.145)	(0.146)	(0.156)	(0.154)	(0.145)
CA3	1.982***	1.977***	1.996***	1.988***	2.208***
	(0.142)	(0.143)	(0.152)	(0.150)	(0.142)
CA4/8	1.558***	1.554***	1.568***	1.561***	1.733***
	(0.108)	(0.109)	(0.115)	(0.114)	(0.108)
CA5	2.047***	2.043***	2.059***	2.052***	2.280***
	(0.143)	(0.144)	(0.153)	(0.151)	(0.143)
CA7	1.722***	1.718***	1.732***	1.725***	1.915***
	(0.118)	(0.119)	(0.126)	(0.124)	(0.117)
CA10	1.471***	1.467***	1.479***	1.473***	1.633***
	(0.103)	(0.104)	(0.110)	(0.108)	(0.103)
CA14	1.870***	1.867***	1.884***	1.878***	2.086***
	(0.129)	(0.130)	(0.138)	(0.137)	(0.130)
CA15	2.335***	2.329***	2.350***	2.340***	2.597***
	(0.162)	(0.163)	(0.173)	(0.171)	(0.161)
CA16	1.456***	1.453***	1.465***	1.459***	1.619***
	(0.098)	(0.099)	(0.105)	(0.104)	(0.098)
CA17	1.074***	1.072***	1.079***	1.076***	1.192***
	(0.073)	(0.073)	(0.077)	(0.076)	(0.073)
CA18	0.981***	0.979***	0.989***	0.985***	1.090***
	(0.066)	(0.067)	(0.071)	(0.070)	(0.067)
CA19	1.365***	1.362***	1.373***	1.368***	1.519***
	(0.098)	(0.098)	(0.104)	(0.103)	(0.098)
LA Care ×					
CA16	−0.791***	−0.789***	−0.798***	−0.794***	−0.884***
	(0.066)	(0.066)	(0.070)	(0.069)	(0.068)
Nesting Parameter	0.308***	0.307***	0.310***	0.309***	0.343***
	(0.022)	(0.022)	(0.023)	(0.023)	(0.022)

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 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)	-0.827^{***}	-0.828^{***}	-0.865^{***}	-0.867^{***}	-0.847^{***}	-0.678^{***}
	(0.025)	(0.025)	(0.018)	(0.017)	(0.025)	(0.060)
Penalty ($100)			-0.444^{***}	-0.235^{***}		
			(0.025)	(0.025)		
Actuarial Value (AV)	3.591^{***}	3.607^{***}	4.090^{***}	4.139^{***}	3.739^{***}	2.607^{***}
	(0.159)	(0.155)	(0.125)	(0.123)	(0.154)	(0.300)
HMO	1.009^{***}	1.014^{***}	1.162^{***}	1.178^{***}	1.033^{***}	0.613^{***}
	(0.085)	(0.083)	(0.074)	(0.074)	(0.081)	(0.095)
Deductible Ratio	-0.096^{***}	-0.096^{***}	-0.107^{***}	-0.107^{***}	-0.095^{***}	-0.051^{***}
	(0.008)	(0.008)	(0.006)	(0.006)	(0.007)	(0.008)
Max. OOP Ratio	0.010	0.010	0.019^{**}	0.021^{***}	0.020^{**}	0.041^{***}
	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.002)
Premium ($100) ×						
138-250	0.367^{***}	0.368^{***}	0.369^{***}	0.372^{***}	0.378^{***}	0.317^{***}
	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)	(0.022)
250-400	0.445^{***}	0.447^{***}	0.456^{***}	0.463^{***}	0.464^{***}	0.367^{***}
	(0.015)	(0.014)	(0.013)	(0.013)	(0.015)	(0.028)
400+	0.589^{***}	0.588^{***}	0.576^{***}	0.563^{***}	0.571^{***}	0.441^{***}
	(0.028)	(0.028)	(0.018)	(0.017)	(0.024)	(0.046)
Male	-0.089^{***}	-0.091^{***}	-0.112^{***}	-0.127^{***}	-0.102^{***}	-0.053^{***}
	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
0-17	-0.003^{***}	-0.003^{***}	-0.004^{***}	-0.004^{***}	-0.003^{***}	-0.002^{***}
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
18-34	-0.553^{***}	-0.554^{***}	-0.670^{***}	-0.655^{***}	-0.553^{***}	-0.426^{***}
	(0.017)	(0.016)	(0.017)	(0.015)	(0.014)	(0.043)
35-54	-0.276^{***}	-0.276^{***}	-0.320^{***}	-0.311^{***}	-0.278^{***}	-0.212^{***}
	(0.012)	(0.012)	(0.010)	(0.010)	(0.011)	(0.027)
Smoker	-0.409^{***}	-0.411^{***}	-0.504^{***}	-0.505^{***}	-0.404^{***}	
	(0.024)	(0.024)	(0.020)	(0.019)	(0.021)	
Black	-0.456^{***}	-0.459^{***}	-0.512^{***}	-0.531^{***}	-0.475^{***}	-0.299^{***}
	(0.034)	(0.033)	(0.027)	(0.027)	(0.033)	(0.055)
Asian	-0.093^{***}	-0.093^{***}	-0.100^{***}	-0.104^{***}	-0.099^{***}	-0.073^{***}
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)
White	0.057^{***}	0.057^{***}	0.067^{***}	0.061^{***}	0.048^{***}	0.036^{***}
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)

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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
Family	-0.080^{***}	-0.081^{***}	-0.103^{***}	-0.111^{***}	-0.086^{***}	-0.022^{***}
	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)	(0.007)
Year 2015	0.063^{***}	0.064^{***}	0.069^{***}	0.072^{***}	0.066^{***}	0.042^{***}
	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.005)
Intercept						
Base	-3.187^{***}	-3.180^{***}	-4.058^{***}	-3.918^{***}	-3.932^{***}	-1.544^{***}
	(0.316)	(0.313)	(0.263)	(0.257)	(0.305)	(0.499)
138-250	-0.186^{**}	-0.129^{*}	-0.218^{***}	0.186^{***}	-1.092^{***}	-0.486^{***}
	(0.078)	(0.069)	(0.070)	(0.062)	(0.100)	(0.132)
250-400	0.194	0.257^{**}	0.495^{***}	0.890^{***}	-0.699^{***}	-0.478^{**}
	(0.118)	(0.106)	(0.101)	(0.093)	(0.131)	(0.207)
400+	-0.802^{***}	-0.747^{***}	0.197^{**}	0.444^{***}	0.772^{***}	-1.293^{***}
	(0.084)	(0.075)	(0.091)	(0.088)	(0.111)	(0.169)
Male	-0.024	-0.020	-0.046^{**}	-0.008	-0.084^{***}	-0.148^{***}
	(0.024)	(0.023)	(0.021)	(0.021)	(0.024)	(0.031)
0-17	-9.661^{***}	-9.668^{***}	-10.16^{***}	-10.14^{***}	-9.580^{***}	-9.207^{***}
	(0.194)	(0.194)	(0.180)	(0.181)	(0.191)	(0.267)
18-34	-1.682^{***}	-1.677^{***}	-1.609^{***}	-1.586^{***}	-1.609^{***}	-1.706^{***}
	(0.025)	(0.024)	(0.025)	(0.022)	(0.023)	(0.050)
35-54	-0.531^{***}	-0.526^{***}	-0.451^{***}	-0.434^{***}	-0.408^{***}	-0.702^{***}
	(0.037)	(0.036)	(0.032)	(0.029)	(0.034)	(0.058)
Black	-1.016^{***}	-1.008^{***}	-1.058^{***}	-0.982^{***}	-1.023^{***}	-1.571^{***}
	(0.094)	(0.092)	(0.074)	(0.073)	(0.090)	(0.145)
Asian	-0.682^{***}	-0.682^{***}	-0.769^{***}	-0.747^{***}	-0.697^{***}	-0.679^{***}
	(0.039)	(0.039)	(0.038)	(0.037)	(0.039)	(0.056)
White	-1.412^{***}	-1.411^{***}	-1.648^{***}	-1.597^{***}	-1.412^{***}	-1.463^{***}
	(0.023)	(0.023)	(0.022)	(0.022)	(0.024)	(0.033)
Family	1.090^{***}	1.095^{***}	1.017^{***}	1.068^{***}	1.056^{***}	0.971^{***}
	(0.024)	(0.023)	(0.021)	(0.021)	(0.024)	(0.031)
Year 2015	0.124^{***}	0.123^{***}	0.349^{***}	0.301^{***}	0.143^{***}	0.192^{***}
	(0.020)	(0.019)	(0.017)	(0.016)	(0.019)	(0.025)
Mandate	0.095^{***}		0.754^{***}		1.565^{***}	0.277^{***}
	(0.034)		(0.030)		(0.063)	(0.059)
Mandate x gt400					-2.562^{***}	
					(0.075)	
Insurers						

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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
BridgeSpan	0.479***	0.481***	0.549***	0.558***	0.487***	0.274***
	(0.047)	(0.046)	(0.042)	(0.042)	(0.045)	(0.047)
Centene/Health Net	0.165***	0.165***	0.178***	0.179***	0.164***	0.107***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)
CHPW	0.944***	0.948***	1.074***	1.088***	0.977***	0.630***
	(0.064)	(0.063)	(0.056)	(0.055)	(0.063)	(0.086)
Group Health/Kaiser	0.302***	0.303***	0.330***	0.331***	0.306***	0.210***
	(0.019)	(0.019)	(0.016)	(0.016)	(0.018)	(0.025)
Moda	0.715***	0.718***	0.823***	0.835***	0.731***	0.426***
	(0.063)	(0.062)	(0.056)	(0.056)	(0.061)	(0.068)
Premera/Lifewise	1.227***	1.232***	1.401***	1.418***	1.258***	0.776***
	(0.091)	(0.090)	(0.077)	(0.077)	(0.087)	(0.111)
Rating Areas						
WA1	1.308***	1.311***	1.242***	1.276***	1.320***	1.323***
	(0.025)	(0.025)	(0.024)	(0.024)	(0.025)	(0.032)
CA2/WA2	1.205***	1.207***	1.276***	1.284***	1.218***	1.045***
	(0.025)	(0.024)	(0.024)	(0.023)	(0.024)	(0.032)
CA3/WA3	1.664***	1.655***	1.787***	1.712***	1.847***	1.304***
	(0.067)	(0.067)	(0.058)	(0.058)	(0.063)	(0.081)
WA4	0.862***	0.863***	0.873***	0.876***	0.837***	0.810***
	(0.033)	(0.033)	(0.031)	(0.030)	(0.032)	(0.043)
BridgeSpan ×						
WA1	0.000	0.001	0.009	0.009	0.003	−0.004
	(0.014)	(0.015)	(0.017)	(0.017)	(0.015)	(0.010)
CA2/WA2	0.117***	0.118***	0.136***	0.139***	0.121***	0.058***
	(0.021)	(0.020)	(0.021)	(0.021)	(0.020)	(0.016)
WA4	−0.353***	−0.355***	−0.397***	−0.403***	−0.359***	−0.228***
	(0.030)	(0.030)	(0.029)	(0.029)	(0.029)	(0.033)
Centene/Health Net ×						
WA1	−0.093***	−0.093***	−0.094***	−0.093***	−0.094***	−0.088***
	(0.010)	(0.010)	(0.011)	(0.012)	(0.010)	(0.009)
CA2/WA2	−0.303***	−0.304***	−0.342***	−0.343***	−0.312***	−0.230***
	(0.014)	(0.013)	(0.014)	(0.014)	(0.014)	(0.024)
WA4	−0.236***	−0.237***	−0.262***	−0.265***	−0.243***	−0.166***
	(0.016)	(0.016)	(0.015)	(0.015)	(0.016)	(0.021)

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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
CHPW ×						
WA1	0.122***	0.123***	0.155***	0.157***	0.123***	0.065***
	(0.019)	(0.019)	(0.020)	(0.021)	(0.019)	(0.016)
CA2/WA2	−0.241***	−0.242***	−0.269***	−0.271***	−0.251***	−0.184***
	(0.017)	(0.017)	(0.018)	(0.018)	(0.017)	(0.022)
CA3/WA3	−0.532***	−0.534***	−0.601***	−0.610***	−0.551***	−0.361***
	(0.036)	(0.036)	(0.032)	(0.032)	(0.035)	(0.048)
WA4	−0.248***	−0.249***	−0.279***	−0.282***	−0.258***	−0.173***
	(0.022)	(0.022)	(0.022)	(0.023)	(0.022)	(0.025)
Group Health/Kaiser ×						
WA1	−0.113***	−0.112***	−0.111***	−0.110***	−0.112***	−0.094***
	(0.010)	(0.011)	(0.012)	(0.012)	(0.011)	(0.010)
CA2/WA2	−0.159***	−0.159***	−0.176***	−0.174***	−0.163***	−0.129***
	(0.011)	(0.011)	(0.012)	(0.013)	(0.011)	(0.013)
CA3/WA3	−0.727***	−0.730***	−0.821***	−0.831***	−0.737***	−0.454***
	(0.056)	(0.055)	(0.047)	(0.047)	(0.053)	(0.066)
WA4	−0.019*	−0.019	−0.013	−0.012	−0.019	−0.018**
	(0.012)	(0.012)	(0.013)	(0.014)	(0.012)	(0.008)
Moda ×						
WA1	−0.200***	−0.200***	−0.227***	−0.230***	−0.204***	−0.125***
	(0.019)	(0.019)	(0.018)	(0.018)	(0.019)	(0.019)
CA2/WA2	0.046***	0.046***	0.049***	0.051***	0.045***	0.013
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.010)
CA3/WA3	−0.478***	−0.482***	−0.550***	−0.574***	−0.466***	−0.280***
	(0.044)	(0.043)	(0.038)	(0.039)	(0.039)	(0.046)
WA4	−0.361***	−0.362***	−0.409***	−0.415***	−0.367***	−0.225***
	(0.032)	(0.031)	(0.030)	(0.030)	(0.031)	(0.034)
Premera/Lifewise ×						
WA1	0.040***	0.040***	0.059***	0.061***	0.043***	0.018**
	(0.011)	(0.011)	(0.013)	(0.013)	(0.011)	(0.008)
CA2/WA2	−0.087***	−0.087***	−0.097***	−0.095***	−0.090***	−0.078***
	(0.011)	(0.011)	(0.012)	(0.012)	(0.011)	(0.009)
CA3/WA3	−0.583***	−0.587***	−0.660***	−0.678***	−0.583***	−0.362***
	(0.046)	(0.045)	(0.039)	(0.039)	(0.042)	(0.053)

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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
WA4	-0.118^{***}	-0.119^{***}	-0.130^{***}	-0.133^{***}	-0.123^{***}	-0.074^{***}
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)
Nesting Parameter	0.356^{***}	0.358^{***}	0.407^{***}	0.412^{***}	0.366^{***}	0.234^{***}
	(0.023)	(0.023)	(0.019)	(0.019)	(0.022)	(0.032)

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 individual mandate sensitivity runs for Washington state.

Appendix D: Control Function Approach Results

Table 15: Control Function Regression Results

	California		Washington	
	Base	Control Function	Base	Control Function
Monthly Premium ($100)	-0.429^{***}	-0.506^{***}	-0.827^{***}	-0.879^{***}
	(0.027)	(0.024)	(0.025)	(0.038)
Actuarial Value (AV)	4.125^{***}	5.180^{***}	3.591^{***}	4.035^{***}
	(0.240)	(0.200)	(0.159)	(0.215)
HMO	-0.275^{***}	-0.212^{***}	1.009^{***}	0.986^{***}
	(0.016)	(0.011)	(0.085)	(0.140)
Deductible Ratio			-0.096^{***}	-0.074^{***}
			(0.008)	(0.011)
Max. OOP Ratio			0.010	0.097^{***}
			(0.009)	(0.016)
Premium ($100) ×				
138-250	-0.035^{**}	-0.031^{**}	0.367^{***}	0.372^{***}
	(0.017)	(0.015)	(0.012)	(0.015)
250-400	0.070^{***}	0.059^{***}	0.445^{***}	0.442^{***}
	(0.016)	(0.015)	(0.015)	(0.020)
400+	0.126^{***}	0.128^{***}	0.589^{***}	0.593^{***}
	(0.016)	(0.016)	(0.028)	(0.044)
Male	-0.059^{***}	-0.072^{***}	-0.089^{***}	-0.094^{***}
	(0.005)	(0.004)	(0.008)	(0.010)
0-17	-0.569^{***}	-0.889^{***}	-0.336^{***}	-0.629^{***}
	(0.027)	(0.028)	(0.050)	(0.037)
18-34	-0.616^{***}	-0.634^{***}	-0.553^{***}	-0.560^{***}
	(0.033)	(0.025)	(0.017)	(0.027)
35-54	-0.306^{***}	-0.289^{***}	-0.276^{***}	-0.276^{***}
	(0.016)	(0.012)	(0.012)	(0.017)
Smoker			-0.409^{***}	-0.398^{***}
			(0.024)	(0.028)
Black			-0.456^{***}	-0.444^{***}
			(0.034)	(0.052)
Asian			-0.093^{***}	-0.100^{***}
			(0.004)	(0.004)
White			0.057^{***}	0.061^{***}
			(0.002)	(0.003)
Family	-0.015^{***}	-0.153^{***}	-0.080^{***}	-0.126^{***}
	(0.003)	(0.006)	(0.009)	(0.010)

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Table 15 – *Continued from previous page*

	California		Washington	
	Base	Control Function	Base	Control Function
Year 2015	-0.019^{***}	-0.020^{***}	0.063^{***}	0.059^{***}
	(0.002)	(0.002)	(0.004)	(0.004)
Intercept				
Base	-3.866^{***}	-4.755^{***}	-3.187^{***}	-3.517^{***}
	(0.216)	(0.195)	(0.316)	(0.458)
138-250			-0.186^{**}	-0.005
			(0.078)	(0.077)
250-400			0.194	0.503^{***}
			(0.118)	(0.123)
400+	-0.676^{***}	-0.478^{***}	-0.802^{***}	-0.510^{***}
	(0.074)	(0.065)	(0.084)	(0.086)
Male	0.154^{***}	0.197^{***}	-0.024	0.018
	(0.026)	(0.026)	(0.024)	(0.025)
0-17	-2.350^{***}	-2.006^{***}	-9.661^{***}	-9.734^{***}
	(0.101)	(0.112)	(0.194)	(0.258)
18-34	-1.031^{***}	-1.194^{***}	-1.682^{***}	-1.750^{***}
	(0.048)	(0.046)	(0.025)	(0.036)
35-54	-1.099^{***}	-1.385^{***}	-0.531^{***}	-0.582^{***}
	(0.040)	(0.045)	(0.037)	(0.048)
Black			-1.016^{***}	-0.993^{***}
			(0.094)	(0.091)
Asian			-0.682^{***}	-0.710^{***}
			(0.039)	(0.041)
White			-1.412^{***}	-1.436^{***}
			(0.023)	(0.024)
Family	2.046^{***}	2.510^{***}	1.090^{***}	1.208^{***}
	(0.031)	(0.042)	(0.024)	(0.021)
Year 2015	0.327^{***}	0.317^{***}	0.124^{***}	0.133^{***}
	(0.029)	(0.030)	(0.020)	(0.027)
Mandate	0.479^{***}	0.197^{***}	0.095^{***}	-0.061^{*}
	(0.062)	(0.067)	(0.034)	(0.033)
Insurers				
Anthem	0.199^{***}	0.554^{***}		
	(0.030)	(0.033)		
Blue Shield CA	-0.276^{***}	0.128^{***}		
	(0.031)	(0.028)		
BridgeSpan			0.479^{***}	0.456^{***}

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Table 15 – *Continued from previous page*

	California		Washington	
	Base	Control Function	Base	Control Function
			(0.047)	(0.082)
Centene/Health Net	−0.438***	−0.183***	0.165***	0.124***
	(0.038)	(0.031)	(0.014)	(0.022)
Chinese Community	−0.077***	−0.068***		
	(0.026)	(0.025)		
CHPW			0.944***	1.022***
			(0.064)	(0.114)
Group Health/Kaiser	−1.210***	−0.823***	0.302***	0.272***
	(0.089)	(0.068)	(0.019)	(0.028)
LA Care	0.515***	0.723***		
	(0.054)	(0.051)		
Moda			0.715***	0.713***
			(0.063)	(0.111)
Molina	−0.798***	−0.541***		
	(0.061)	(0.047)		
Premera/Lifewise			1.227***	1.201***
			(0.091)	(0.152)
Sharp	−0.061**	0.170***		
	(0.028)	(0.027)		
Valley	−0.277***	−0.235***		
	(0.035)	(0.031)		
Western Health	0.186***	0.154***		
	(0.032)	(0.031)		
Rating Areas				
WA1			1.308***	1.358***
			(0.025)	(0.030)
CA2/WA2	2.311***	3.036***	1.205***	1.258***
	(0.156)	(0.171)	(0.025)	(0.032)
CA3/WA3	0.627***	1.325***	1.664***	1.622***
	(0.087)	(0.097)	(0.067)	(0.116)
WA4			0.862***	0.889***
			(0.033)	(0.050)
CA4/8	2.590***	3.246***		
	(0.117)	(0.129)		
CA5	1.861***	2.458***		
	(0.168)	(0.171)		
CA6	4.177***	4.507***		
	(0.160)	(0.149)		

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Table 15 – *Continued from previous page*

	California		Washington	
	Base	Control Function	Base	Control Function
CA7	2.434***	3.115***		
	(0.124)	(0.141)		
CA9	1.743***	2.452***		
	(0.099)	(0.114)		
CA10	−0.300***	0.249**		
	(0.101)	(0.108)		
CA11	0.399***	0.646***		
	(0.137)	(0.130)		
CA12	3.029***	3.303***		
	(0.118)	(0.115)		
CA14	−1.481***	−0.903***		
	(0.080)	(0.093)		
CA15	−0.755***	−0.366***		
	(0.096)	(0.092)		
CA16	0.765***	1.046***		
	(0.062)	(0.072)		
CA17	−0.189**	0.178**		
	(0.080)	(0.087)		
CA18	1.102***	1.429***		
	(0.067)	(0.078)		
CA19	0.764***	1.164***		
	(0.067)	(0.076)		
Anthem ×				
CA2/WA2	0.086***	−0.210***		
	(0.019)	(0.019)		
CA3/WA3	0.082***	−0.081***		
	(0.022)	(0.021)		
CA4/8	−0.452***	−0.686***		
	(0.034)	(0.032)		
CA5	−0.175***	−0.396***		
	(0.024)	(0.025)		
CA6	−1.945***	−1.821***		
	(0.134)	(0.104)		
CA7	−0.114***	−0.358***		
	(0.014)	(0.017)		
CA9	−0.161***	−0.420***		
	(0.017)	(0.020)		
CA10	−0.202***	−0.597***		

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Table 15 – *Continued from previous page*

	California		Washington	
	Base	Control Function	Base	Control Function
	(0.018)	(0.023)		
CA11	−1.727***	−1.584***		
	(0.120)	(0.092)		
CA12	−1.461***	−1.382***		
	(0.101)	(0.079)		
CA14	0.170***	−0.055**		
	(0.027)	(0.024)		
CA15	0.396***	0.355***		
	(0.041)	(0.036)		
CA16	−0.289***	−0.247***		
	(0.026)	(0.022)		
CA17	−0.915***	−0.846***		
	(0.068)	(0.054)		
CA18	−0.897***	−0.840***		
	(0.065)	(0.051)		
CA19	−0.458***	−0.436***		
	(0.035)	(0.028)		
Blue Shield ×				
CA2/WA2	0.366***	−0.009		
	(0.034)	(0.027)		
CA3/WA3	0.611***	0.153***		
	(0.053)	(0.041)		
CA4/8	0.276***	−0.018		
	(0.022)	(0.017)		
CA5	0.629***	0.239***		
	(0.051)	(0.039)		
CA6	−1.638***	−1.653***		
	(0.109)	(0.086)		
CA7	0.356***	0.126***		
	(0.027)	(0.020)		
CA9	0.060***	−0.329***		
	(0.015)	(0.017)		
CA10	0.062***	−0.265***		
	(0.016)	(0.017)		
CA11	−1.315***	−1.296***		
	(0.090)	(0.071)		
CA12	−1.130***	−1.117***		
	(0.078)	(0.062)		

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Table 15 – *Continued from previous page*

	California		Washington	
	Base	Control Function	Base	Control Function
CA14	0.704***	0.438***		
	(0.057)	(0.044)		
CA15	1.207***	1.084***		
	(0.093)	(0.075)		
CA16	0.318***	0.318***		
	(0.022)	(0.018)		
CA17	−0.214***	−0.249***		
	(0.014)	(0.012)		
CA19	0.298***	0.246***		
	(0.025)	(0.021)		
BridgeSpan ×				
WA1			0.000	0.037**
			(0.014)	(0.016)
CA2/WA2			0.117***	0.122***
			(0.021)	(0.025)
WA4			−0.353***	−0.314***
			(0.030)	(0.037)
Centene/Health Net ×				
WA1			−0.093***	−0.098***
			(0.010)	(0.010)
CA2/WA2			−0.303***	−0.331***
			(0.014)	(0.021)
WA4			−0.236***	−0.255***
			(0.016)	(0.022)
CA15	1.278***	1.161***		
	(0.098)	(0.078)		
CA16	0.363***	0.343***		
	(0.028)	(0.022)		
CA19	0.381***	0.284***		
	(0.031)	(0.025)		
CHPW ×				
WA1			0.122***	0.088***
			(0.019)	(0.019)
CA2/WA2			−0.241***	−0.276***
			(0.017)	(0.026)
CA3/WA3			−0.532***	−0.558***

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Table 15 – *Continued from previous page*

	California		Washington	
	Base	Control Function	Base	Control Function
			(0.036)	(0.058)
WA4			−0.248***	−0.284***
			(0.022)	(0.030)
Group Health/Kaiser ×				
WA1			−0.113***	−0.088***
			(0.010)	(0.012)
CA2/WA2	2.091***	1.693***	−0.159***	−0.161***
	(0.145)	(0.110)	(0.011)	(0.013)
CA3/WA3	1.982***	1.473***	−0.727***	−0.655***
	(0.142)	(0.107)	(0.056)	(0.088)
WA4			−0.019*	−0.013
			(0.012)	(0.012)
CA4/8	1.558***	1.188***		
	(0.108)	(0.081)		
CA5	2.047***	1.623***		
	(0.143)	(0.108)		
CA7	1.722***	1.419***		
	(0.118)	(0.089)		
CA10	1.471***	1.055***		
	(0.103)	(0.079)		
CA14	1.870***	1.622***		
	(0.129)	(0.098)		
CA15	2.335***	2.225***		
	(0.162)	(0.127)		
CA16	1.456***	1.418***		
	(0.098)	(0.077)		
CA17	1.074***	1.044***		
	(0.073)	(0.058)		
CA18	0.981***	1.002***		
	(0.066)	(0.054)		
CA19	1.365***	1.205***		
	(0.098)	(0.076)		
LA Care ×				
CA16	−0.791***	−0.729***		
	(0.066)	(0.054)		
Moda ×				

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Table 15 – *Continued from previous page*

	California		Washington	
	Base	Control Function	Base	Control Function
WA1			-0.200^{***}	-0.182^{***}
			(0.019)	(0.027)
CA2/WA2			0.046^{***}	0.011
			(0.015)	(0.014)
CA3/WA3			-0.478^{***}	-0.458^{***}
			(0.044)	(0.067)
WA4			-0.361^{***}	-0.349^{***}
			(0.032)	(0.046)
Premera/Lifewise ×				
WA1			0.040^{***}	0.059^{***}
			(0.011)	(0.011)
CA2/WA2			-0.087^{***}	-0.094^{***}
			(0.011)	(0.011)
CA3/WA3			-0.583^{***}	-0.539^{***}
			(0.046)	(0.071)
WA4			-0.118^{***}	-0.123^{***}
			(0.014)	(0.018)
Residual		0.001^{***}		0.001^{***}
		(0.000)		(0.000)
eta		0.004		-0.024^{***}
		(0.003)		(0.005)
Nesting Parameter	0.308^{***}	0.297^{***}	0.356^{***}	0.347^{***}
	(0.022)	(0.017)	(0.023)	(0.034)

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 16: Estimated Mean Own-Premium Elasticities and Semi-Elasticities (Control Function)

	California		Washington	
	Elasticity	Semi-Elasticity	Elasticity	Semi-Elasticity
Overall	-10.6	-26.8	-8.1	-22.3
Income (% of FPL)				
0-138	-10.6	-27.1	-11.7	-31.3
138-250	-11.0	-28.0	-8.2	-22.6
250-400	-9.9	-25.5	-7.6	-21.0
400+	-9.1	-23.7	-6.2	-17.5
Gender				
Female	-10.2	-25.9	-7.7	-21.2
Male	-11.0	-27.8	-8.6	-23.4
Age				
18-34	-14.7	-33.3	-11.0	-27.5
35-54	-10.6	-24.1	-8.4	-20.9
55+	-7.2	-16.3	-5.8	-14.5
Smoking Status				
Smoker			-11.2	-29.9
Non-Smoker			-7.5	-20.7
Race				
Asian			-9.2	-24.8
Black			-12.4	-32.8
White			-7.7	-21.0

Notes: Table shows mean own-premium elasticities and semi-elasticities in the estimation using the control function approach of Petrin and Train (2010). A plan's own-premium elasticity indicates the percentage change in enrollment for a 1 percent increase in its premium and is computed using equation (9). A plan's own-premium semi-elasticity indicates the percentage change in enrollment for a $100 increase in its annual premium and is computed using equation (10). I use the plan market shares as weights to compute the mean elasticities and semi-elasticities.

Table 17: Estimated Mean Elasticities and Semi-Elasticities for Exchange Coverage (Control Function)

	California		Washington	
	Elasticity	Semi-Elasticity	Elasticity	Semi-Elasticity
Overall	-1.2	-3.8	-1.2	-4.0
Income (% of FPL)				
0-138	-1.3	-3.9	-1.7	-5.7
138-250	-1.3	-4.0	-1.2	-4.2
250-400	-1.2	-3.6	-1.2	-4.0
400+	-1.1	-3.4	-1.0	-3.4
Gender				
Female	-1.2	-3.7	-1.1	-3.8
Male	-1.3	-4.0	-1.2	-4.2
Age				
18-34	-1.6	-4.6	-1.5	-4.7
35-54	-1.2	-3.3	-1.1	-3.6
55+	-0.8	-2.2	-0.8	-2.5
Smoking Status				
Smoker			-1.6	-4.9
Non-Smoker			-1.1	-3.4
Race				
Asian			-1.3	-4.2
Black			-1.8	-5.5
White			-1.1	-3.6

Notes: Table shows mean elasticities and semi-elasticities for exchange coverage by demographic group using the control function approach of Petrin and Train (2010). The mean elasticity for exchange coverage indicates the percentage change in exchange enrollment if all exchange premiums increase by 1 percent and is computed using equation (11). The mean semi-elasticity for exchange coverage indicates the percentage change in exchange enrollment if all annual exchange premiums increase by $100 and is computed using equation (12). I use the plan market shares as weights to compute the mean elasticities and semi-elasticities.

Appendix E: Computing Elasticities and Semi-Elasticities

This appendix provides equations for the elasticity and semi-elasticity estimates. The own-premium elasticity of demand ε_{ij} of household i for plan j equals

$$\begin{aligned}\varepsilon_{ij} &= \frac{\partial \ln q_{ij}(\mathbf{p})}{\partial \ln p_j} = \left(r_{ij} p_j \frac{\partial \ln q_{ij}(\mathbf{p})}{\partial p_{ij}} \right) \frac{\partial p_{ij}}{\partial p_j} \\ &= \overline{\alpha}_i r_{ij} p_j \left(\frac{1}{\lambda} + \left(\frac{\lambda - 1}{\lambda} \right) \frac{q_{ij}(\mathbf{p})}{\sum_j q_{ij}(\mathbf{p})} - q_{ij}(\mathbf{p}) \right) \end{aligned} \tag{9}$$

The own-premium semi-elasticity of demand ς_{ij} of household i for plan j equals

$$\begin{aligned}\varsigma_{ij} &= \frac{\partial \ln q_{ij}(\mathbf{p})}{\partial p_j} \times (100/12) \\ &= \overline{\alpha}_i \left(\frac{1}{\lambda} + \left(\frac{\lambda - 1}{\lambda} \right) \frac{q_{ij}(\mathbf{p})}{\sum_j q_{ij}(\mathbf{p})} - q_{ij}(\mathbf{p}) \right) \times (100/12) \end{aligned} \tag{10}$$

The exchange coverage elasticity of demand ϱ_i of household i equals

$$\begin{aligned}\varrho_i &= \sum_j q_{ij}(\mathbf{p}) \left[\frac{\partial \ln \left(\sum_j q_{ij}(\mathbf{p}) \right)}{\partial \ln p_j} \right] \\ &= \sum_j \left[\overline{\alpha}_i r_{ij} p_j q_{ij}(\mathbf{p}) \left(1 - \frac{q_{ij}(\mathbf{p})}{\sum_j q_{ij}(\mathbf{p})} \right) \right] \end{aligned} \tag{11}$$

The exchange coverage semi-elasticity of demand ϑ_i of household i equals

$$\begin{aligned}\vartheta_i &= \sum_j q_{ij}(\mathbf{p}) \left[\frac{\partial \ln \left(\sum_j q_{ij}(\mathbf{p}) \right)}{\partial p_j} \right] \\ &= \sum_j \left[\overline{\alpha}_i q_{ij}(\mathbf{p}) \left(1 - \frac{q_{ij}(\mathbf{p})}{\sum_j q_{ij}(\mathbf{p})} \right) \right] \times (100/12) \end{aligned} \tag{12}$$

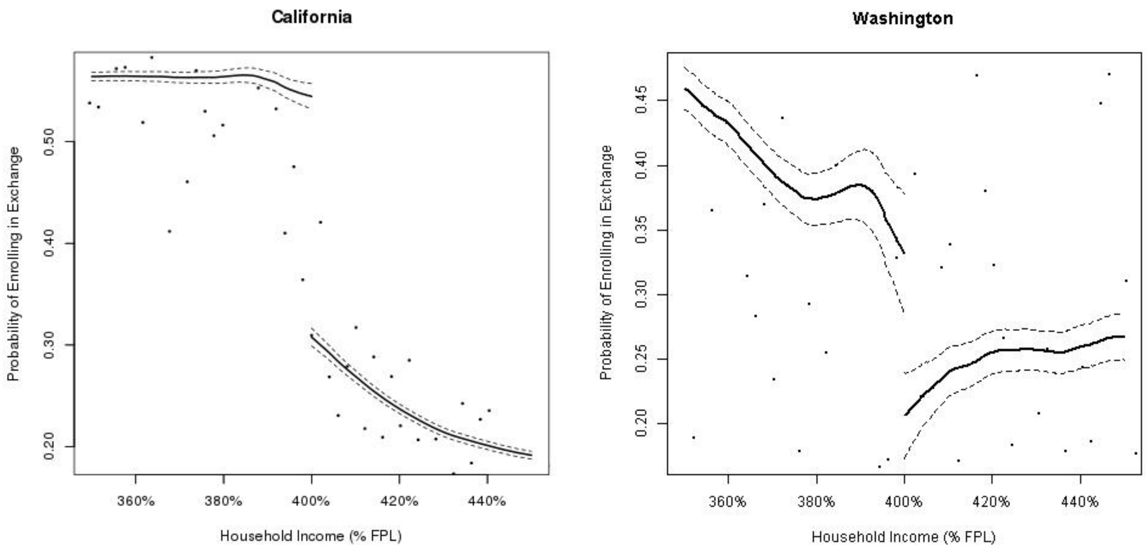
Appendix F: Reduced Form Results

Table 18: Regression Discontinuity Results on Exchange Enrollment Probability by State

	California	Washington
Premium Changes		
400% Subsidy Eligibility Threshold	-0.237^{***}	-0.125^{***}
	(0.010)	(0.036)
Age 21 Rating Curve Breakpoint	0.013	-0.041^{*}
	(0.017)	(0.018)
Mandate Exemptions		
Tax Filing Threshold	0.188^{***}	0.134^{***}
	(0.017)	(0.031)
Affordability Threshold	-0.006	-0.118^{***}
	(0.014)	(0.029)

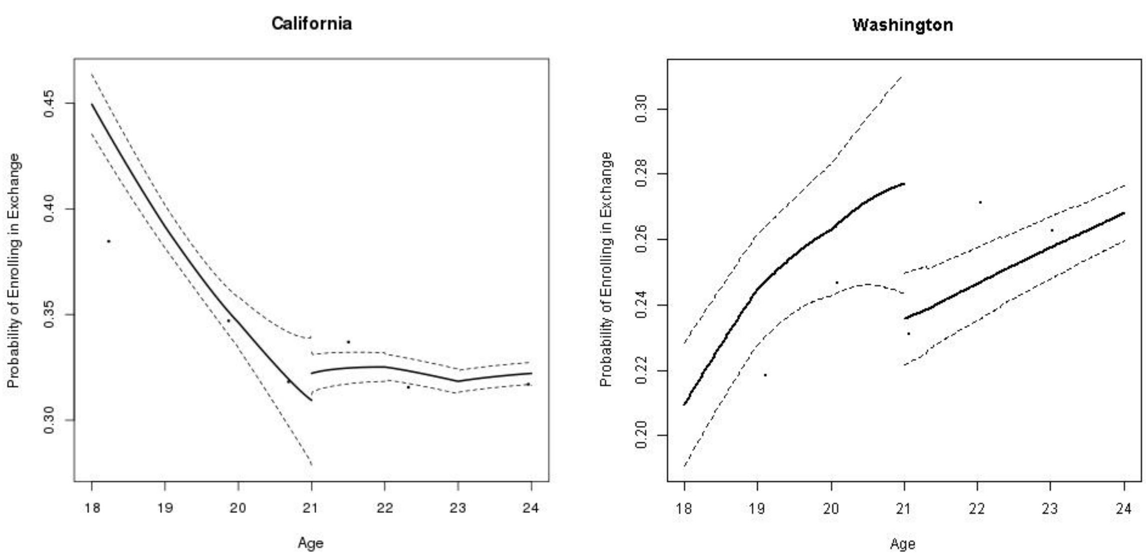
Notes: ***Significant at the 1 percent level. **Significant at the 5 percent level. *Significant at the 10 percent level. Robust standard errors are in parentheses. Table shows the results of four different regression discontinuity design regressions for each state in which the choice of enrolling in an exchange plan is regressed on dummy variables for whether (1) the household has income above the upper limit for receiving subsidies of 400 percent of FPL; (2) the consumer is above the age of 21 (3) the household has income above the tax filing threshold; and (4) the household has an affordable offer. Local linear regressions are performed on either side of the thresholds using a triangular kernel and the Imbens-Kalyanamaran optimal bandwidth calculation.

Figure 2: Probability of Enrolling in an Exchange Plan by Income



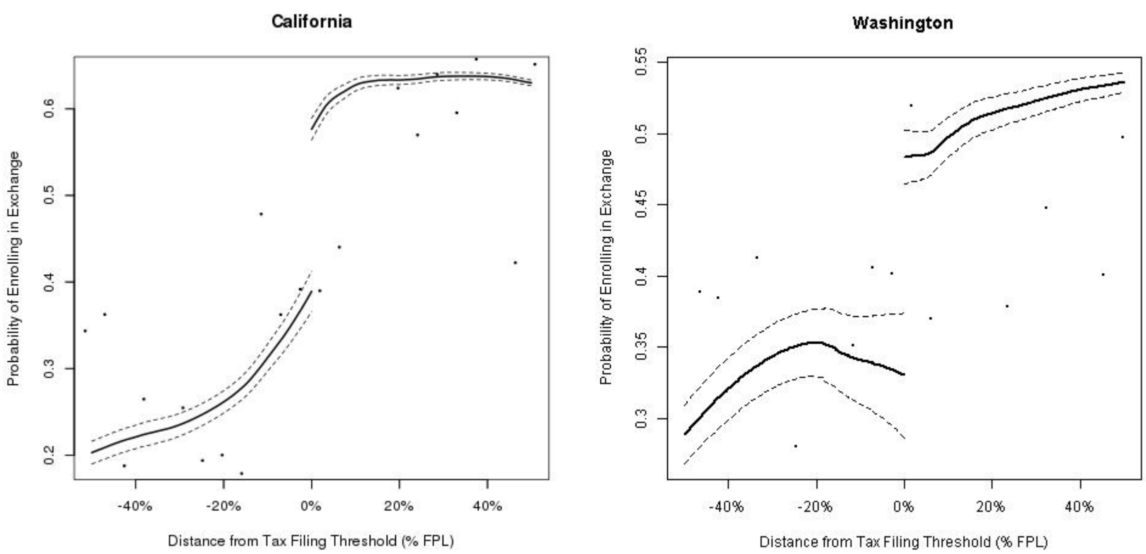
Notes: Figure shows how the probability of enrolling in an exchange plan changes at 400 percent of poverty, the upper income eligibility limit for receiving premium subsidies. Local linear regressions are performed on either side of the subsidy threshold using a triangular kernel and the Imbens-Kalyanamaran optimal bandwidth calculation.

Figure 3: Probability of Enrolling in an Exchange Plan by Age



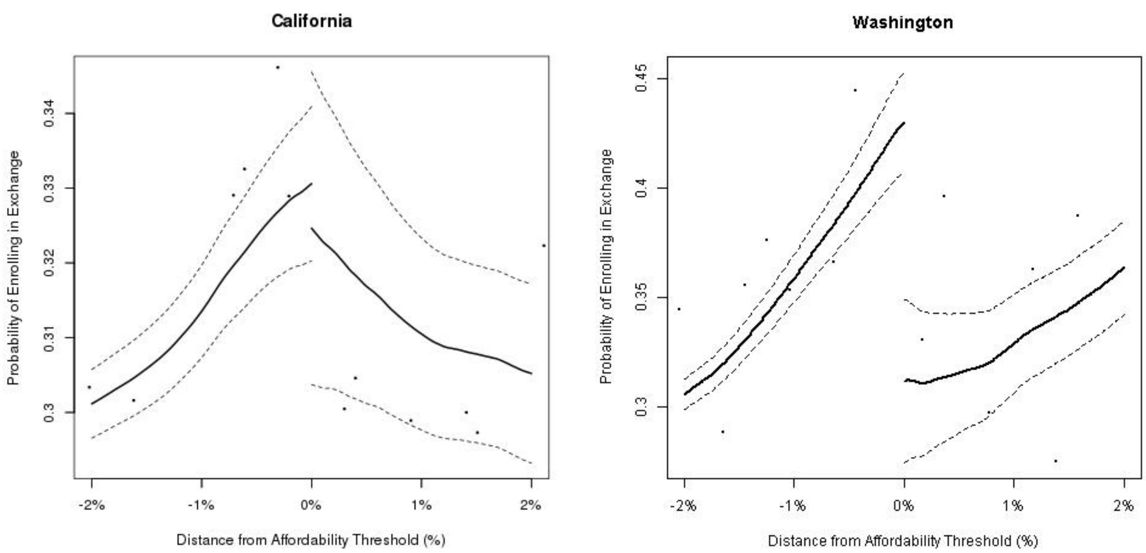
Notes: Figure shows how the probability of enrolling in an exchange plan changes at age 21. Local linear regressions are performed on either side of the age threshold using a triangular kernel and the Imbens-Kalyanamaran optimal bandwidth calculation.

Figure 4: Probability of Enrolling in an Exchange Plan by Tax Filing Status



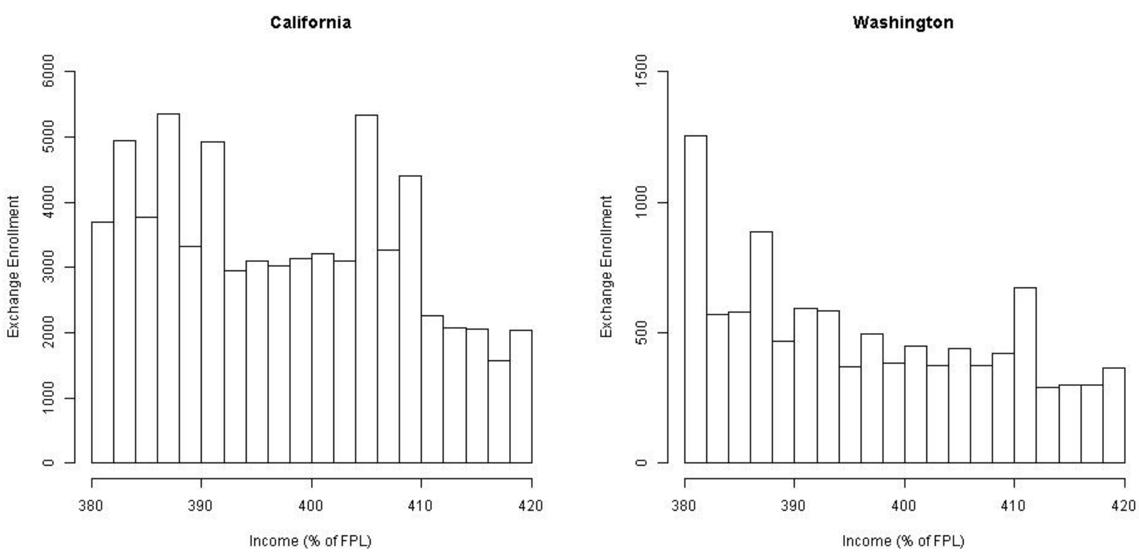
Notes: Figure shows how tax filing status affects the probability of enrolling in an exchange plan. Distance from tax filing threshold is the difference between the household's income and its tax filing threshold, measured as a percent of the poverty level. Local linear regressions are performed on either side of the tax filing threshold using a triangular kernel and the Imbens-Kalyanamaran optimal bandwidth calculation.

Figure 5: Probability of Enrolling in an Exchange Plan by Affordability Exemption Status



Notes: Figure shows how affordability exemption status affects the probability of enrolling in an exchange plan. Distance from affordability threshold is the difference between the household's income and its affordability threshold, measured as a percent of household income. The affordability threshold was 8 percent of household income in 2014 and 8.05 percent of household income in 2015. Local linear regressions are performed on either side of the affordability threshold using a triangular kernel and the Imbens-Kalyanamaran optimal bandwidth calculation.

Figure 6: Exchange Enrollment by Income and State



Notes: Figure shows total exchange enrollment in California and Washington for enrollees with incomes between 380 and 420 percent of the federal poverty level (FPL).