Adverse Selection in ACA Exchange Markets: Online Appendix

By Matthew Panhans

The first section of this Appendix provide further details of the ACA, including the Essential Health Benefits (EHB) required for insurance plans, and an explanation of how the premium tax credits work. Section B is the data appendix describing the steps used to determine the sample for estimation. Section C provides the details of the Chronic Condition Indicator tool. Section D includes the theoretical model which guides the empirical specifications and in particular shows why the main specification provides a lower bound of the effect of selection on the extensive margin. Section E provides the details of the model used in the welfare exercise and policy evaluation. Finally, Section F includes the Appendix Figures and Tables.

A. Affordable Care Act Details

A1. Essential Health Benefits

The Affordable Care Act's the Essential Health Benefits[1] are:

1) Ambulatory patient services (Outpatient care)
2) Emergency Services (Trips to the emergency room)
3) Hospitalization (Treatment in the hospital for inpatient care)
4) Maternity and newborn care
5) Mental health services and addiction treatment
6) Prescription drugs
7) Rehabilitative services and devices
8) Laboratory services
9) Preventive services, wellness services, and chronic disease treatment
10) Pediatric services

[1]See "ObamaCare Essential Health Benefits," http://obamacarefacts.com/essential-health-benefits/.

All qualified health plans (QHPs) sold in the individual and small group must cover these ten essential benefits beginning January 1st, 2014. However, the exact scope of services offered can vary. Grandfathered plans are not required to meet these requirements, though they will generally meet some of them.

QHPs must also cover at least 60% of out-of-pocket expenses on average, and must have reasonable annual out-of-pocket maximums. Most common services such as preventative services and wellness visits have no cost sharing. In addition, there are no annual or lifetime limits on Essential Health Benefits.

A2. How do premium tax credits work?

The premium tax credits give premium assistance to those earning below 400% of the federal poverty line (FPL) by capping the share of income that an individual or family would have to pay for health insurance. For example, a family of four earning 200% FPL makes \$3,925 per month. In the 200% FPL bracket, the ACA requires that the family should spend no more than 6.3% of income on health insurance, or \$247 per month. If in this rating area, the second lowest cost silver plan was \$400 per month, the family would be eligible for a monthly subsidy of \$400-\$247 = \$153. This \$153 could be applied to any plan available in the location.

B. Data Appendix

The sample used in estimation includes all individual in Colorado's non-group market in 2014, as well as 2013 for the placebo checks. This data appendix provides a step-by-step description of how the dataset used for estimation is constructed.

I begin by importing all individuals in the insurers' member eligibility files, excluding those on Medicaid, Medicare, or Medigap coverage or those who have have indicated "No" to whether it is the individual's primary insurance coverage. Dental plans are also dropped. In order to isolate individuals in the non-group market in 2013 and 2014, several variables are used because although there is a variable for "market category", there is some inconsistency across payers in how this variable is coded. For some payers, the market category code clearly distinguishes the large group, small group, and non-group markets. For other payers, a combination of the "group policy number" and "coverage type" variables seemed to give a fairly good indication of whether individuals were participating in the non-group market. Having isolated those insured in the non-group market in 2013 and 2014, these individual are then linked to their medical claims for profession, outpatient, inpatient, and pharmacy claims generated during the years 2013 and 2014.

Each individual's location in this sample is identified by a 5-digit zip code of residence. In order to construct pairs of neighboring 5-digit zip codes that could be used as comparison groups, I started with a shapefile of all zip codes in the state, and constructed a matching of each zip with all of its neighboring zip codes. I then kept only matched zip code pairs that were neighbors and also (1) belonged to different rating areas while (2) belonging to the same local medical market. Pairs that shared a border of less than .1 of a mile, or were only neighbors based on a common node (i.e. shared a border length of 0, but intersected at a corner) were excluded. For the primary estimation, zip codes A and B were paired into a "zip code group" if zip A's closest neighbor (in terms of sharing the largest border) was B, and vice versa.

The sample used for estimation includes all individuals determined to be in the non-group market, and who also live in a zip code that was paired with another zip code that belonged to another rating area in 2014. The sample was also restricted to include only individuals below age 65, and only individuals who were insured for at least 9 months of 2014.

For the welfare exercises, I need to calculate an estimate of the distribution of ages in the entire non-group market, including both individuals who are uninsured as well as those who are uninsured. I do this by combining the observed numbers of uninsured individuals in the sample of boundary zip codes with statewide estimates of take-up rates from the Colorado Health Access Survey (CHAS). For example, suppose each individual has been grouped into one of four age bins denoted by i. For each age bin, the observed number of insured individuals is denoted obs_i. The survey data provides an estimate of the take-up rate for bin i, denoted $takeup_i$. Supposing that the total number of individuals in the market from age bin i is $total_i \cdot takeup_i = obs_i$, then the unobserved total number of individuals can be solved for using the two observed quantities by:

$$total_i = \frac{obs_i}{takeup_i}$$

C. Chronic Conditions Indictor tool

The chronic condition regressions use the Healthcare Cost and Utilization Project's (HCUP) Chronic Condition Indicator (CCI) tool, which categorizes ICD-9 diagnosis codes as indicators of chronic or non-chronic conditions.

The tool also categorizes the ICD-9 diagnosis codes into one of 18 body system indicators, which are as follows:

1: Infectious and parasitic disease
2: Neoplasms
3: Endocrine, nutritional, and metabolic diseases and immunity disorders
4: Diseases of blood and blood-forming organs
5: Mental disorders
6: Diseases of the nervous system and sense organs
7: Diseases of the circulatory system
8: Diseases of the respiratory system
9: Diseases of the digestive system

10: Diseases of the genitourinary system
11: Complications of pregnancy, childbirth, and the puerperium
12: Diseases of the skin and subcutaneous tissue
13: Diseases of the musculoskeletal system
14: Congenital anomalies
15: Certain conditions originating in the perinatal period
16: Symptoms, signs, and ill-defined conditions
17: Injury and poisoning
18: Factors influencing health status and contact with health services

D. Theoretical Underpinning of Empirical Analysis

D1. Model Setup

This section details the theoretical model underpinning the empirical estimation, an exercise which allows for a precise decomposition of the various margins over which individuals are able to adjust to premiums increasing, which effects are captured in the current analysis, and the direction of the biases caused by effects not explicitly captured in the analysis.

To do so, I first begin by introducing the relevant notation. Each individual receives a draw of private information from a distribution, denoted $\theta_i \sim F(\theta)$. An insurance contract j is a defined by a pair (ϕ_j, p_j), the plan generosity and monthly premium, respectively. For this example, let $j \in \{N, B, S\}$, that is the choice set consists of choosing no insurance, a bronze plan, or a silver plan.

Each i has a valuation v_{ij} for plan j. For example,

$$v_{ij} = \theta_i \phi_j - p_j + \varepsilon_{ij}$$

The heterogeneity in θ_i implies selection. A higher θ_i means an individual has a higher value for plan generosity. If θ_i is an individual's risk, then this model implies adverse selection. However, if θ_i were something like risk preference, such as a measure of risk aversion, then the selection would be advantageous.

Each i chooses how much healthcare to seek, $m_i(\theta_i, \phi_j)$, which is a function of both the individual's private information and their level of coverage. If there is no moral hazard, that means that the healthcare sought does not depend on coverage, and so $m(\theta_i)$. Moral hazard means that the behavior can change with the level of coverage.

The cost to the insurer from offering the policy to i is denoted $c(\phi_j, m(\theta_i, \phi_j))$. In the case without moral hazard, costs are denoted as $c(\phi_j, m(\theta_i))$, which is an increasing function of both arguments. Then the nature of selection depends on $\frac{\partial m(\theta_i, \phi_j)}{\partial \theta_i}$, where if this term is > 0 implying adverse selection, while < 0 implies advantageous selection.

D2. Use of Premium Variation

To illustrate the usefulness of premium variation, consider a simpler case where there are only two options, N, no insurance, or B, insurance with a bronze plan. We allow for the choice of healthcare expenditures to depend on the coverage level of the plan, so that $m(\theta_i, \phi_N) \neq m(\theta_i, \phi_B)$. Let $I(j)$ denote the population that chose option j.

With medical claims from individuals making both choices, one could compare the average expenditures from each choice, in the spirit of testing for a positive correlation between demand for insurance and expenditures:

$$E_\theta[m(\theta_i, \phi_B)|i \in I(B)] > E_\theta[m(\theta_i, \phi_N)|i \in I(N)]$$

However, finding this positive relationship could be due to either moral hazard even with random sorting (i.e. $m(\theta_i, \phi_B) > m(\theta_i, \phi_N)\,\forall i$), or it could be due to selection even if there is no moral hazard (i.e. $m(\theta_i, \phi_B) = m(\theta_i, \phi_N)\,\forall i$, but if $\theta_i > \theta_j \iff v_{iB} > v_{iN}, \implies m(\theta_i, \phi_B) > m(\theta_j, \phi_B)$). It could also be due to a combination of both effects.

Suppose exogenous premium variation is available which provides two populations with an identical distribution of $\theta_i \sim F$, but facing different premiums for choice B. Denote these populations as I^H and I^L for those facing higher and lower premiums, respectively. The difference in the two populations will be how marginal individuals respond to the different premiums. If the first individuals to drop out of the insurance market (switch from B to N) are relatively healthy, and thus the market is adversely selected, that means a low $\theta \implies$ low m. An empirical implication of this pattern is that:

$$E_\theta[m(\theta_i, \phi_B)|i \in I^H(B)] > E_\theta[m(\theta_i, \phi_B)|i \in I^L(B)]$$

Thus the average costs of the insured populations can be compared as a test for the existence of adverse selection. This is exactly the logic developed in Einav, Finkelstein, and Cullen (2010).

D3. Market with More Than Two Choices

This logic is slightly complicated by the existence of more than two choices, where there is a menu of plan generosity available. In addition, there is a general problem that medical claims datasets will typically not include information on the uninsured. In my particular context, there is an additional problem that the exact plan details are not always available, so that information such as whether the insured individual is in a bronze or silver plan is known only for a subsample of the observations.

Recall that the premium variation provides two populations, I^H and I^L. To match my empirical context, assume here that the high premium side means that all insurance plans (all metal levels) are more expensive for the I^H population than for the I^L population, relative to remaining uninsured (denoted choice N). If the choice of an individual's metal level is not known, one could start by simply comparing the costs to the insurer in each insured population, which would be equivalent to running the test of whether:

$$E_\theta[c(\phi_S, m(\theta_i, \phi_S))|i \in I^H(S)] \cdot \frac{I^H(S)}{I^H(S) + I^H(B)} + E_\theta[c(\phi_B, m(\theta_i, \phi_B))|i \in I^H(B)] \cdot \frac{I^H(B)}{I^H(S) + I^H(B)}$$
$$> E_\theta[c(\phi_S, m(\theta_i, \phi_S))|i \in I^L(S)] \cdot \frac{I^L(S)}{I^L(S) + I^L(B)} + E_\theta[c(\phi_B, m(\theta_i, \phi_B))|i \in I^L(B)] \cdot \frac{I^L(B)}{I^L(S) + I^L(B)}$$

However, there are three effects that can cause this inequality to hold:

- (i) Selection on Extensive Margin (main effect of interest)
- (iia) Selection on Intensive Margin
- (iib) Moral Hazard on Intensive Margin

Note that by making this comparison only on the insured sample, moral hazard on the extensive margin, that is, individual behavior changes when uninsured compared to being insured, are controlled for. There may exist such an effect, but the estimated effects from the other channels are estimated taking moral hazard on the extensive margin as given.

The effect (iia) occurs because even without moral hazard or adverse selection, plan generosity changes. That is, even for the same level of healthcare utilized m_i, $c(\phi_B, m_i) < c(\phi_S, m_i)$ because the silver plan is more generous than the bronze plan, and this will incur higher claims for the insurer. Even without moral hazard, this (iia) effect will lead to an underestimation of the selection effect when comparing expenditures across the H and L populations.

Rather than estimating the difference in average costs incurred by the plan, using the total medical expenditure $m(\theta_i)$ will address the effect of (iia) by controlling for plan generosity. Indeed, even in the presence of adverse selection, estimating the average costs incurred by the plan can lead to no effect because of the countering effect of changing plan generosity. For example, this can occur if the average costs to the plan of both the silver and bronze plans increase, but as a greater share of individuals are in the bronze plan, the average cost to the plan of the entire population can be flat or even decrease.

Thus, in my empirical estimation, I use the total annual medical expenditure of an individual, which corresponds to $m(\phi_j, \theta_i)$ in this model, because it controls for plan generosity and thus addresses the effect (iia). This corresponds then to testing for the following relationship:

$$E_\theta[m(\theta_i,\phi_S)|i\in I^H(S)]\cdot\frac{I^H(S)}{I^H(S)+I^H(B)}+E_\theta[m(\theta_i,\phi_B)|i\in I^H(B)]\cdot\frac{I^H(B)}{I^H(S)+I^H(B)}$$
$$>E_\theta[m(\theta_i,\phi_S)|i\in I^L(S)]\cdot\frac{I^L(S)}{I^L(S)+I^L(B)}+E_\theta[m(\theta_i,\phi_B)|i\in I^L(B)]\cdot\frac{I^L(B)}{I^L(S)+I^L(B)}$$

Though this test controls for moral hazard on the extensive margin and selection on the intensive margin, there remains the effect of selection on the extensive margin (the effect of interest), but this could be biased by the effect of moral hazard on the intensive margin (effect (iib)).

However, theory predicts that moral hazard is not symmetric, but rather the logic of moral hazard implies that utilization should not increase as plan generosity decreases. That is, $m(\theta_i,\phi_B)\leq m(\theta_i,\phi_S)\,\forall i$. This allows for a sign to be placed on the bias from moral hazard on the intensive margin, and it can be shown that this will lead to an underestimate of the selection effect (i).

If there were exogenous premium variation available across each plan available, one could estimate the costs of the switchers between each level of plan generosity, and quantify the relative effects of (i) and (iib). However, the premium variation I have available in this context makes all plans more expensive relative to the outside option of remaining uninsured, N. Thus, my analysis focuses on this extensive margin. The point of this section is that although this premium variation from rating area boundaries does not lend itself to quantifying the effects of moral hazard on the intensive margin, to the extent that it exists, it should only lead to an underestimate of the main effect of interest: selection on the extensive margin.

E. Welfare Exercise and Policy Evaluation Details

This section describes the details and shows all equations used for the calculation of the welfare estimates.

Framework

I first impose that there exists a competitive equilibrium point $(p_{\text{eq}}, q_{\text{eq}})$ at the observed share of the non-group population that is insured, such that insurers break-even by earning enough premiums to offset their incurred costs. This implies that the market demand and average cost curves will intersect at this point. I then assume linear demand and cost curves (later I also relax this), and derive the equations for the curves using my estimates from the demand and cost regressions and linearizing around the equilibrium point. With linear forms for the demand and cost equations, it then also becomes straightforward to derive a simple form of the marginal cost curve as well:

$$D=\alpha+\beta\cdot q$$

$$AC = \gamma + \delta \cdot q$$

$$MC = \frac{\partial TC(q)}{\partial q} = \frac{\partial (AC(q) \cdot q)}{\partial q} = \frac{\partial}{\partial q}(\gamma q + \delta q^2) = \gamma + 2\delta q$$

The competitive equilibrium, where the average cost and demand curves intersect, is the break-even pricing for insurers. The efficient allocation occurs where the marginal cost and demand curves intersect. At this point all individuals whose valuation for insurance is higher than their costs are insured. With the linear form for the curves, the efficient allocation give given by $q_{\text{eff}} = \frac{\alpha - \gamma}{2\delta - \beta}$ and $p_{\text{eff}} = \alpha + \beta q_{\text{eff}}$. Given my estimates, however, the demand and marginal cost curves do not intersect over the range of the share insured $\in [0, 1]$, and because demand is always higher than marginal costs, this suggests that the efficient allocation is full insurance.

With this framework it is simple to calculate various welfare quantities of interest. The amount of welfare loss to the marginal consumer is $D(q_{\text{eq}}) - MC(q_{\text{eq}})$. The welfare loss due to selection is the area above the marginal cost curve but below the demand curve, between q_{eq} and q_{eff}. Selection raises average premiums for silver plans from p_{eff} to p_{eq}. The linear specification is likely an upper bound on the welfare loss, particularly given the divergence between the demand and marginal cost curves, which leads to large welfare implications as the share insured approaches 1. For this reason, my preferred specification assumes a non-linear functional form. Specifically, because the parameter estimates from the research design can be interpreted as elasticities, I repeat the analysis assuming constant elasticity functional forms, and directly plug in my parameter estimates for the average cost (shown in Figure AIV).

To obtain standard errors on the welfare estimates, I use the bounds on the 95% confidence interval for the cost estimates and compute the welfare quantities. A sensitivity analysis suggests that the welfare estimates do not vary much given the chosen demand estimates for a reasonable range. In the preferred CES specification, the estimated monthly welfare loss of \$25.70 has a 95% confidence interval from \$0.70 to \$51.30. For the linear case, the estimated welfare loss was \$43.80, with the 95% confidence interval ranging from \$0.80 to \$93.80.

Premium Subsidies

One tool that can be used to increase coverage and address adverse selection is to subsidize consumer premiums. Funding the premium subsidies is not costless, however. Implementing subsidies to achieve the efficient level of coverage should only be undertaken if the welfare gains outweigh the costs of funding the subsidies. To illustrate the evaluation of a subsidy policy, suppose the linear functional form for the cost and demand curves:

$$p_D = \alpha + \beta \cdot q$$

$$AC = \gamma + \delta \cdot q$$

The equilibrium in a competitive market is given by the break-even condition:

$$
\begin{aligned}
p_D &= AC \\
\alpha + \beta \cdot q &= \gamma + \delta \cdot q \\
q_{eq} &= \frac{\alpha - \gamma}{\delta - \beta} \\
p_{eq} &= \alpha + \beta \cdot q_{eq}
\end{aligned}
$$

Adverse selection causes under-insurance relative to an efficient level ($q_{\text{eq}} < q_{\text{eff}}$).

To evaluate the welfare effects of the policy, now suppose a subsidy of \$s per person is provided to consumers for the purchase of health insurance. Thus, when insurers post some price p_S, consumers effectively face the price $p_D \equiv p_S - s$. The equilibrium with a subsidy in a competitive market will be a quantity q_S such that:

$$p_D(q_S) + s = AC(q_S)$$

This is the point at which the total revenue to insurers will be equal to the total costs incurred.

Solving for q_S:

$$
\begin{aligned}
\alpha + \beta \cdot q + s &= \gamma + \delta \cdot q \\
\alpha + s\ \gamma &= (\delta - \beta) \cdot q \\
q_S &= \frac{\alpha + s - \gamma}{\delta - \beta} \\
p_S &= \alpha + \delta \cdot q_S
\end{aligned}
$$

Thus for any given subsidy amount s, these equations yield new equilibrium prices and quantities (q_S, p_S). The change in welfare resulting from the subsidy policy is then the increase in consumer surplus minus the cost of the policy:

$$
\begin{aligned}
\Delta W &= CB - C \\
&= \int_{q_{\text{eq}}}^{q_{\text{s}}} (D(q) - MC(q))dq - q_s \cdot s
\end{aligned}
$$

Benefits from subsidies exist if the value of coverage exceeds marginal cost for consumers between q_{eq} and q_{s}. The evidence of adverse selection suggests that this is the indeed the case in Colorado. However, this benefit needs to be weighed against the cost of the subsidy, $q_s \cdot s$, which is provided to all consumers (including infra-marginal consumers). In the next section, I use this approach to evaluate both an age-targeted premium subsidy, and a blanket subsidy provided to everyone without conditioning on age in any way.

Age-targeted Premium Subsidies

To take into account the age heterogeneity, I proceed as before but deriving separate curves by age:

$$D = \alpha_{\text{AGE}} + \beta_{\text{AGE}} \cdot q$$

$$AC = \gamma_{\text{AGE}} + \delta_{\text{AGE}} \cdot q$$

$$MC = \gamma_{\text{AGE}} + 2\delta_{\text{AGE}} \cdot q$$

The same welfare quantities can then be computed as before, and each weighted by the share of the non-group market in each age bin. This approach allows for costs to reflect a changing age distribution of the insured pool, as allowed for in Tebaldi (2016), as well as to reflect selection within any age group.

The welfare effects of additional subsidies can be computed using the age-specific demand, average cost, and marginal cost curves, averaging across age bins weighted by the population share for each bin. Specifically, suppose there is an \$$s$ premium subsidy targeted at the 25-34 age group. In a competitive market, the equilibrium price will move to a point where insurers are breaking even taking into account the subsidy. This implies that insurers could lose up to \$$s$ per person, and still break even. In the first case I consider where insurers break even by each age group, the new equilibrium quantity supported is given by the quantity q_{s} that solves: $AC_{\text{AGE}}(q_s) - D_{\text{AGE}}(q_s) = s$ and must hold for all age groups. With linear curves that intersect at most once, this subsidy equilibrium quantity q_s will be unique for any given s. The equilibrium price that achieves q_s will be $p_s = D_{\text{AGE}}(q_s) + s$. The cost of such a subsidy is $q_s \times s$, and the benefit will be the area between q_{eq} and q_s that lies above the marginal cost curve but below the demand curve.

When pricing on age is not flexible, but restricted as required by the ACA, the gains from using age-targeted premiums will be mitigated, but still present and will create spillovers as discussed above, so that even age groups that do not receive subsidies can benefit. Rather than decreasing the premium for only the subsidized age group as the average cost of that age group fall, insurers would need to decrease the premiums for all age groups to maintain the 3:1 pricing distribution. This induces spillovers to non-targeted age groups. For example, consider that given the estimates from this study, the 55-64 age group receives essentially no direct subsidy in the optimal case, while the 35-44 and 25-34 age groups are heavily subsidized. However, the unsubsidized 55-64 age group still experiences a net benefit. This is because although they receive no subsidy, as healthy individuals in the subsidized age groups enter the market, the marketwide average costs fall and thus insurers lower premiums. Keeping the ACA age pricing ratio means that the premiums will fall for all groups, and thus even those that are not subsidized receive a benefit. Overall, the benefit/cost ratio for the age-targeted subsidies with the ACA pricing restrictions are 1.1, suggesting that the benefits are greater than the costs. But when taking into account a cost of public funds of 1.3, this policy is no longer clearly cost effective. Under a pricing ratio of 5:1 or 7:1, however, the subsidies would have effects closer to the first case, and perhaps be cost effective.

Non-linear specifications

Alternatively, the equilibrium can be derived using demand and average cost curves that are non-linear. In particular, since I estimate parameters that can be interpreted as elasticities, I can assume that the demand and cost curves exhibit an isoelastic functional form. Specifically the curves have the form:

$$D(p) = \alpha_{AGE} \cdot p^{\beta_{AGE}}$$

$$AC(p) = \gamma_{AGE} \cdot p^{\delta_{AGE}}$$

Here, β_{AGE} and δ_{AGE} are quantities estimated directly from regressions using the research design, with the demand coefficient β_{AGE} coming from a $\log - \log$ specification regressing share insured on premiums. α_{AGE} and γ_{AGE} are, as before, pinned down by imposing a break-even equilibrium. The same logic as the linear case applies to calculate the welfare quantities of interest, the only difference being that numerical integration is used in some calculations (for example, finding the area below the demand curve and above the marginal cost curve). Otherwise the same welfare exercises can be carried out using these new functional forms.

F. Appendix Figures and Tables

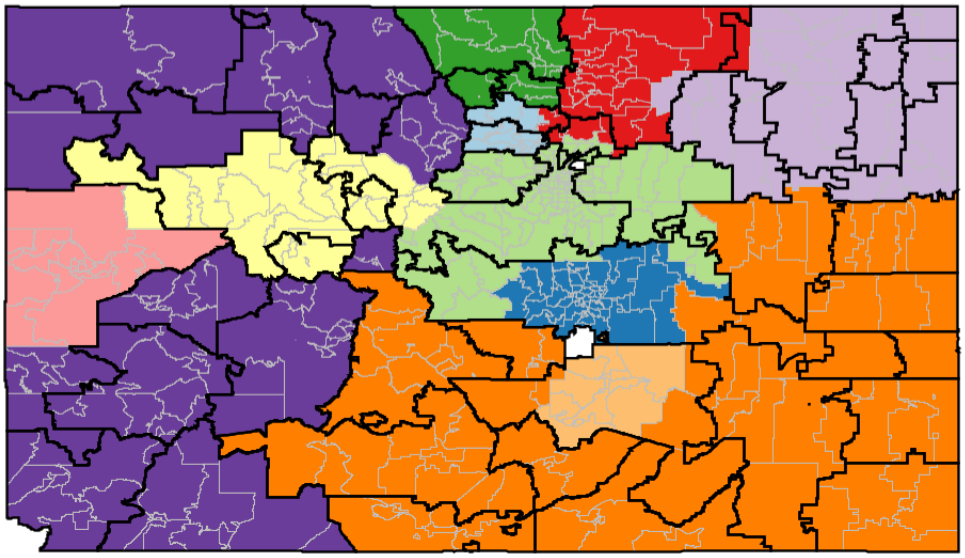
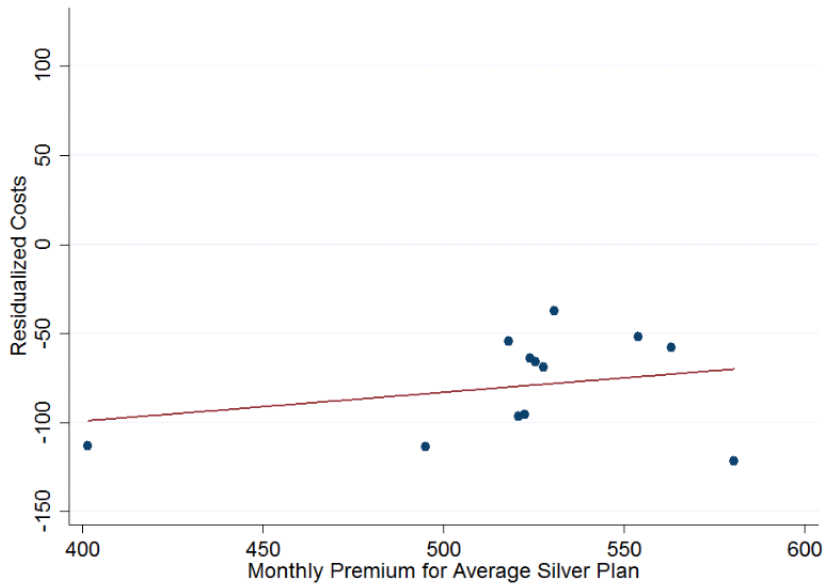
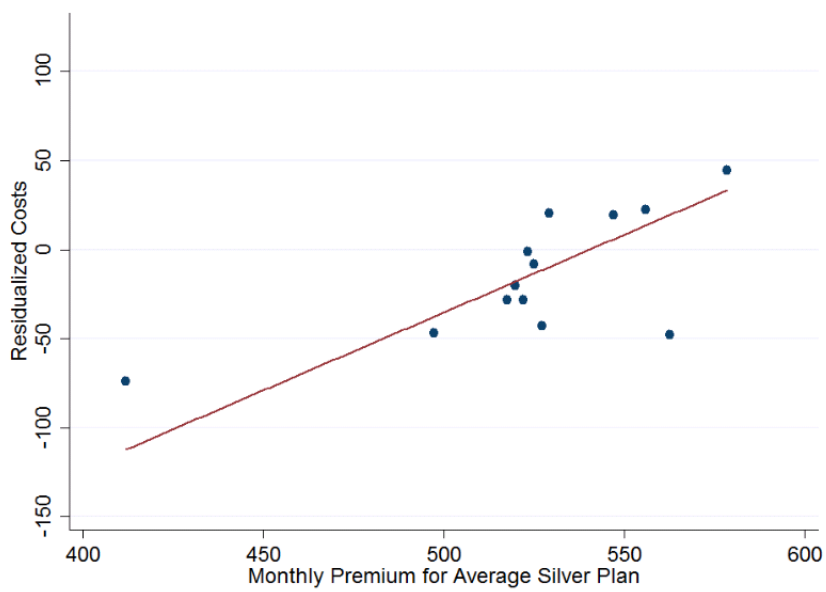


Figure AI. 2014 Rating Areas in Colorado.

Note: 5-digit Zip codes are shown grouped into Rating Areas based on color. The outlines designate the grouping of Zip codes into medical markets, here defined as the Hospital Service Areas (HSA).



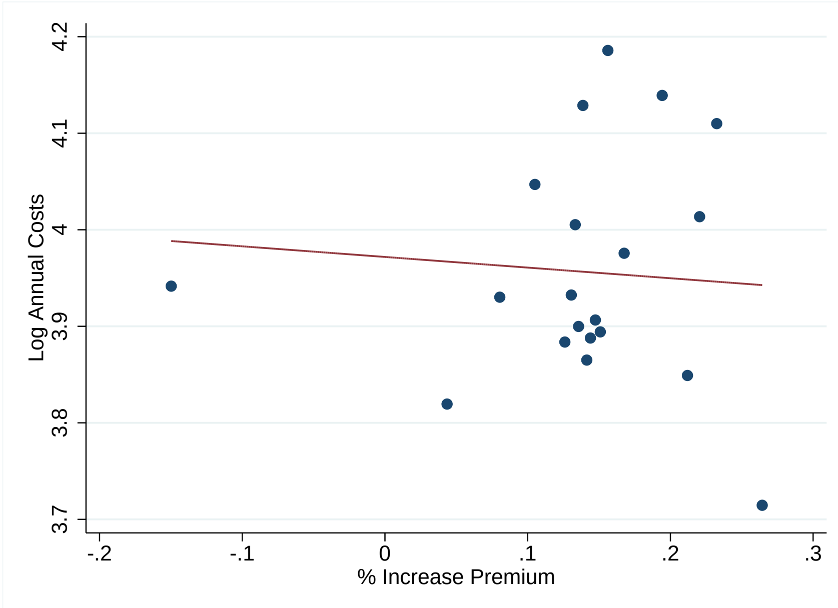
(a) 2013: Placebo Regression



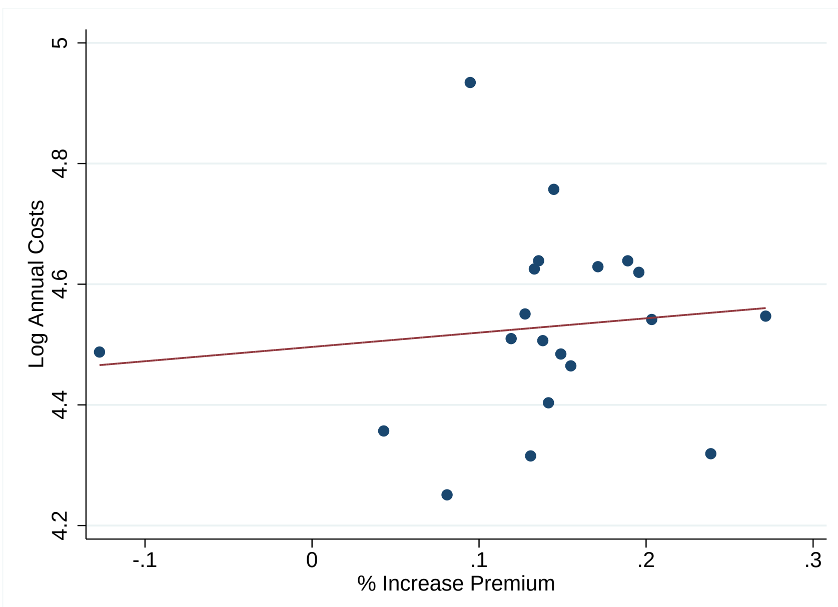
(b) 2014: Adverse Selection

Figure AII. Binned Scatterplot of Evidence of Selection Using Predicted Costs.

Note: These results show graphically the results from the regressions in Column (1) of Table A13. In these regressions, the dependent variable is predicted annual medical expenditures, based on each individual's age, gender, total number of chronic conditions, and type of chronic conditions by body system. The patterns corroborate the main results.



(a) 2013: Placebo Regression



(b) 2014: Adverse Selection

Figure AIII. Binned Scatterplot of Evidence of Selection Using Log-Log Specification.

Note: These results show graphically the results from the regressions in Column (1) of Table A9. These regressions include controls for each individual's age and gender, as well as zip code pair fixed effects. The patterns corroborate the main results.

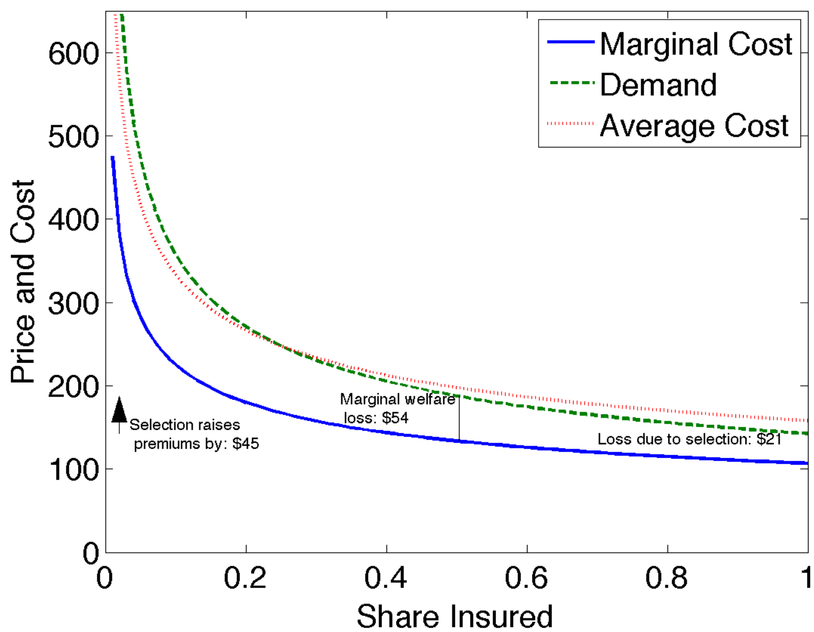


Figure AIV. Welfare estimates with constant elasticity functions.

Note: Because demand is always above marginal costs, this suggests the efficient allocation is full coverage. The calculated welfare loss due to selection is $21 per person per month.

Table A1—Healthcare Utilization in 2014 by Market Segment

	Newly Insured 2014	Previously Enrolled	Employer-Based
Inpatient Admissions	51	25	41
Outpatient Visit Rates	624	545	560
Professional Medical Services	7807	5103	7282
Pharmacy	9352	5349	9036

Note: Rates given as claims per 1,000 enrollees.

Table A2—Healthcare Expenditures of New Enrollees

	(1)	(2)	(3)
Previously Enrolled	-1077.4***	-807.6***	-829.3***
	(84.83)	(83.59)	(83.12)
Employer-Based Group	-1241.5***	-919.5***	-870.3***
	(89.80)	(85.13)	(79.32)
Female		64.72***	66.33***
		(24.88)	(24.80)
Constant	3521.4***	6093.7***	5952.6***
	(91.87)	(256.0)	(251.4)
Age FE	No	Yes	Yes
Zip3 FE	No	No	Yes
Observations	1377072	1377034	1377034

Note: This table compares the total annual medical expenditures in 2014 of new enrollees in the non-group market (omitted category) to those who were previously insured and those insured in the employer-sponsored group market. The results show that, even when controlling for age and geography, newly insured individuals spent on average $830 more compared to those who were previously insured in the non-group market, and $870 more than individuals in the group market. Standard errors in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A3—Average annual spending, by plan generosity

	mean	sd	p25	p50	p75
Platinum	15386.94	68386.93	415.37	1819.54	8588.33
Gold	5998.29	29711.6	350.06	978.13	2970.14
Silver	4852.28	23305.12	306.61	811.64	2410.25
Bronze	3225.78	16245.04	210.63	557.46	1475.1
Total	4716.4	24664.98	273.27	726.05	2164.83

Note: This table shows the average annual medical expenditures for individuals in the non-group market in 2014, by metal level. This positive correlation between plan generosity and spending is in the spirit of Chiappori and Salanié's test for asymmetric information. These patterns, however, cannot disentangle moral hazard from adverse selection.

Table A4—Balance in Choice Set Across Boundary

	Diff. # metal levels available	# Zip pairs	Diff. # insurers available	# Zip pairs
	0	16	0	8
	1	16	1	20
	2	0	2	4
Total		32		32

Note: This table shows the difference in the choice set within the 32 across-boundary pairs of zip codes matched using the HRR criteria for local medical market. The number of metal levels change across some boundaries because although Bronze, Silver, and Gold plans are available statewide, there are some areas in which no Platinum level plan is available. This is unlikely to affect selection on the extensive margin, however. Also, because insurers make county level entry decisions, there are some cases where the number of insurers offering plans changes across the rating area boundary. However, everywhere has at least 4 insurers operating with a fairly large menu of plans.

TABLE A5—EXTERNAL VALIDITY OF BOUNDARY SAMPLE

	Full Sample	Boundary Sample
Female, %	0.53	0.51
	(0.50)	(0.50)
Avg Age	35.61	36.42
	(18.88)	(19.18)
Population 18-34, %	23.47	20.45
	(8.83)	(5.58)
Population 35-64, %	41.63	43.63
	(5.74)	(5.95)
Median Age	38.25	40.28
	(5.50)	(5.86)
Less than H.S., %	6.77	10.69
	(6.16)	(6.64)
Bachelor's, %	27.81	22.54
	(9.53)	(10.43)
Labor Force Participation	69.89	67.17
	(6.62)	(10.59)
Per Capita Income	36308.30	30785.89
	(10212.73)	(9948.30)
Native Born Pop, %	91.89	91.24
	(5.04)	(5.49)
N	248273	15710

Note: Comparison of boundary sample to entire population insured in non-group market. The age and gender variables are from the medical claims database. Other variables are Zip code level demographics from the 5-year ACS (2010-2014).

Table A6—Evidence of Selection, Median Regressions

Panel A: 2013 (Placebo)

	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.0864	0.146	0.0803	0.143	-0.0425
	(0.159)	(0.171)	(0.158)	(0.175)	(0.185)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	10422	10422	10422	10422	10422

Panel B: 2014

	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.473**	0.578***	0.505***	0.418**	0.601***
	(0.188)	(0.215)	(0.191)	(0.172)	(0.153)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	9730	9730	9730	9730	9730

Panel C: 2015

	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.324	0.0268	-0.312	0.211	0.566
	(0.454)	(0.382)	(0.334)	(0.224)	(0.557)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	6996	6996	6996	6996	6996

Note:
This table shows estimates from regressions of annual medical expenditures on premiums, but estimating median regressions. All specifications also include age and gender fixed effects. Standard errors in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A7—Evidence of Selection, Quantile Regressions (p75)

Panel A: 2013 (Placebo)					
	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.249	0.679*	0.272	0.458	-0.0644
	(0.418)	(0.374)	(0.360)	(0.435)	(0.441)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	10422	10422	10422	10422	10422

Panel B: 2014					
	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	1.221**	1.428*	1.413**	1.139**	1.536***
	(0.515)	(0.740)	(0.567)	(0.463)	(0.463)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	9730	9730	9730	9730	9730

Panel C: 2015					
	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.749	0.702	-0.322	-0.0902	0.658
	(0.938)	(1.206)	(1.383)	(0.475)	(1.099)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	6996	6996	6996	6996	6996

Note:
This table shows estimates from regressions of annual medical expenditures on premiums, but estimating quantile regressions at the 75th percentile. All specifications also include age and gender fixed effects. Standard errors in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

TABLE A8—EVIDENCE OF SELECTION, BOOTSTRAPPED STANDARD ERRORS

Panel A: 2014					
	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.881***	1.028***	1.000***	0.762**	0.946*
	(0.321)	(0.510)	(7.67e-20)	(0.378)	(0.548)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	9180	9180	9180	9180	9180

Panel B: 2015					
	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.669	0.190	-0.0067	0.113	1.095
	(1.056)	(1.190)	(0.931)	(0.391)	(0.901)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	6648	6648	6648	6648	6648

Note: This table reproduces the results from Table 3, but deriving standard errors using the wild cluster bootstrap with 999 replications to address concerns of few clusters. The standard errors are generally very similar when bootstrapping or not, mitigating concerns that the few clusters problem is causing significant over-rejection of the null hypothesis in this case. The bootstrap estimation was implemented using the *cgmwildboot* Stata program written by Judson Caskey. Standard errors corrected for clustering at zip-pair level in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A9—Evidence of Selection

	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium % Increase	0.683*	0.881***	0.695**	0.989**	0.612***
	(0.347)	(0.291)	(0.338)	(0.422)	(0.173)
IV:					
Premium % Increase	0.747**	0.811**	0.732**	1.102**	0.618***
	(0.346)	(0.333)	(0.366)	(0.440)	(0.226)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	9735	9735	9735	9735	9735

Note: Results from regression of 2014 log residualized annual medical expenditures on % increase in premiums. The second row uses leave-out costs as an instrument for premiums. The columns represent different measures of changing premiums when stepping across the boundary. Column (1) is the change in the premium for the average silver plan. Columns (2)-(4) use the change in premium for the exact same silver plan offered by three statewide insurers (BlueCross BlueShield, Rocky Mountain Health Plan, New Health Ventures). Column (5) uses the change in premium for the second lowest cost silver plan (2LCS). The results generally imply that a 1% increase in the insurance premiums in an area increases the annual medical expenditures of the insured population by about 0.8%. Standard errors corrected for clustering at zip-pair level in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A10—Placebo IV Regressions

	2013 Non-group		2014 Group		2014 Medicaid	
Premium Measure:	AvgSilver	BCBS	AvgSilver	BCBS	AvgSilver	BCBS
Premium % Increase	0.274	0.289	-0.0301	-0.0347	-0.189	-0.220
	(0.367)	(0.387)	(0.214)	(0.248)	(0.239)	(0.289)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10429	10429	38516	38516	68007	68007

Note: Results from placebo test of regression of log annual medical expenditures on % increase in premiums, using leave-out costs as an instrument for premiums. The placebo test runs the same regression on samples whose behavior should not be affected by rating area boundaries. Standard errors corrected for clustering at zip-pair level in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A11—Breakdown by Age

	(1)
Premium % Increase	-0.0534
	(0.395)
Premium % Increase × Age in 2014	0.0447**
	(0.0213)
Premium % Increase × Age in 2014 × Age in 2014	- 0.000618***
	(0.000296)
Zip Pair FE	Yes
Observations	9730

Note: Results from median regression of log annual medical expenditures on % increase in Average Silver premiums, broken down by age. The significance on the quadratic age variables indicate that adverse selection appears to be driven primarily by individuals below age 55, and particularly for those ages 35-44, while less for 25-34. In this specification, there is little change in costs across the boundaries for individuals in the older 55-64 age group. Standard errors corrected for clustering at zip-pair level in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A12—Descriptives of Chronic Conditions

VARIABLES	(1) N	(2) mean	(3) sd
Infectious diseases	372,699	0.00273	0.0522
Neoplasms	372,699	0.0122	0.110
Endocrine and immunity disorders	372,699	0.109	0.312
Diseases of blood	372,699	0.00483	0.0693
Mental disorders	372,699	0.0598	0.237
Diseases of the nervous system	372,699	0.0640	0.245
Diseases of the circulatory system	372,699	0.0499	0.218
Diseases of the respiratory system	372,699	0.0559	0.230
Diseases of the digestive system	372,699	0.0222	0.147
Diseases of the genitourinary system	372,699	0.0492	0.216
Complications of pregnancy	372,699	0.000875	0.0296
Diseases of the skin	372,699	0.0113	0.106
Diseases of the musculoskeletal system	372,699	0.0540	0.226
Congenital anomalies	372,699	0.00795	0.0888
Ill-defined conditions	372,699	0.00491	0.0699
Injury and poisoning	372,699	0.000445	0.0211
Factors influencing health	372,699	0.00479	0.0691

Table A13—Predicted Costs with Chronic Conditions

Panel A: 2013 (Placebo)

	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.162	0.292	0.139	0.144	0.0654
	(0.227)	(0.260)	(0.216)	(0.224)	(0.127)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	9941	9941	9941	9941	9941

Panel B: 2014

	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.875***	1.029***	0.911***	1.102***	1.002***
	(0.276)	(0.322)	(0.258)	(0.283)	(0.201)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	9144	9144	9144	9144	9144

Panel C: 2015

	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.707	0.175	-0.269	0.347	1.020*
	(0.741)	(0.751)	(0.450)	(0.295)	(0.586)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	6603	6603	6603	6603	6603

Note: This table shows estimates from regressions with the dependent variable as predicted annual medical expenditures, based on each individual's age, gender, total number of chronic conditions, and type of chronic conditions by body system (See Appendix C). Though insurers are unable to price based on chronic conditions, these estimates provide further evidence of selection on those observable chronic conditions. The patterns also corroborate the main results. Standard errors corrected for clustering at zip-pair level in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A14—Indicator for Chronic Condition

	2015 Non-group		2014 Non-group		2013 Non-group (Placebo)	
	AvgSilver	BCBS	AvgSilver	BCBS	AvgSilver	BCBS
Premium % Increase	0.0131	0.00686	0.0210***	0.0164*	-0.00382	-0.00204
	(0.0250)	(0.0207)	(7.67e-18)	(0.00930)	(0.00859)	(0.0112)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7039	7039	9731	9731	10423	10423

Note: This table reproduces the results from Table 6, but deriving standard errors using the wild cluster bootstrap with 999 replications to address concerns of few clusters. The standard errors are generally very similar when bootstrapping or not, mitigating concerns that the few clusters problem is causing significant over-rejection of the null hypothesis in this case. The bootstrap estimation was implemented using the *cgmwildboot* Stata program written by Judson Caskey. Standard errors corrected for clustering at zip-pair level in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A15—Balance in Choice Set Across Boundary: Evidence of Selection

Panel A: Exact same insurers across boundary					
	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.958**	1.292**	0.891**	1.092**	0.802***
	(0.345)	(0.393)	(0.309)	(0.431)	(0.180)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	1732	1732	1732	1732	1732

Panel B: One insurer different across boundary					
	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	1.209**	1.501**	1.312**	1.200	1.439**
	(0.557)	(0.685)	(0.497)	(0.758)	(0.559)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	6983	6983	6983	6983	6983

Note: Panel A shows the main boundary regressions for only the 8 zip code pairs that have the exact same insurers on either side of the boundary. Panel B additionally includes 20 zip code pairs with a difference of 1 insurer across the boundary. Standard errors corrected for clustering at zip-pair level in parentheses.

***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A16—Robustness to Dropping Ambiguous Zip Codes

Panel A: 2014					
	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.644	0.803	0.954**	0.442	0.746
	(0.446)	(0.569)	(0.442)	(0.479)	(0.462)
IV:					
Premium $ Increase	0.622	0.718	0.595	0.693	0.591
	(0.473)	(0.550)	(0.421)	(0.561)	(0.450)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	6530	6530	6530	6530	6530
Panel B: 2015					
	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	1.344	1.429	1.060	0.188	1.566**
	(0.870)	(0.919)	(0.773)	(0.463)	(0.590)
IV:					
Premium $ Increase	1.656*	1.867*	2.220	0.666*	1.641*
	(0.890)	(1.005)	(1.728)	(0.385)	(0.839)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	4027	4027	4027	4027	4027

Note: Robustness to analysis run after dropping all zip codes that span counties that are part of different rating areas. Although the smaller sample size leads to a lack of statistical significance for the 2014 estimates, the coefficients are consistently positive and of a similar magnitude. The results for 2015 are actually larger and have slight statistically significance, reinforcing the possibility that there may be some evidence of selection even in 2015. Standard errors corrected for clustering at zip-pair level in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A17—Robustness to Using HSA Definition

Panel A: 2014					
	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	0.328*	0.373*	0.343*	0.447	0.218**
	(0.187)	(0.211)	(0.190)	(0.305)	(0.0928)
IV:					
Premium $ Increase	0.302	0.329	0.306	0.281	0.317
	(0.280)	(0.305)	(0.280)	(0.263)	(0.316)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	5977	5977	5977	5977	5977

Panel B: 2015					
	(1)	(2)	(3)	(4)	(5)
Premium Measure:	AvgSilver	BCBS	RMHP	NHV	2LCS
OLS:					
Premium $ Increase	1.129	0.845	0.320	0.318	1.374*
	(0.937)	(0.726)	(0.600)	(0.546)	(0.690)
IV:					
Premium $ Increase	1.240	1.058	1.468	0.583	1.417*
	(0.890)	(0.914)	(1.843)	(0.376)	(0.847)
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	4813	4813	4813	4813	4813

Note: Robustness to analysis run after dropping all zip codes that span counties that are part of different rating areas. Although the smaller sample size leads to a lack of statistical significance for the 2014 estimates, the coefficients are consistently positive but smaller in magnitude. The results for 2015 are larger, reinforcing the possibility that there may be some evidence of selection even in 2015. Standard errors corrected for clustering at zip-pair level in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A18—Results for Bronze Plans

	(1) AvgSilver	(2) BCBS	(3) RMHP	(4) NHV	(5) 2LCS
Premium $ Increase	2.312**	2.193	2.383**	3.059***	2.390***
	(1.117)	(1.498)	(0.983)	(0.794)	(0.624)
Female	47.54	44.02	47.23	47.42	50.95
	(173.7)	(173.4)	(173.5)	(171.8)	(173.8)
Age FE	Yes	Yes	Yes	Yes	Yes
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	698	698	698	698	698

Note: Results from regression of 2014 annual medical expenditures on $ increase in premiums, but only for individuals in Bronze metal level plans. The significant, positive coefficients indicate that the average costs of the Bronze enrollee pool increases with premiums. This can be driven by two effects: (1) the relatively healthy individuals from Bronze plans drop out of the market as premiums increase, and (2) relatively less healthy individuals who were previously in more generous plans may sort into Bronze plans. Standard errors corrected for clustering at zip-pair level in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A19—Results for Silver Plans

	(1) AvgSilver	(2) BCBS	(3) RMHP	(4) NHV	(5) 2LCS
Premium $ Increase	3.456*	4.656**	3.966**	3.144*	4.262***
	(1.743)	(1.892)	(1.764)	(1.780)	(1.242)
Female	238.3	236.2	235.5	234.2	240.0
	(185.8)	(184.8)	(186.9)	(183.3)	(182.2)
Age FE	Yes	Yes	Yes	Yes	Yes
Zip Pair FE	Yes	Yes	Yes	Yes	Yes
Observations	685	685	685	685	685

Note: Results from regression of 2014 annual medical expenditures on $ increase in premiums, but only for individuals in Silver metal level plans. The significant, positive coefficients indicate that the average costs of the Silver enrollee pool increases with premiums. This can be driven by two effects: (1) the relatively healthy individuals from Silver plans drop out of the market or to Bronze plans as premiums increase, and (2) relatively less healthy individuals who were previously in more generous plans may sort into Silver plans. Standard errors corrected for clustering at zip-pair level in parentheses.
***Significant at the 1 percent level.
**Significant at the 5 percent level.
*Significant at the 10 percent level.

Table A20—Optimal subsidy policy by age, linear functions

	Subsidy, $	Share	Benefit	Cost	Net	Ratio (Benefit/Cost)
Optimal Subsidy						
25-34	15.86	0.77	2.92	3.01	-0.09	0.97
35-44	50.76	1.00	5.82	11.05	-5.23	0.53
45-54	0.01	0.79	3.07	0.00	3.07	-
55-64	0.02	0.70	2.47	0.00	2.47	-
Total	14.07	0.81	14.29	14.07	0.22	1.02
Blanket Subsidy						
25-34	11.40	0.58	1.40	1.65	-0.25	0.85
35-44	11.40	0.62	1.52	1.54	-0.02	0.99
45-54	11.40	0.75	2.45	2.36	0.08	1.04
55-64	11.40	0.67	1.68	1.97	-0.29	0.85
Total	7.52	0.66	7.05	7.52	-0.47	0.94

Note: This table shows the effects of age-targeted premium subsidies. The top panel shows the results of the optimal subsidy for each age group. The bottom panel shows the effects of a policy of spending the same amount of money as the age-targeted subsidy policy, but only using a blanket subsidy. The first column shows the monthly per person subsidy amount. Share indicates the share of the age group that is covered under the optimal subsidy amount. The benefit, cost, and net amounts indicate the per person welfare quantities resulting from the subsidy. A ratio greater than one indicates that the benefits are greater than the costs. The key takeaway is that spending the same amount of money but without age targeting leads to lower welfare gains and lower coverage levels.