14.472 Public Finance II

Topic IIb: Detecting Asymmetric Information

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Topic II: Empirical analysis of insurance markets

- Theory: adverse selection can impair efficient operation of insurance markets and create scope for welfare improving government intervention
- Raises empirical questions:
  - Does selection exist in a particular market?
  - What are the efficiency costs of this adverse selection
  - What are the welfare consequences of alternative government interventions?

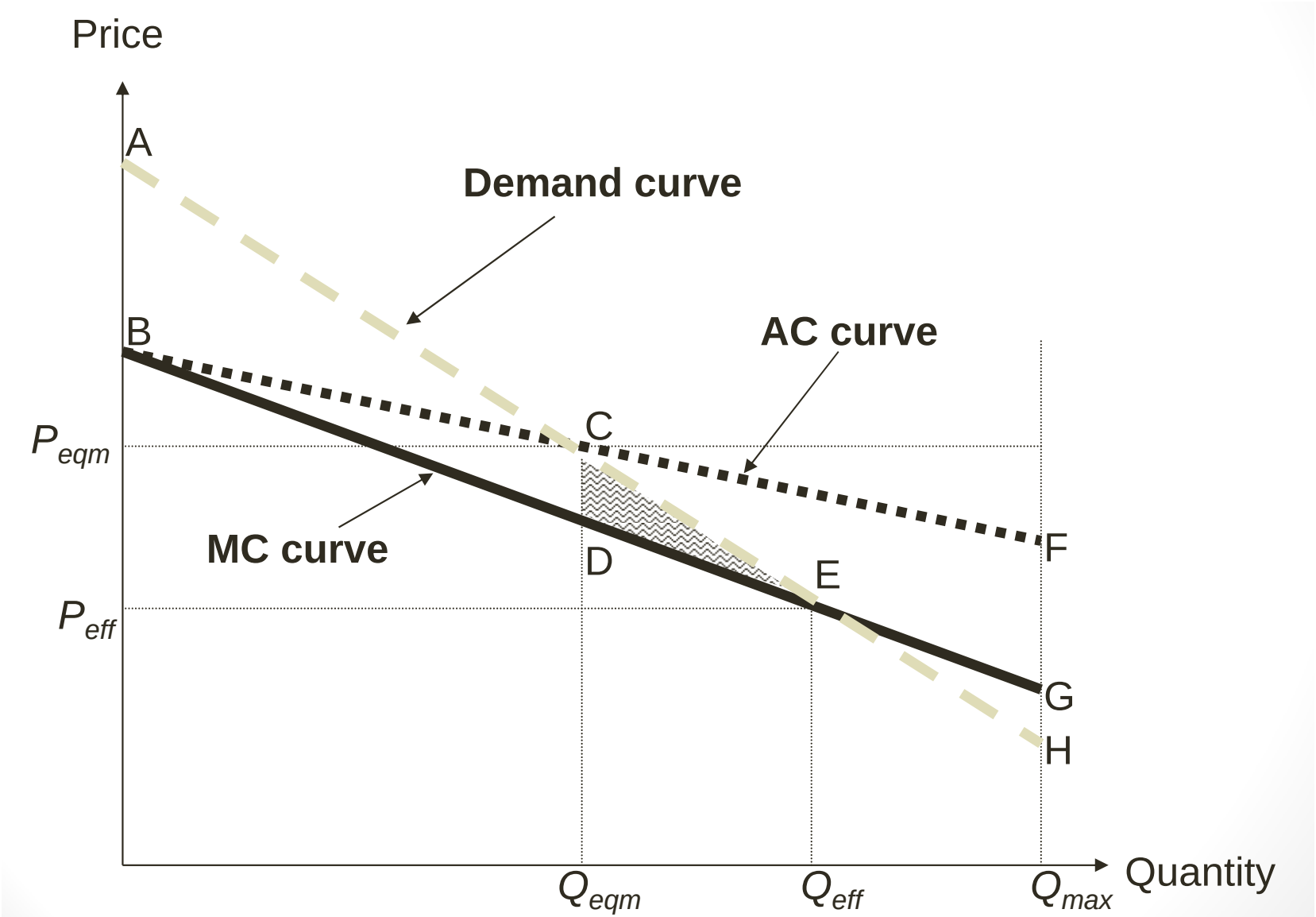
Outline of Topic II

- Testing for selection
- Empirical welfare analysis I: Using choices and claims
  - Welfare cost of selection
  - Welfare consequences of government intervention
- Empirical welfare analysis II: When can't use choices
  - Don't accept revaled preference
  - Markets don't exist

Outline for Today: testing for selection

- Three main topics
  - Positive correlation test (Chiapporie and Salanie JPE 2000).
  - Issues with positive correlation test:
    - Preference heterogeneity (Finkelstein and McGarry, 2006)
    - Moral hazard
  - Cost curve test (Einav, Finkelstein and Cullen 2010)
- Overview article: Einav and Finkelstein (JEP 2011)

Adverse selection: downward sloping marginal cost curve



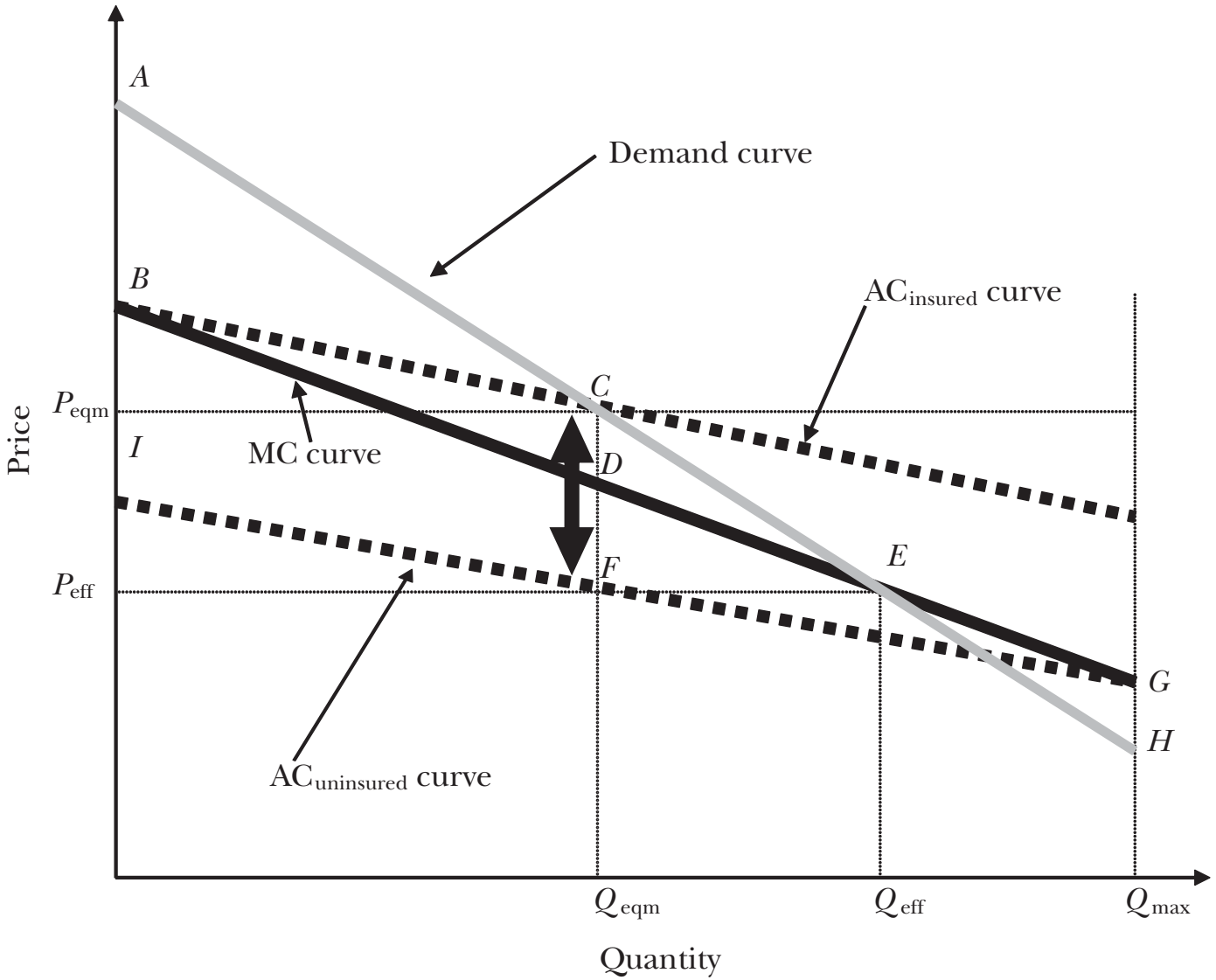
"Positive correlation" test

- Testing for adverse selection essentially requires testing whether MC curve downward sloping
- Making inferences about marginal individuals can be difficult
- Early empirical approaches developed strategies that could focus on averages
- "Positive correlation" or "bivariate probit" test (Chiappori and Salanie, JPE 2000)
  - "Early" for empirical literature on adverse selection in insurance markets
  - "Late" relative to theory (1970s)!

"Positive correlation" test

- Reject null of symmetric information if there is a positive correlation between insurance coverage and ex-post risk occurrence
- Are average costs of insured higher than average costs of uninsured?
  - At any given price, and in particular at the equilibrium price, adverse selection implies that average cost of insured individuals is higher than average costs of uninsured individuals

"Positive correlation" test: graphical illustration



Note: AC_insured is prior AC curve. AC_uninsured averages over people "from the right"

Example: Annuitants vs Population Mortality

	Annuitant Mortality		Population Mortality	
	Men	Women	Men	Women
65	1.02%	0.57%	1.72%	1.16%
75	2.98	1.61	4.29	2.98
85	8.06	5.08	11.35	8.54

Annual mortality rates, US 2007.

"Positive correlation test": regression version

$$\begin{aligned} Coverage_i &= X_i\beta+\varepsilon_i \\ Accident_i &= X_i\gamma+\mu_i \end{aligned}$$

- Simultaneously estimate above two equations (e.g. bivariate probit)
  - Under the null of symmetric information, residuals should be uncorrelated
  - Statistically significant positive correlation between two implies rejection of the null hypothesis
- Spawned a cottage industry of papers in many markets (with mixed results)
  - acute health insurance, annuities, life insurance, long term care insrance, Medigap, auto insurance.....

Practical implementation

- Typically implemented by comparing proxies for expected costs across individuals with different insurance coverage
  - Controlling for characteristics that determine prices
  - Crucial to condition on what is priced. *Test is among a set of individuals who are treated symmetrically by insurance company!*
- Often use data from a single company and examine average claims across individuals who are offered same contracts but who choose more vs. less coverage

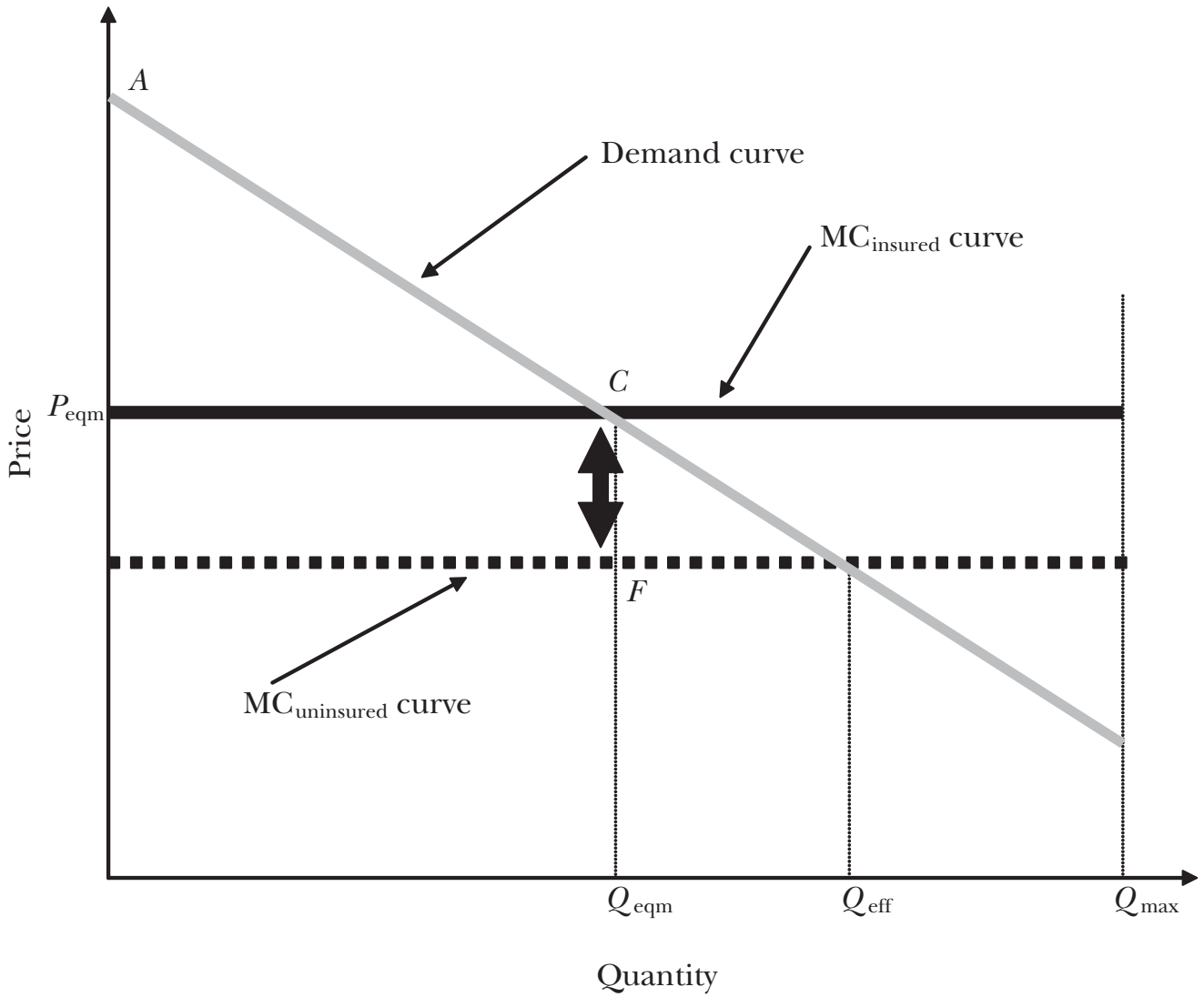
Two important limitations to positive correlation test

1. Does not distinguish between adverse selection and moral hazard
2. Not robust to allowing for unobserved preference heterogeneity in addition to unobserved risk type

Moral hazard also generates positive correlation

- Adverse selection: those with private information they are high expected cost self select into insurance market
- Moral hazard: individuals identical before purchasing insurance; those with greater coverage have less incentive to take actions to reduce their expected costs ex post

Moral hazard also generates positive correlation



"Positive correlation" test is joint test of either adverse selection or moral hazard

- Conceptually very different: ex ante vs. ex post private information
- Policy implications different: government tends not to have comparative advantage w moral hazard
    - So really want to know which you have detected

Distinguishing selection from moral hazard

- Key point: need exogenous variation in contracts
  - Basic problem: distinguishing treatment (moral hazard) from selection (selection!)
- Variety of sources of variation
  - Quasi-Exogenous variation in premiums. e.g.
    - Over time (e.g. Cutler and Reber, 1998)
    - Premium RD in income (e.g. Finkelstein et al. 2019) or geography (e.g. Panhans 2019)
  - Field experiment (e.g. Karlan and Zinman 2009)

Karlan and Zinman (2009)

- Setting: Consumer lender (South Africa)
- Randomized offer interest rate and contract rate on loan
- Selection: compare repayment rate of those offered different rates (but receiving same rate)
- MH: compare repayment rates of those responding to same high offer rate but facing different contract rates

	High Contract Rate	Low Contract Rate
High Offer Rate		Moral Hazard ↔
Low Offer Rate	N/A	↕ Adverse Selection

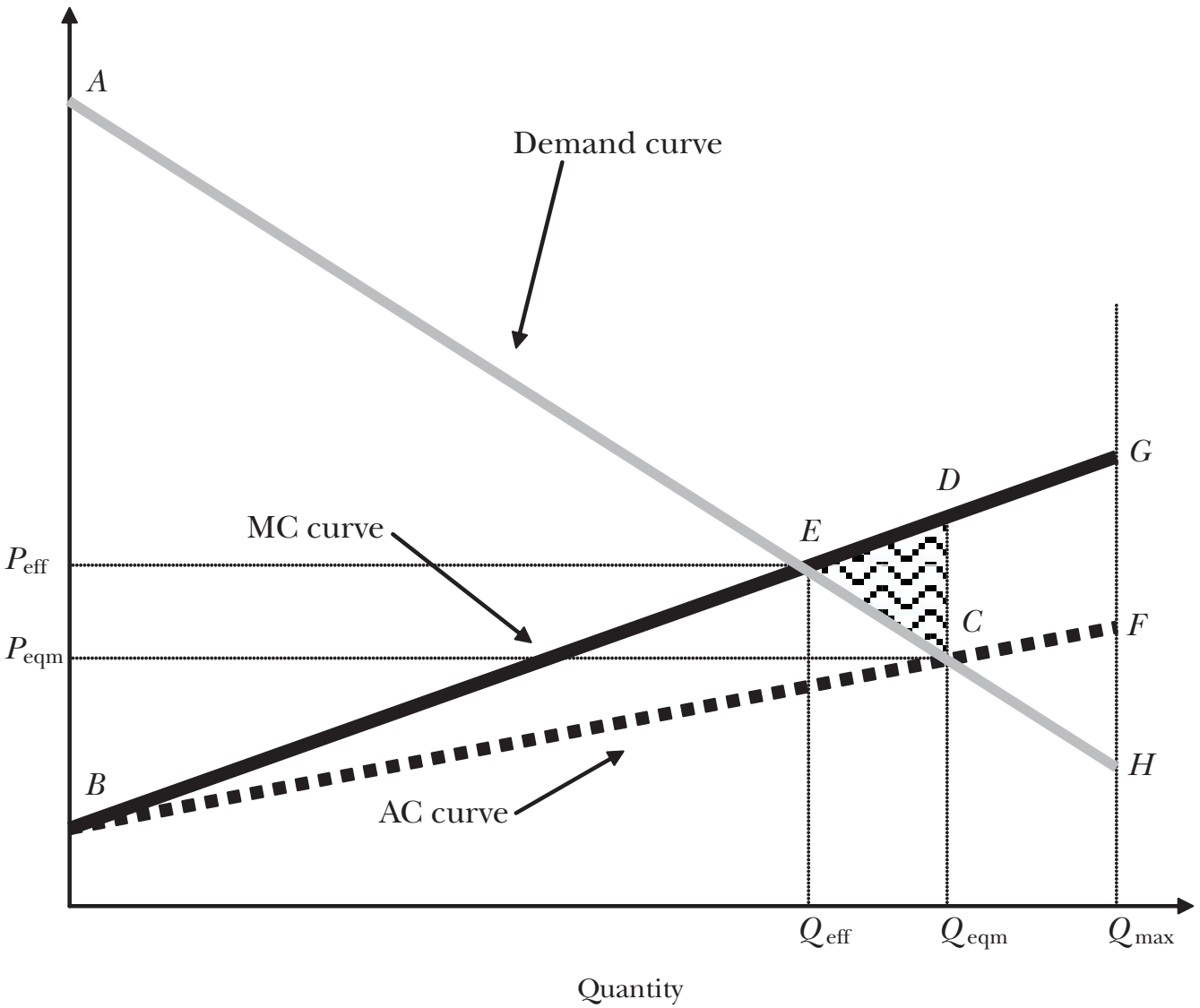
Interpreting results of positive correlation test

- Positive correlation may reflect adverse selection, moral hazard, or both
- Lack of positive correlation
  - No asymmetric information
  - Offsetting advantageous selection and moral hazard?

Unobserved heterogeneity in preferences

- Standard theory models: individuals may potentially differ on only one unobserved dimension: risk type
- With unobserved preferences as well, positive correlation between insurance and risk occurrence is not necessary for asymmetric information.
- Example:
  - Private information about risk type and risk aversion
  - More risk averse are lower risk
  - Can get no or negative correlation between insurance and risk occurrence (high risk and low risk but risk averse pool)
  - But there is private information that impairs market efficiency

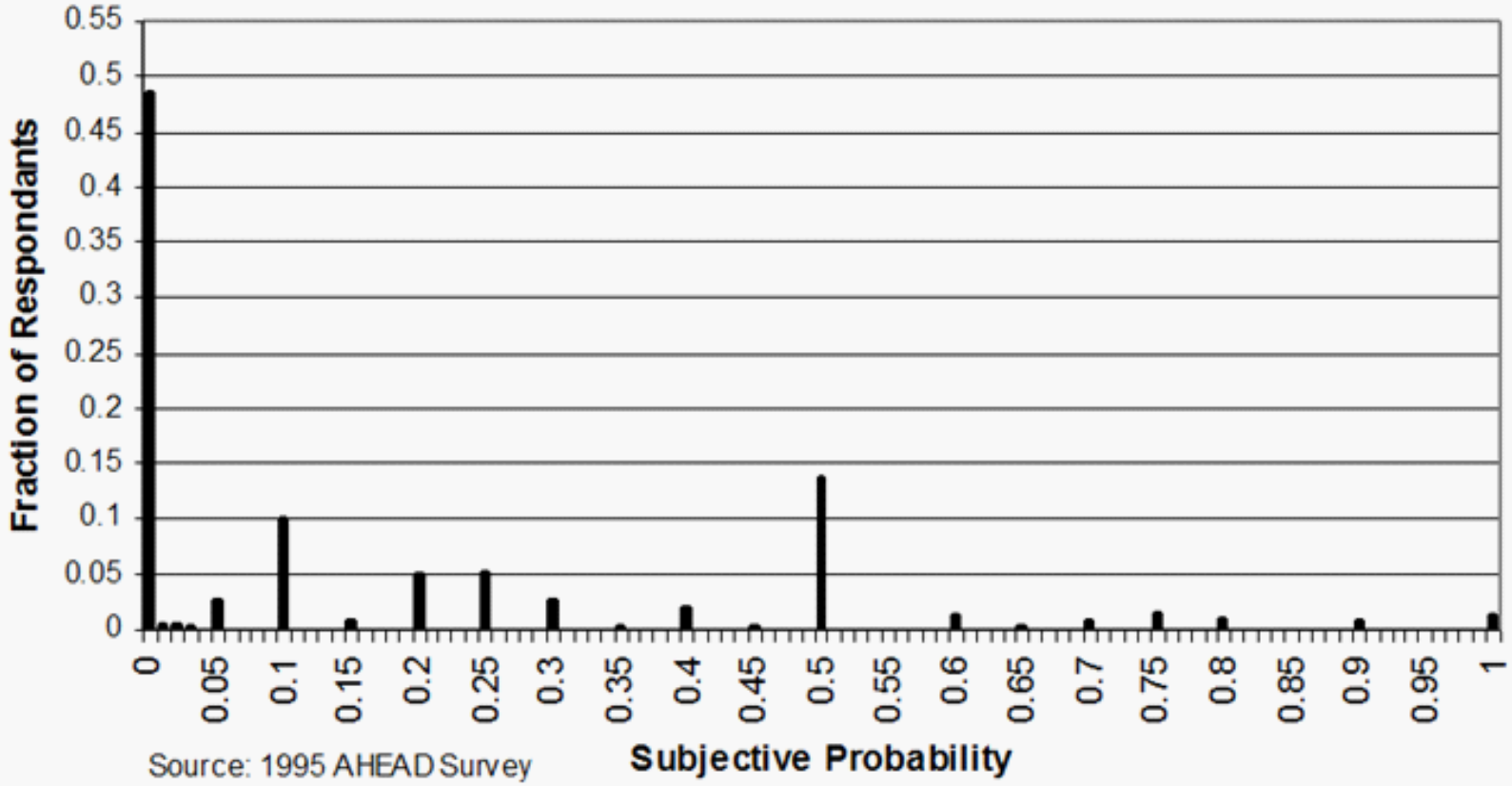
Recall: Advantageous selection



Empirical example: Long-Term Care Insurance

- Finkelstein and McGarry (2006, AER)
- Data from AHEAD cohort of HRS: 1995 - 2000
  - Panel data set on elderly
  - Average age in 1995: 78
- Observe in AHEAD:
  - In 1995: Do you own long-term care insurance? (11%)
  - In 1995: What is your subjective assessment of the chance you go into a nursing home over next five years?
  - 1995 – 2000: Do you in fact go into a nh? (16%)
  - Detailed demographic and health information
- Supplement with:
  - External information from insurance companies on what they price on (the X's you need to condition on in pos corr test)
  - Actuarial model of nh use as function of observed demographics and health

Figure 2: Distribution of Subjective Probability of Entering NH within Five Years



Source: 1995 AHEAD Survey

Overview

- Positive correlation test unable to reject null of symmetric information
  - On average, those who own long term care insurance are not more likely (indeed less likely) to subsequently go into nursing home
- But direct evidence that indivdiuals have private information about their risk type that is postiively correlated with both insurance coverage and subsequent nursing home use:
  - Conditional on insurance company information, individuals' subjective beliefs about expected nh use correlated with insruance coverage AND predict subsequent utilization
- Reconciliation: other unobserved characteristics of the individual are positively correlated with insurance coverage but negatively correlated with insurance use
  - NB: these must be characteristics that are not priced

Relationship between LTCI and NH use

TABLE 3—THE RELATIONSHIP BETWEEN LONG-TERM CARE INSURANCE AND NURSING HOME ENTRY

	No controls (1)	Controls for insurance company prediction (2)	Controls for application information (3)
Correlation coefficient from bivariate probit of LTCINS and CARE	−0.105***	−0.047	−0.028
	(p = 0.006)	(p = 0.25)	(p = 0.51)
Coefficient from probit of CARE on LTCINS	−0.046***	−0.021	−0.014
	(0.015)	(0.016)	(0.016)
N	5,072	5,072	4,780

Notes: Top row reports the correlation of the residual from estimation of a bivariate probit of any nursing home use (1995–2000) and long-term care insurance coverage (1995); p values are given in parentheses. Bottom row reports marginal effect on indicator variable for long-term care insurance in 1995 from probit estimation of equation (3). The dependent variable is an indicator variable for any nursing home use from 1995 through 2000; heteroskedacticity-adjusted robust standard errors are in parentheses. For all rows, control variables are described in column headings; see text for more information. ***, **, * denote statistical significance at the 1-percent, 5-percent, and 10-percent level, respectively. Means of CARE and LTCINS are 0.16 and 0.11, respectively.

Relationship between LTCI and NH use

TABLE 4—RELATIONSHIP BETWEEN LTCINS AND CARE
(*Sample restricted to individuals with same choice set*)

	No controls (1)	Controls for insurance company prediction (2)	Controls for application information (3)
Correlation coefficient from bivariate probit of LTCINS and CARE	−0.123* ($p = 0.08$)	−0.122* ($p = 0.10$)	−0.191** ($p = 0.017$)
Coefficient from regression of CARE on LTCINS	−0.032* (0.018)	−0.028* (0.015)	−0.033** (0.012)
N	1,504	1,504	1,438

Notes: Sample is limited to individuals in the top quartile of the wealth and income distribution and who have none of the health characteristics that might make them ineligible for private insurance. Top row reports the correlation of the residual from estimation of a bivariate probit of any nursing home use (1995–2000) and long-term care insurance coverage (1995); *p* values are given in parentheses. Bottom row reports marginal effect on indicator variable for long-term care insurance in 1995 from probit estimation in equation (3). The dependent variable is an indicator variable for any nursing home use from 1995 through 2000; heteroskedacticity-adjusted robust standard errors are in parentheses. For all rows, control variables are described in column headings; see text for more information. ***, **, * denote statistical significance at the 1-percent, 5-percent, and 10-percent level, respectively. Means of CARE and LTCINS are 0.09 and 0.17, respectively.

But individuals have residual private information

TABLE 1—RELATIONSHIP BETWEEN INDIVIDUAL BELIEFS AND SUBSEQUENT NURSING HOME USE

	No controls	Control for insurance company prediction		Control for application information
	(1)	(2)	(3)	(4)
Individual prediction	0.091***		0.043**	0.037*
	(0.021)		(0.020)	(0.019)
Insurance company prediction		0.400***	0.395***	
		(0.020)	(0.021)	
pseudo-R^2	0.005	0.097	0.099	0.183
N	5,072	5,072	5,072	4,780

Notes: Reported coefficients are marginal effects from probit estimation of equation (1). Dependent variable is an indicator for any nursing home use from 1995 through 2000 (mean is 0.16). Both individual and insurance company predictions are measured in 1995. Heteroskedacticity-adjusted robust standard errors are in parentheses. ***, **, * denote statistical significance at the 1-percent, 5-percent, and 10-percent level, respectively. Column 4—which includes controls for "application information"—includes controls for age (in single year dummies), sex, marital status, age of spouse, over-35 health indicators, and a complete set of two-way and three-way interactions for all of the variables used in the insurance company prediction (age dummies, sex, limitations to activities of daily living, limitations to instrumental activities of daily living, and cognitive impairment); see text for more details.

And private information positively correlated with LTCI

TABLE 2—RELATIONSHIP BETWEEN INDIVIDUAL BELIEFS AND INSURANCE COVERAGE

	No controls	Control for insurance company prediction		Control for application information
	(1)	(2)	(3)	(4)
Individual prediction	0.086***		0.099***	0.083***
	(0.017)		(0.017)	(0.016)
Insurance company prediction		−0.125***	−0.140***	
		(0.023)	(0.023)	
pseudo-R^2	0.007	0.010	0.019	0.079
N	5,072	5,072	5,072	4,780

Notes: Reported coefficients are marginal effects from probit estimation of equation (2). Dependent variable is an indicator for whether individual has long-term care insurance coverage in 1995 (mean is 0.11). Both individual and insurance company predictions are measured in 1995. Heteroskedacticity-adjusted robust standard errors are in parentheses. ***, **, * denote statistical significance at the 1-percent, 5-percent, and 10-percent level, respectively. Column 4—which includes controls for "application information"—includes controls for age (in single year dummies), sex, marital status, age of spouse, over-35 health indicators, and a complete set of two-way and three-way interactions for all of the variables used in the insurance company prediction (age dummies, sex, limitations to activities of daily living, limitations to instrumental activities of daily living, and cognitive impairment); see text for more details.

Evidence of preference based selection

	No controls		Control for insurance company prediction		Control for application information	
	NH Entry (1)	LTC Insurance (2)	NH Entry (3)	LTC Insurance (4)	NH Entry (5)	LTC Insurance (6)
Panel A: Wealth						
Top wealth quartile	−0.095***	0.150***	−0.038**	0.131***	−0.018	0.139***
	(0.013)	(0.020)	(0.014)	(0.020)	(0.015)	(0.022)
Wealth quartile 2	−0.073***	0.104***	−0.025*	0.089***	−0.013	0.092***
	(0.013)	(0.020)	(0.014)	(0.020)	(0.014)	(0.020)
Wealth quartile 3	−0.030**	0.062***	0.0004	0.052***	0.006	0.057***
	(0.015)	(0.020)	(0.016)	(0.019)	(0.015)	(0.020)
Bottom wealth quartile (omitted)	—	—	—	—	—	—
Individual prediction	0.086***	0.089***	0.042**	0.098***	0.035*	0.086***
	(0.021)	(0.017)	(0.020)	(0.017)	(0.019)	(0.017)
Panel B: Preventive health activity						
Preventive activity	−0.106***	0.066***	−0.054***	0.052***	−0.016	0.016
	(0.0118)	(0.017)	(0.018)	(0.017)	(0.019)	(0.017)
Individual prediction	0.095***	0.082***	0.047**	0.095***	0.037*	0.082***
	(0.021)	(0.017)	(0.020)	(0.017)	(0.020)	(0.017)
Panel C: Seat belt use						
Always wear seatbelt	−0.059***	0.053***	−0.031**	0.048***	−0.018	0.029***
	(0.014)	(0.010)	(0.013)	(0.010)	(0.012)	(0.010)
Individual prediction	0.092***	0.084***	0.044**	0.097***	0.038*	0.082***
	(0.021)	(0.017)	(0.020)	(0.017)	(0.019)	(0.016)

Perspective on the-paper-as-a-paper

- Strengths:
  - documents an important limitation with an existing literature
  - opens up new areas of research
- Empirical Weaknesses:
  - Subjective probabilities are ordinal not cardinal
  - Don't observe option set for each person (have to crudely proxy)
    - not ideal for testing
  - Shows limitation of positive correlation test without proposing an alternative
- Conceptual Weaknesses
  - What is the underlying primitive of the preference heterogeneity
  - What are the implications for welfare??

Implications for testing

- Asymmetric information can exist even when there is no positive correlation between insurance coverage and risk occurrence
  - i.e. positive correlation test not robust to preference heterogeneity
- Motivates "Unused observables" test for asymmetric information (Finkelstein and Poterba 2014)
  - Reject null of symmetric information if, conditional on information of insurance company, econometrician can observe a characteristic of the individuals that is correlated (in any direction) with both quantity of insurance coverage and ex post risk occurrence
  - Downside: one sided (and conflates selection and moral hazard)
  - Application: UK annuity market; geographic location. Why unused?

Implications for theory

- Multiple dimensions of private information substantially complicates theory
- Many insurance models endogenize contract space (e.g. R&S 1976) but have uni-dimensional heterogeneity
  - with multi-dimensional heterogeniety no longer have single crossing
- Azevedo and Gottlieb (EMA 2017) endogenize contract space with multiple dimensions of heterogeneity
  - Maintain perfect competition assumption

Addressing the limitations of the positive correlation test

- Recall two key issues:
  - Not robust to preference heterogeneity
  - Joint test of moral hazard and selection
- "Cost curve" test of selection (Einav, Finkelstein and Cullen, 2010)
  - Addresses both these issues
  - But no free lunch: now need quasi-random variation in prices

Cost curve test (Einav, Finkelstein and Cullen 2010)

- Idea: slope of MC curve provides a direct test of existence and nature of selection
- Reject null of no selection if reject null of constant MC curve
- Slope of cost curve indicates if selection is adverse or advantageous

Cost curve test implementation

- Estimate average cost curve *on sample who are insured*

$$c_i = \gamma + \delta p_i + u_i$$

c_i is average insurable costs (claims)
p_i is price of insurance

- Estimating how costs change for **endogenously selected sample of those who stay insured** as you vary the price
  - = key idea of selection.
- Data requirements higher than for positive correlation test:
  - As with positive correlation test, need to know insurance coverage (since limit sample based on this) and costs (left hand side)
  - *Additional empirical hurdle*: Also need exogenous variation in prices

Aside: Selecting on the endogenous outcome

- Useful if you want to understand the *characteristics* of those who respond to the intervention
- Other examples:
  - What type of DI applicants deterred from hassles (Deshpande and Li forthcoming)?
  - Who is the marginal child when abortion is legalized (Gruber, Levine and Staiger 1999)?
- More generally: "characterizing the compliers" (Abadie 2002).

Cost curve test: example from Colorado health insurance exchange

- Panhans (2019 AEJ: Applied)
- Colorado Health Insurance Exchange 2014
  - Created by Affordable Care Act (ACA)
  - Subsidized for low income individuals
- Statewide data on premiums, claims, insurance coverage (exchange coverage vs. not)
- Source of premium variation: geographic discontinuities in insurance premiums at boundaries of "rating areas" established by law
  - Premiums change discretely at "artificial" boundaries of rating areas
  - Compare costs of those enrolled on either side of the border (fixed effect for each zip code pair $\phi_{g(k)}$)

$$c_i = \gamma + \delta p_{ik} + \phi_{g(k)} + u_i$$

Border Design

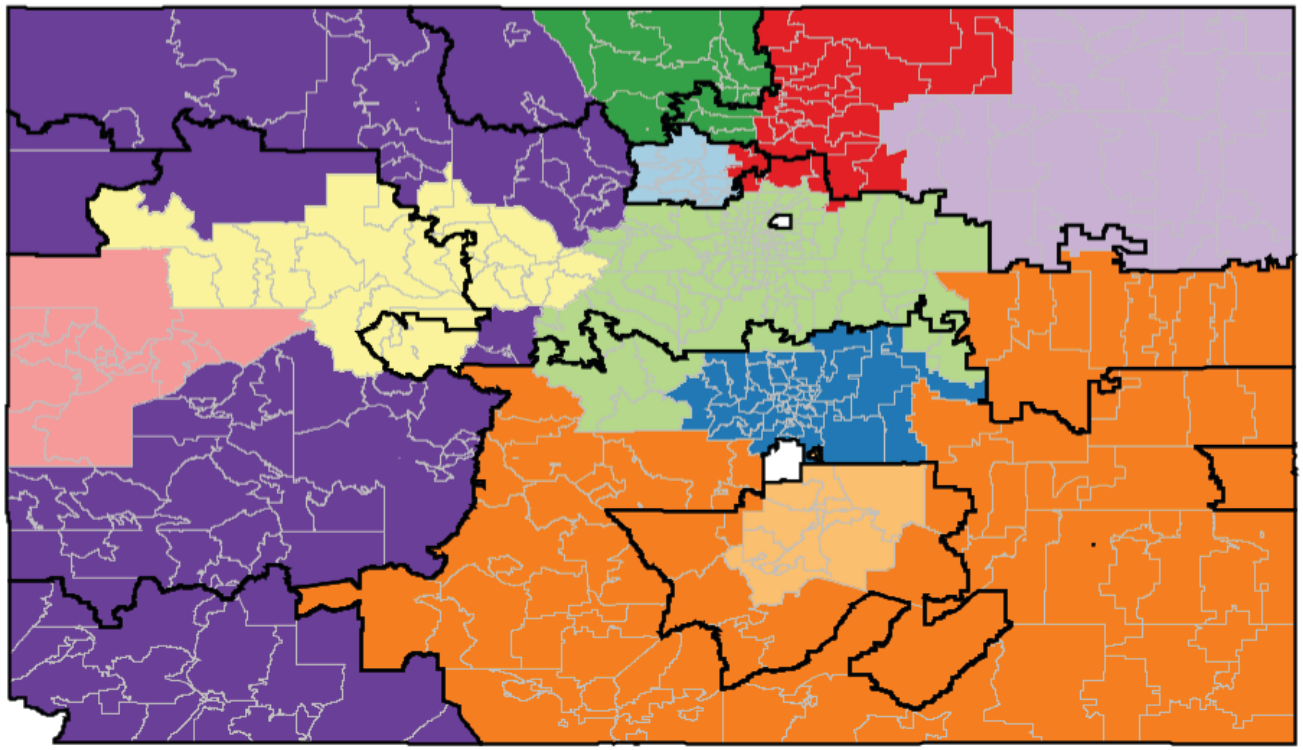


FIGURE 2. 2014 RATING AREAS IN COLORADO

Notes: Five-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 Referral Region (HRR).

Border-induced premium variation

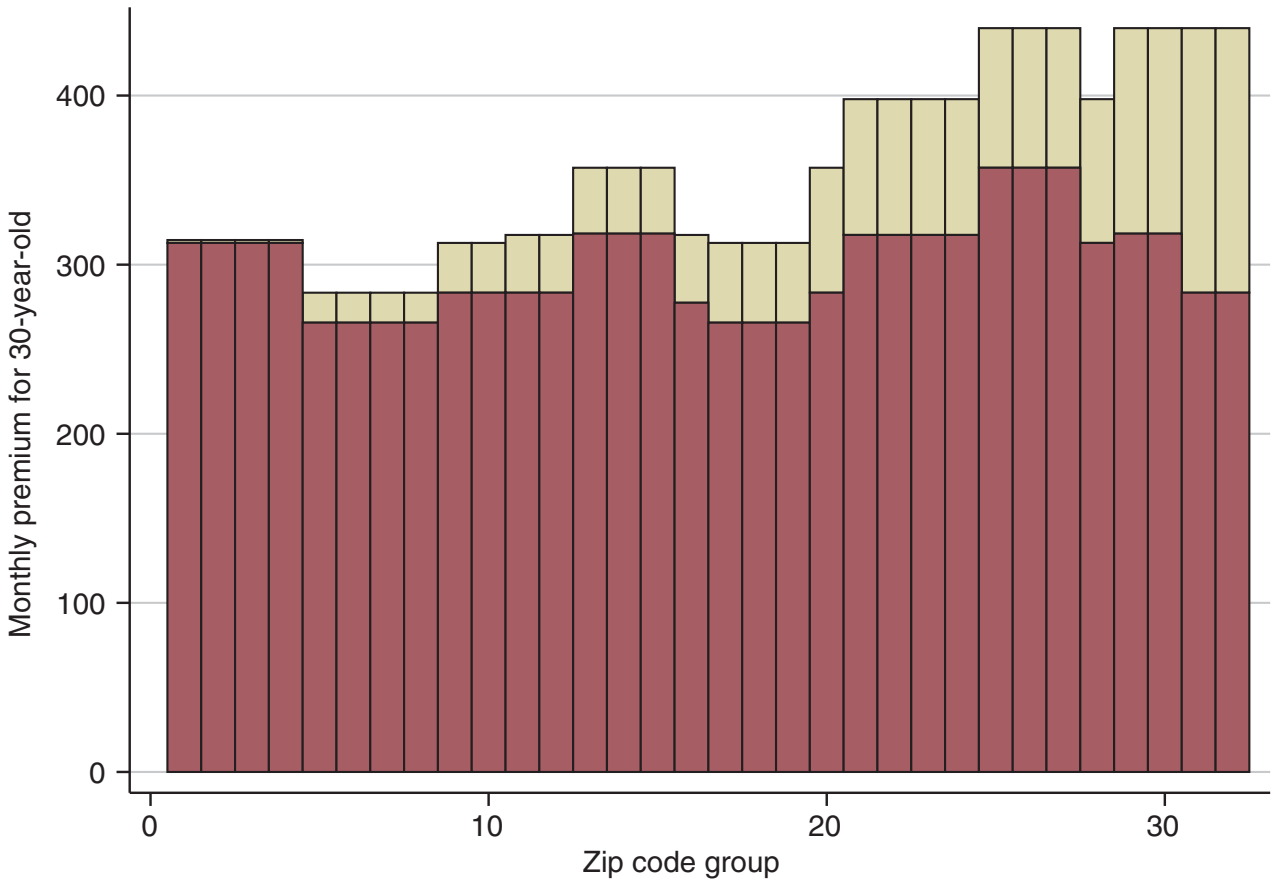


FIGURE 3. CHANGE IN PREMIUM ACROSS RATING AREA BOUNDARY

Notes: There are 32 pairs of neighboring zip codes that cross a rating area while remaining in the same HRR. This graph shows the change in monthly premium for Blue Cross Blue Shield's Silver Plan across each of the 32 pairs of zip codes.

Cost curve indicates selection

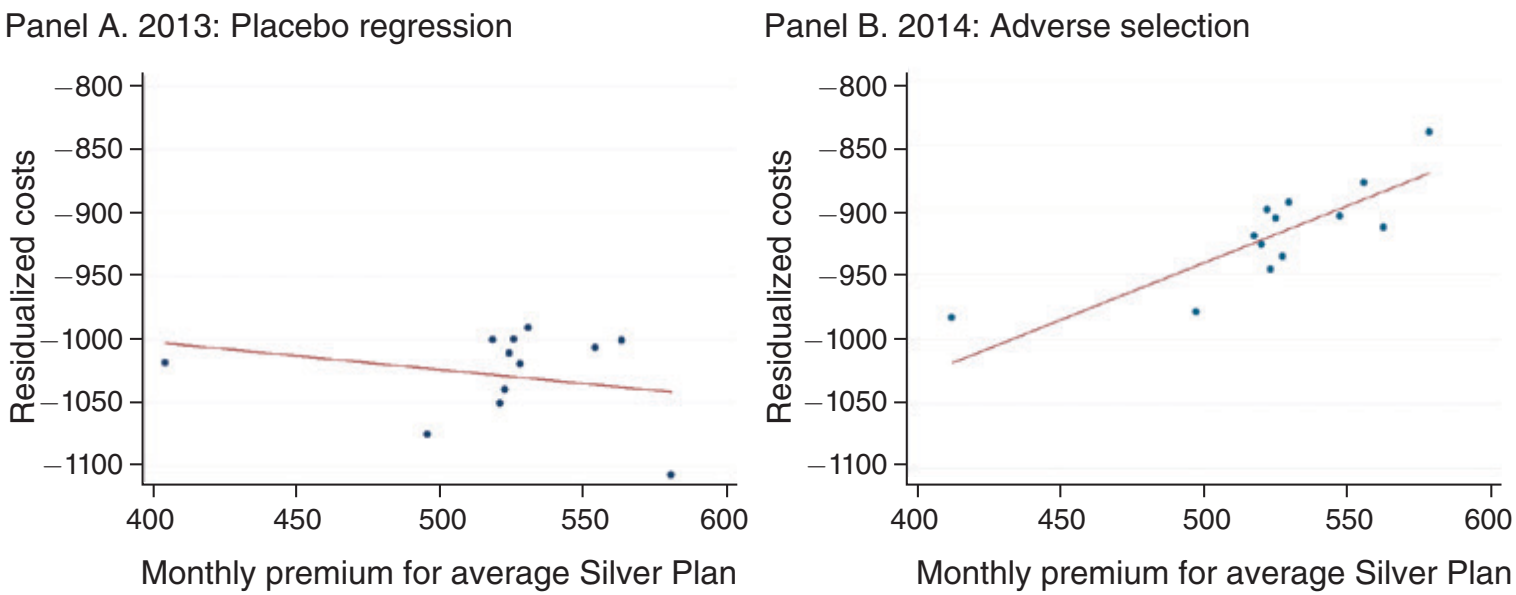


FIGURE 5. BINNED SCATTERPLOT OF SELECTION REGRESSION

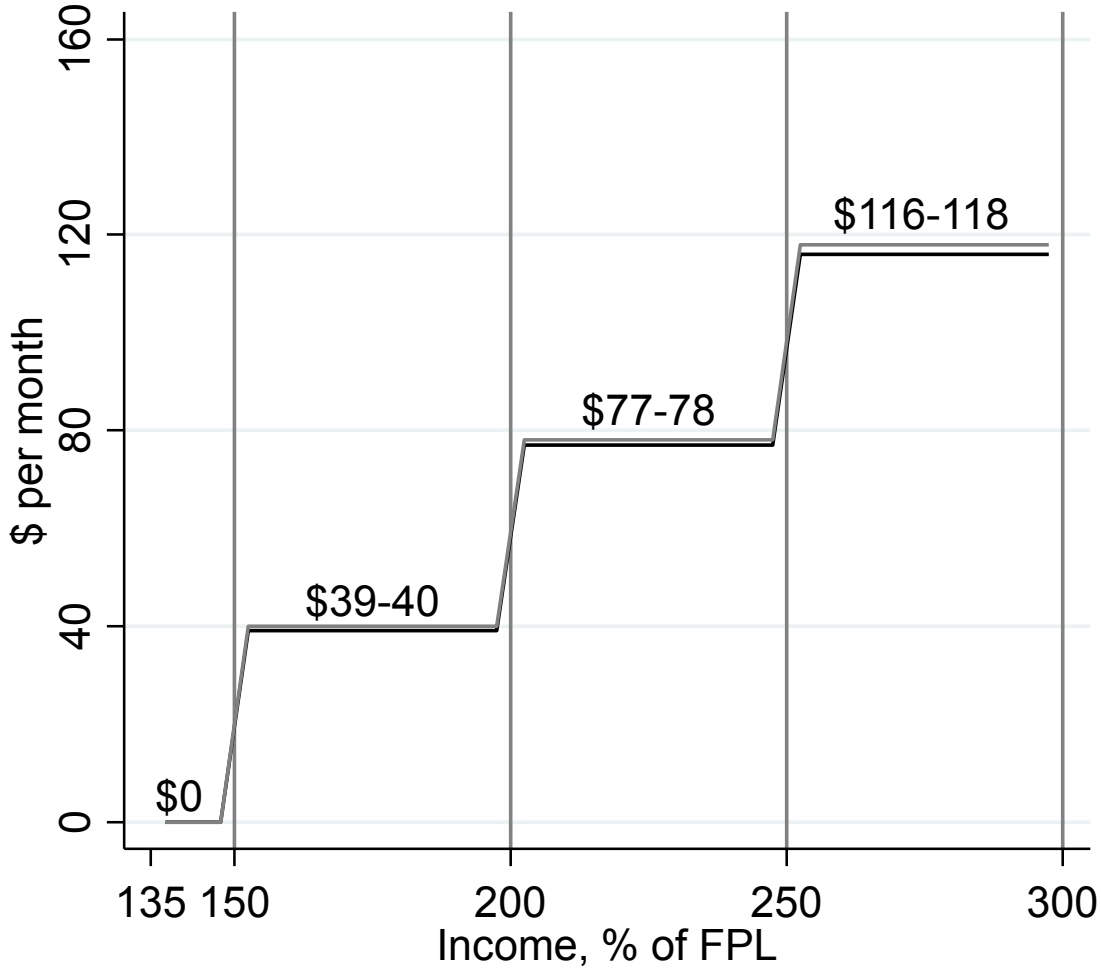
Notes: Panel A presents graphically the results from the placebo regression in column 1 of Table 4. Panel B presents the results from the main OLS results in panel A, column 1 of Table 3, which indicate adverse selection. The sample means of premiums have been added back in to the premium residuals before plotting.

Cost curve test: example from MA health insurance exchange

- Finkelstein et al. (2019)
- Subsidized health insurance exchanged introduce in MA in 2006 ("Romneycare")
  - Precursor to ACA exchanges
- Data on premiums, claims, enrollment
- Source of premium variation: regression discontintuity in premium subsidies by income
  - Public subsidies designed to make insurance "affordable"
  - Increase at discrete income bins

Quasi-random Variation in Premiums

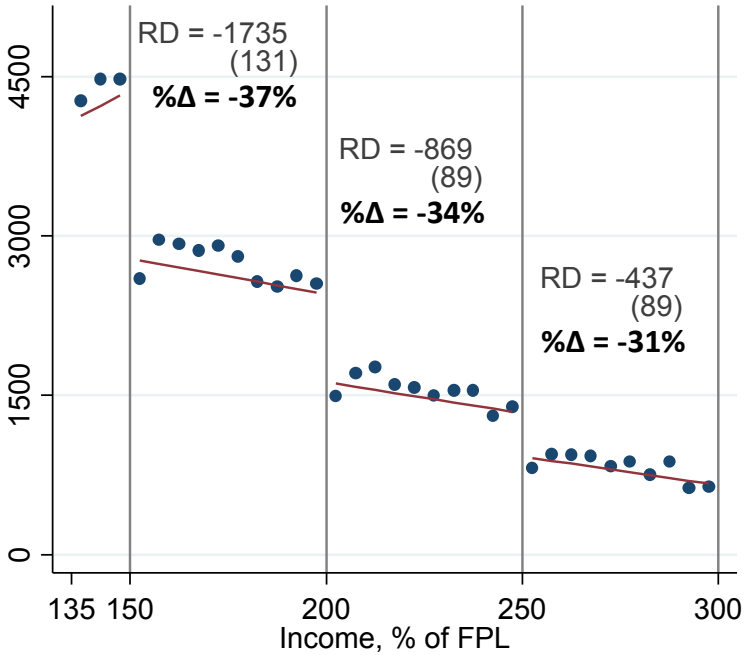
Panel A: Premiums for Cheapest Plan (2009-2013)



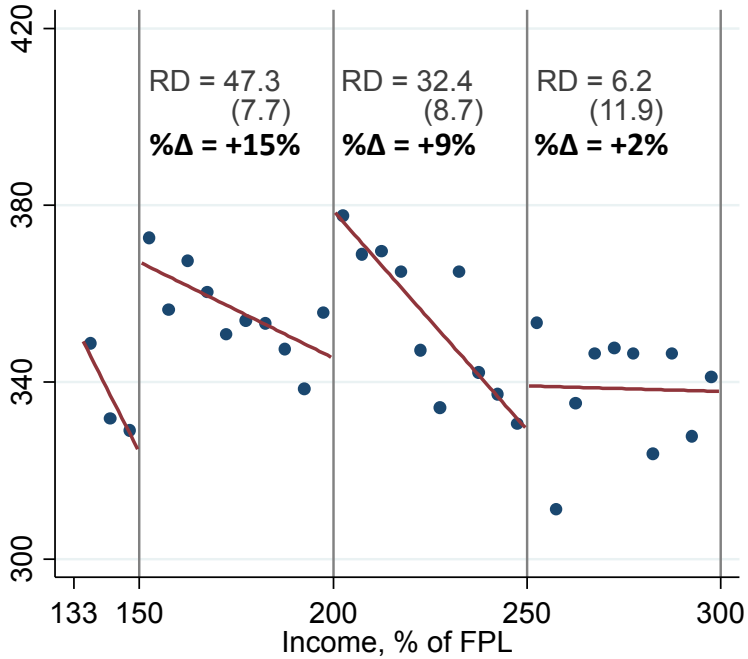
Demand and cost as function of premiums

Figure 4: CommCare Enrollment and Average Insurer Costs, 2009-2013

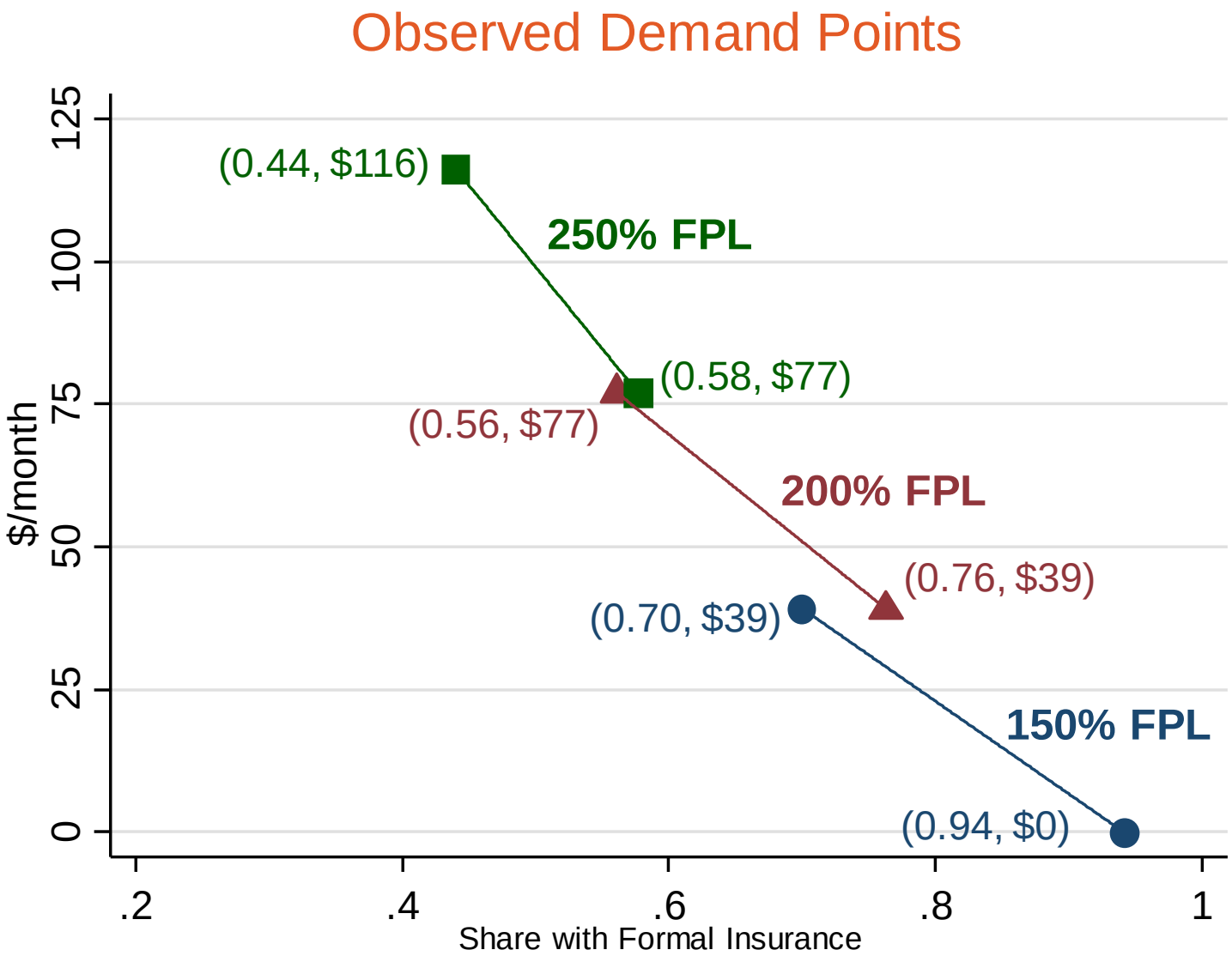
Panel A: Average Monthly Enrollment by Income



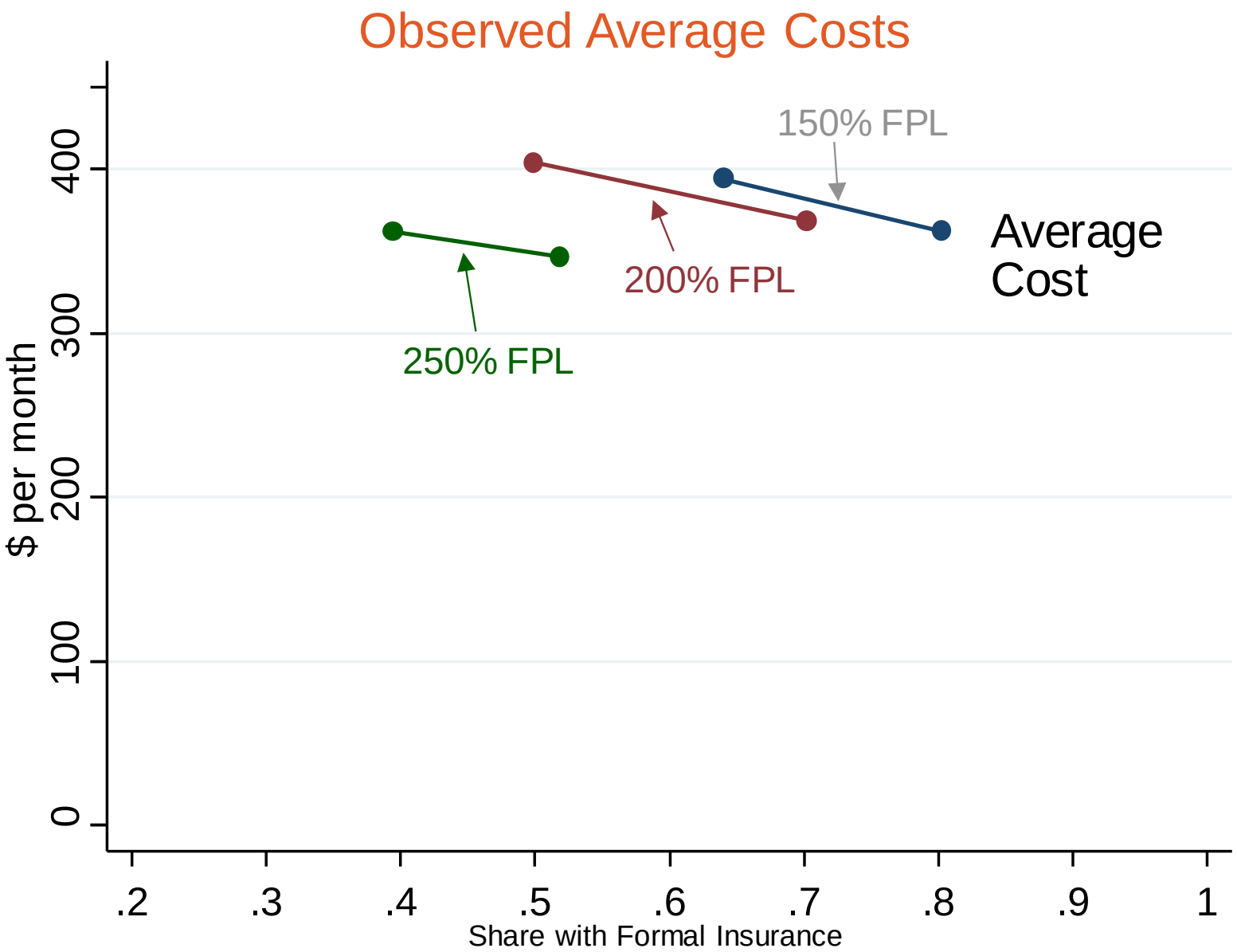
Panel B: Average Monthly Insurer Costs



Constructing demand curve



Constructing cost curve



Moral hazard and the cost curve test

- "Cost curve" test not affected by existence (or lack thereof) of moral hazard
  - Estimate cost curve on sample in which coverage is fixed
- But slope of cost curve may reflect selection based on differential expected responsiveness to incentive effects
  -
    - "Selection on moral hazard" (Einav, Finkelstein, Ryan, Schrimpf and Cullen 2013)
    - Specific example of Roy selection / selection on gains (heterogeneous treatment effects)

Complementarities between theory and empirics

- Original seminal theory assumed single dimensional heterogeneity
- Empiricals work suggests multiple dimensions of heterogeneity
  - Complicating both theory and empirics
- Both responding and evolving
  - Empirical work advanced by fixing contract space
  - Recent theory (Azevedo and Gottlieb EMA 2017) endogenizes contract space with multiple dimensions of heterogeneity (and perfect competition)
    - Takes it to the data
  - Challenge: multiple dimensions of heterogeneity and imperfect competition

Other consequences of adverse selection

- Most existing work looks at impact of adverse selection on (mis-) pricing and insurance coverage
- Selection may also give insurers incentives to distort plan benefits (Rothschild-Stiglitz 1976)
- Very little existing work (using EFC test or otherwise) looking at impact of selection on contract / benefit *design*
  - Formulary (drug benefit) design to discourage high cost enrollees
    - e.g. high cost-sharing for HIV drugs in health insurance exchanges (Jacobs and Sommers 2015 NEJM)
  - Shepard (2016 JMP): Broader networks attract higher cost enrollees

Some open testing questions

- Impact of selection on contract design (a la Shepard; more work needed)
- Many markets have not been studied at all (e.g. adverse selection in Disability Insurance if offered a choice?)
    - There's lots of public policy (and research on the public policy) but not on the underlying market failure
- Why don't insurance companies price on more observable characteristics?

Recent Evidence of Adverse Selection in Unemployment Insurance

- Landais, Nekoei, Nilsson, Seim and Spinnewijn (2017 WP) "Risk-based selection in UI: evidence and implications"
- Study demand for (optional, public) supplemental UI in Sweden
  - Swedish workers entitled to minimum benefit financed by payroll tax
  - Option to buy a more comprehensive policy (same duration etc, just higher payouts) at a (uniform) premium set by goverment
- Administrative data on worker choices and outcomes
- Implement the whole panoply of tests and discuss what learn from each
  - positive correlation test
  - unused observables test
  - cost curve test
- Provides nice review / test your understanding of lecture material
  - The last section of the paper builds on the welfare analysis we are going to discuss next...