Empirical Analysis of Insurance Markets

Ben Handel

Berkeley & NBER

October 16, 2012

Insurance Markets

Why do we have them?

- If consumers have diminshing marginal utility from income, they will have a desire to smooth income over risky states of the world
  - Expected-utility theory
  - More necessary the larger the risk
- Insurers aggregate many risks (LLN, risk neutrality)
- Major insurance markets for:
  - Health care expenses: (20% of US GDP)
  - Life / Annuities: (3 trillion per year)
  - Home and Property: ($\approx$ 90% homes)
  - Auto accidents / liability
  - Employment

Insurance Markets

Characteristic Features

- Consumers:
  - Choice under uncertainty: preferences can be directly linked to lotteries / risk aversion
  - Trade-off between moral hazard and risk protection
  - Heterogeneity in risk types key for choices
  - Complex financial instruments, chosen infrequently
- Firms:
  - Insurer costs linked directly to consumer characteristics
  - Costs realized after sales / production
  - Adverse selection
  - Menu design, screening, competition & complexity

Insurance Markets

Health Insurance

- Wide gap between theory and reality
- Potentially very high expenses sometimes predictable
- Special moral / equity concerns imply need for either:
  - Forced pooling in short-term contracts
  - Long-term contracts
- Adverse selection on observed but unpriced information
- In U.S., insurance tied to access to providers
  - Not just financial lottery in many cases
  - Adds to complexity, potential for efficiencies from competition
- Implications for design US and abroad

Insurance Markets

Other Key Markets

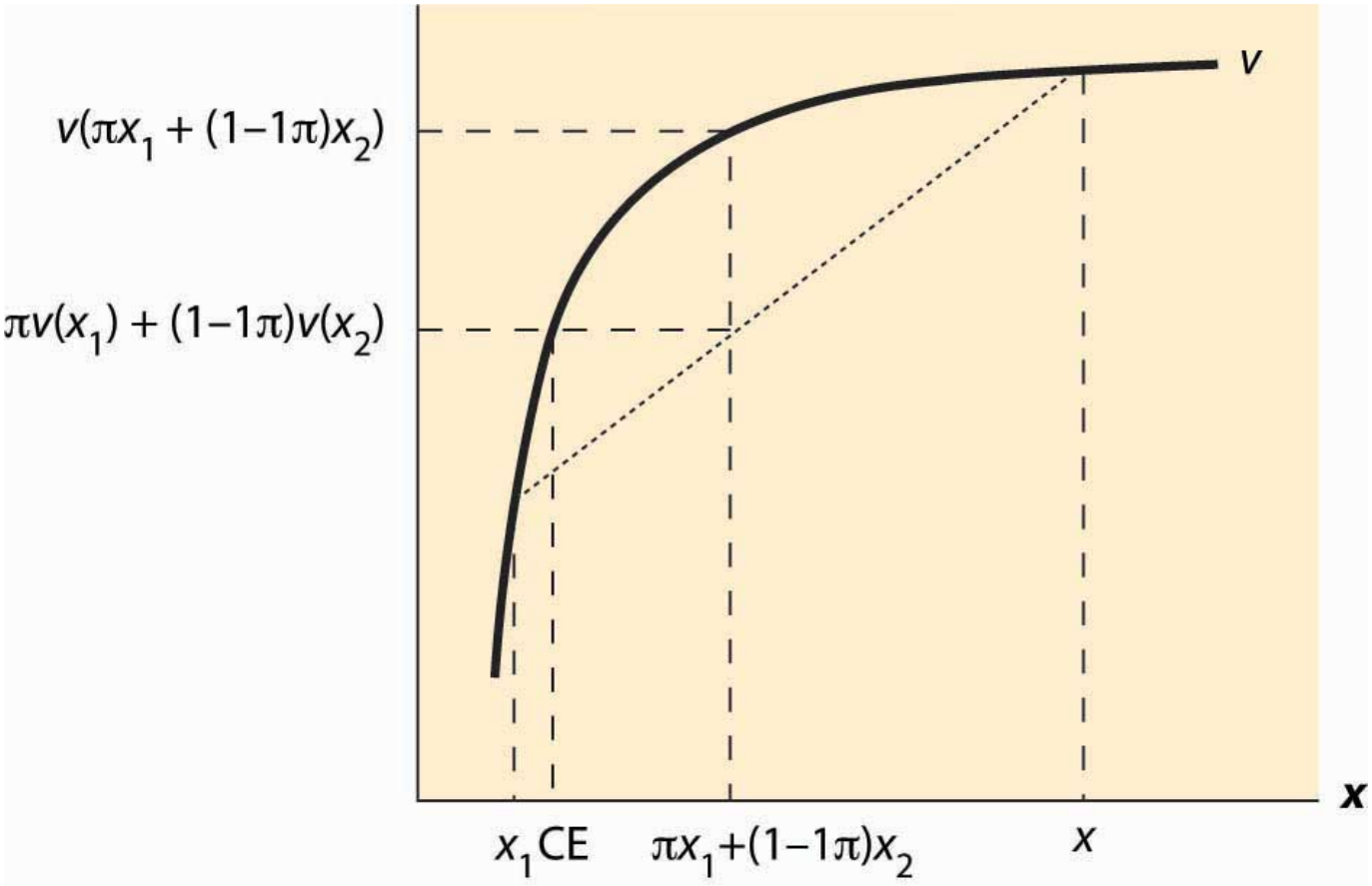
- Auto Insurance:
  - Minimum coverage requirements due to negative externality for not owning
  - Full risk-rating possible in general, good information
  - Limited issues with adverse selection / moral hazard
  - Well-functioning market in many ways
- Life insurance:
  - Regulated with one-sided commitment, leads to front-loading
  - Adverse selection important issue, substantial screening
- Disaster insurance: correlated risks preclude private markets
- Information structure, risk size key factors

Outline

- Model of Insurance Markets
- Empirics: Standard Choice Foundations
- Empirics: Adverse Selection
- Empirics: Choice Frictions

Risk Preferences

Concave Utility in Wealth



- Empirical: What is $u(\cdot)$?
- Empirical: What is uncertainty π?

Adverse Selection

Costs Linked to Choice

- With information asymmetries, adverse selection can cause market for comprehensive insurance to unravel
- True also when *observed* information can't be priced
- When is selection adverse?
  - Link between endogenous costs and prices excludes people from market
  - Selection could be advantageous
- Welfare consequences of selection:
  - Why did someone want product to begin with?
  - What would they get if only person in market?

Adverse Selection

Example: Cutler-Reber (1998)

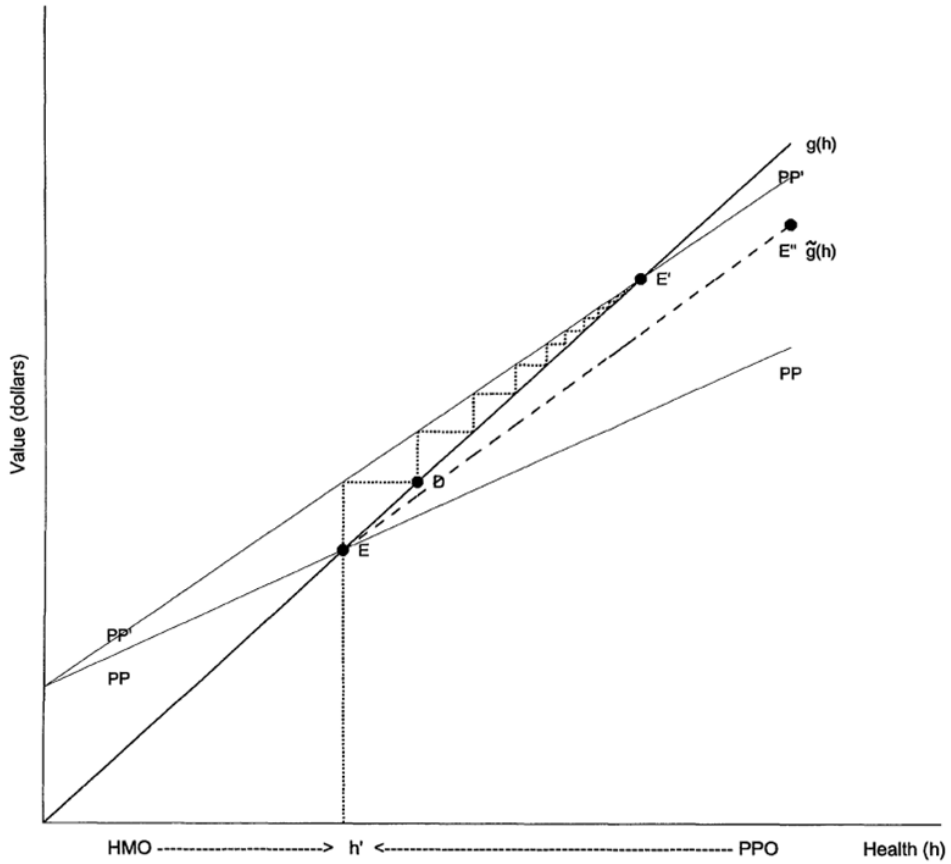


FIGURE I
Insurance Market Equilibrium

Adverse Selection

Market Equilibrium

- Cutler & Reber analyzes case with simple deterministic pricing rule in market
  - AS primarily from observed unpriced observed information
- Intuition similar to Akerlof (1970):
  - Unobserved quality in used car markets
  - Static Equilibrium with pure asymmetric information
  - Even very simple example non-trivial to solve

Adverse Selection

Rothschild & Stiglitz (1976)

- Competitive equilibrium with adverse selection:
  - In general model where insurers choose insurance levels and prices, complicated screening problem
  - Equilibrium may not exist
- In empirical applications, regulation or stylized assumptions simplify equilibrium problem
- Setup of RS still pretty simple: what about dynamic concerns, inertia, choice complexity?

Moral Hazard

Behavior Change

- Do consumers change their behavior when facing different marginal incentives in insurance contracts?
  - Auto
  - Health
  - Life
  - Home
  - Bankruptcy law
- Unlike AS, no externality of one consumer on another
- Competitive insurers will find second-best solution without help?
- Important efficiency implications: data / monitoring

Choice and Behavior

Complex Decisions

- Different potential types of information asymmetries:
  - Consumers have more information than insurers
  - Consumers have *less* information
- If limited information / choices are complex:
  - Implications for adverse selection
  - Implications for consumer welfare
  - Implications for firm responses
  - Market / policy design
- How do you determine this empirically? How do you move away from canonical / simple framework with data?

Outline

- Model of Insurance Markets
- Empirics: Standard Choice Foundations
- Empirics: Adverse Selection
- Empirics: Choice Frictions

Empirical Analysis of Insurance Markets

- Similar to other applied fields, researchers use a variety of empirical techniques to investigate important questions in insurance markets
- Reduced form: Econometric analysis shows relationship between economic quantities of interest, without direct link to theoretical foundations
- Structural: Integrates theoretical models with data
  - Directly quantifies micro-foundations from theory
  - Can be used to evaluate welfare / counterfactual policies
- Range of structural approaches in insurance markets:
  - 'Realized' utility model (Einav et al. (2010))
  - Characteristic model

Theory and Data

Emphasis on Structural

- Insurance markets great environments to study micro-foundations we see in theory
  - Potential for detailed data / clear preference structures
  - Glorified financial lotteries in many cases
- Structural foundations to look for in each paper:
  - Choices between contracts $\rightarrow$ risk preferences
  - Clear quantification of risk types
  - Mapping from risk realization to contract valuation give unique ability to identify 'value foregone'

Deductible Choice in Auto Insurance

Cohen & Einav (2007) *AER*

- Study of deductible choice in auto insurance markets
- Choice between high-deductible contract $(d_{i,HD}, p_{i,HD})$ and low deductible contract $(d_{i,LD}, p_{i,LD})$
- Explicit estimates of realized expected-utility model:
  - Risk preferences
  - Accident risk
- Data from Israeli car insurance firm:
  - Analysis of 105,800 new policyholders, 1994-1999
  - Direct to consumer sales, 7% of market, first such firm
  - All data at individual level

Cohen & Einav (2007) *AER*

Data & Environment

- Contracts: Four one-period insurance contracts offered to each individual
- Pricing / deductible based on 'regular' policy
  - Regular deductible d_{it} equals $\min\{\frac{p_{it}}{2}, cap_{it}\}$
  - p_{it} equals unknown function of observables x_{it}
- Other contracts:
  - 'Low' deductible: $0.6d_{it}$ and $1.06\ p_{it}$
  - Other two plans: $(1.8d_{it}, 0.875p_{it}$ and $(2.6d_{it}, 0.8p_{it}$
- 81% choose regular, 18% choose low

Cohen & Einav (2007) *AER*

Data & Environment

- Average marginal choice in the data (regular to low): \$55 in incremental premium for \$182 lower expenditures with accident
  - Regular has mean deductible \$400, low \$250
- This implies risk-neutral person with $>$ .3 accident probability should choose 'low'
- 24.5% average claim rate in the data
- 18% choose low: higher risk or more risk averse?

Descriptive Evidence

Cohen & Einav (2007)

TABLE 2B—SUMMARY STATISTICS—CONTRACT CHOICES AND REALIZATIONS

Claims	Low	Regular	High	Very high	Total	Share
0	11,929 (0.193)	49,281 (0.796)	412 (0.007)	299 (0.005)	61,921 (1.00)	0.8034
1	3,124 (0.239)	9,867 (0.755)	47 (0.004)	35 (0.003)	13,073 (1.00)	0.1696
2	565 (0.308)	1,261 (0.688)	4 (0.002)	2 (0.001)	1,832 (1.00)	0.0238
3	71 (0.314)	154 (0.681)	1 (0.004)	0 (0.000)	226 (1.00)	0.0029
4	6 (0.353)	11 (0.647)	0 (0.000)	0 (0.000)	17 (1.00)	0.0002
5	1 (0.500)	1 (0.500)	0 (0.000)	0 (0.000)	2 (1.00)	0.00003

Notes: The table presents tabulation of choices and number of claims. For comparability, the figures are computed only for individuals whose policies lasted at least 0.9 years (about 73 percent of the data). The bottom rows of Table 2A provide descriptive figures for the full dataset. The numbers in parentheses in each cell represent percentages within each row. The right-hand-side column presents the marginal distribution of the number of claims.

Cohen & Einav (2007) *AER*

Identification

- Non-parametric identification of risk preferences relies on:
  - Accident claims data and parametric count model
  - Exogenous variation in pricing / menus
- Exogenous price / menu variation:
  - Price experimentation by firm
  - Deductible cap changes over time impact 33% of population
- Limited selection into vs. out of firm
- In estimation model, identifying power may also come from functional form

Model Results

Cohen & Einav (2007)

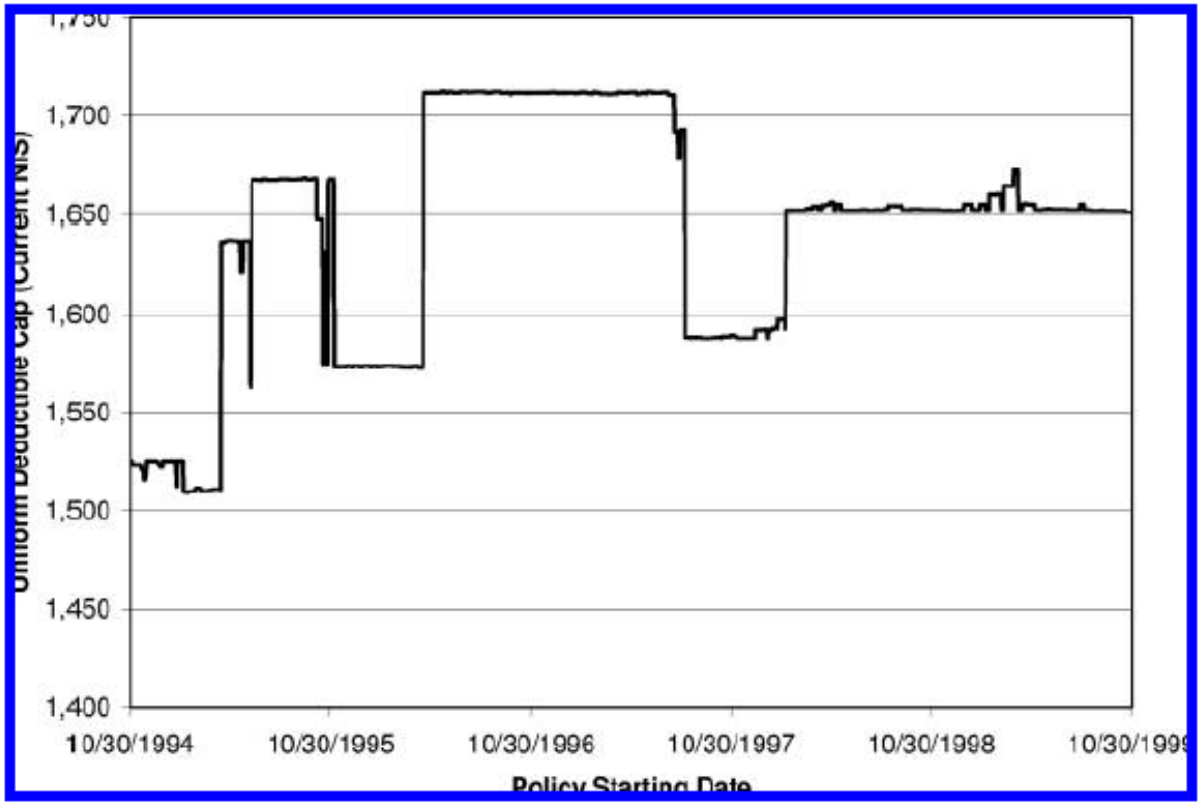


FIGURE 1. VARIATION IN THE DEDUCTIBLE CAP OVER TIME

Model

Cohen & Einav (2007)

- Model assumes Poisson claim arrival and CARA risk aversion
- Expected utility model for empirical setting:

$$v_i(p, d, w_i, \lambda_i, \psi_i) = (1 - \lambda_i t)u_i(w_i - pt) + (\lambda_i t)u_i(w_i - pt - d)$$

- λ_i Possion risk, w_i wealth, $u_i(x) = -exp(-r_i x)$
- Main object of interest is $G(r, \lambda)$
- With some additional derivations, utility models defines indifference curve in risk type / risk preference space

Model Results

Cohen & Einav (2007)

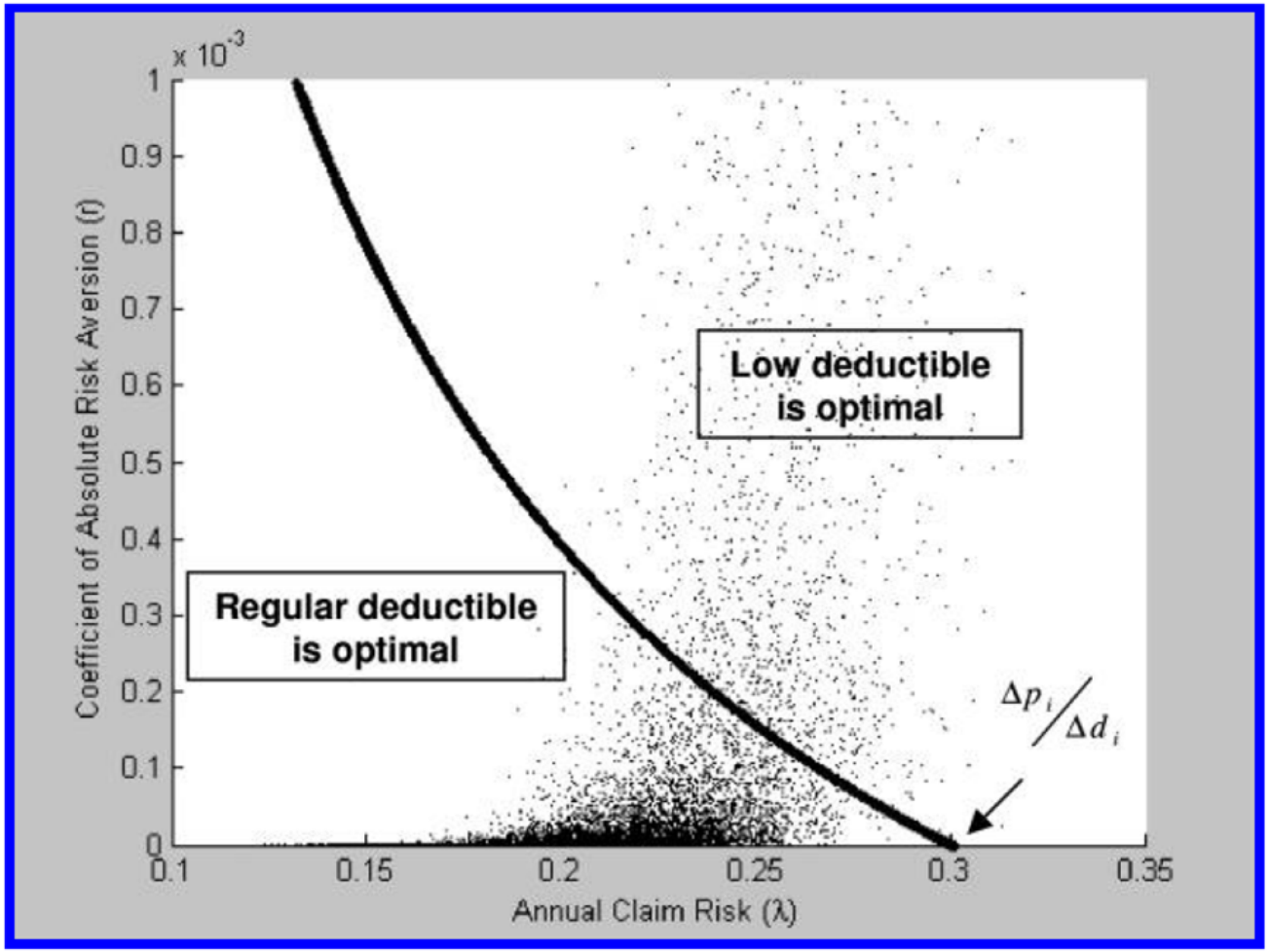


FIGURE 2. THE INDIVIDUAL'S DECISION—A GRAPHICAL ILLUSTRATION

Model to Data

Cohen & Einav (2007)

- Ex post information about claims proxies for private information about risk that consumers may have had at time of purchase
  - Assumption: Consumers know individual specific Poisson rate
  - Assumption: λ and r jointly lognormally distributed
  - Mapping from claims to marginal Poisson, then use choice to recover CARA and correlation with risk
- Results on joint distribution G:
  - High degree of risk aversion, high dispersion
  - Positive correlation between risk and risk-aversion

Model Results

Cohen & Einav (2007)

TABLE 5—RISK-AVERSION ESTIMATES

Specification[a]	Absolute risk aversion[b]	Interpretation[c]	Relative risk aversion[d]
Back-of-the-envelope	$1.0 \cdot 10^{-3}$	90.70	14.84
Benchmark model:			
Mean individual	$6.7 \cdot 10^{-3}$	56.05	97.22
25th percentile	$2.3 \cdot 10^{-6}$	99.98	0.03
Median individual	$2.6 \cdot 10^{-5}$	99.74	0.37
75th percentile	$2.9 \cdot 10^{-4}$	97.14	4.27
90th percentile	$2.7 \cdot 10^{-3}$	78.34	39.02
95th percentile	$9.9 \cdot 10^{-3}$	49.37	143.27
CARA utility:			
Mean individual	$3.1 \cdot 10^{-3}$	76.51	44.36
Median individual	$3.4 \cdot 10^{-5}$	99.66	0.50
Learning model:			
Mean individual	$4.2 \cdot 10^{-3}$	68.86	61.40
Median individual	$5.6 \cdot 10^{-6}$	99.95	0.08
Comparable estimates:			
Gertner (1993)	$3.1 \cdot 10^{-4}$	96.99	4.79
Metrick (1995)	$6.6 \cdot 10^{-5}$	99.34	1.02
Holt and Laury (2002)[e]	$3.2 \cdot 10^{-2}$	20.96	865.75
Sydnor (2006)	$2.0 \cdot 10^{-3}$	83.29	53.95

Overview of Empirics

Cohen & Einav (2007)

- Modeling and Identification:
  - Ex ante risk modeled parametrically and backed out directly from realized claims (by assumption)
  - Then, deductible choice identifies unobserved heterogeneity in r
  - Where the indifference sets cross, under assumption that people same on observables, can identify G
  - For tails, they have to rely on parametric assumptions
- For identification intuition, go back to Figure 2 and think about holding claim rate constant, and changing contracts.
- *High-amount of variation in risk-rate and contracts important for this!!*

Cohen & Einav (2007)

Results

- Clear and precise integration of theory of consumer choice in insurance markets, empirical application
- Model makes micro-foundations precise, relative to descriptive tests, allows welfare / counterfactuals.
  - Subject to MH, risk, other assumptions
- Supply side: Incremental cost to insurer of 'low'
- This paper doesn't do welfare analysis, but Einav et al. (2010) on annuities does
  - Correlations preferences / risk and implications for AS
- Interpretation of Risk Preferences
  - Implications for welfare analysis

CARA Risk Preferences

Implications for Scaling

- One reason to estimate structural model is to use risk preference estimates as true model that can be scaled up or down
- However, Rabin (2000) shows that CARA can imply 'unreasonable' preferences when scaled up:

ℓ/g	ρ
\$100 / \$101	0.0000990
\$100 / \$110	0.0009084
\$100 / \$150	0.0032886
\$1,000 / \$1,050	0.0000476
\$1,000 / \$1,500	0.0003288
\$1,000 / \$2,000	0.0004812
\$10,000 / \$11,000	0.0000090
\$10,000 / \$12,000	0.0000166
\$10,000 / \$15,000	0.0000328
\$10,000 / \$20,000	0.0000481

- Counterfactuals in same neighborhood as estimates?

Outline

- Model of Insurance Markets
- Empirics: Standard Choice Foundations
- Empirics: Adverse Selection
- Empirics: Choice Frictions

Testing for Adverse Selection

Existence

- Early empirical work tests for adverse selection, but does not investigate welfare consequences
- Chiappori & Salanie (2000) *JPE*:

$$y_i = \mathbf{1}(X_i\beta + \varepsilon_i)$$
$$z_i = \mathbf{1}(X_i\gamma + \eta_i)$$

- Binary probits (or bivariate) with application to French auto insurance:
  - $y = 1$, comprehensive coverage
  - $z = 1$ auto accident
- Correlation test: ε and η, statistically = 0
- Discussion: Binary costs, application to other markets

Einav et al. (2010) *QJE*

Welfare Consequences of AS

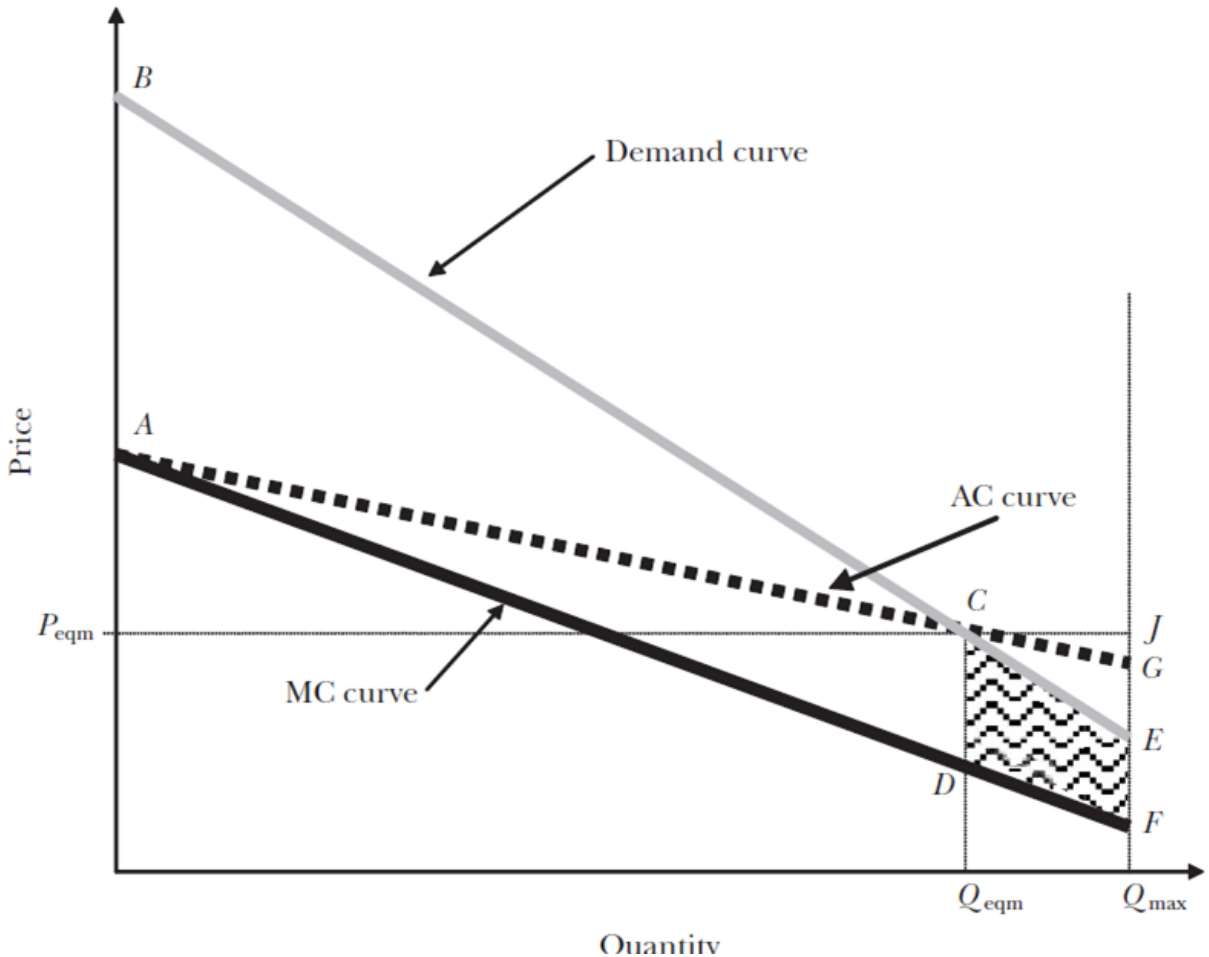
- Reduced form approach with minimal assumptions about micro-foundations
- Main idea: Use price variation in insurance contracts offered by large firm across locations (exogenous?) to trace out insurance demand and cost curves
  - Analysis conditional on set of contracts offered
  - With minimal assumptions, can quantify welfare loss from selection and study pricing counterfactuals
- Very nice complement to more structural papers.

Adverse Selection

EFC-(2010)

Figure 1

Adverse Selection in the Textbook Setting

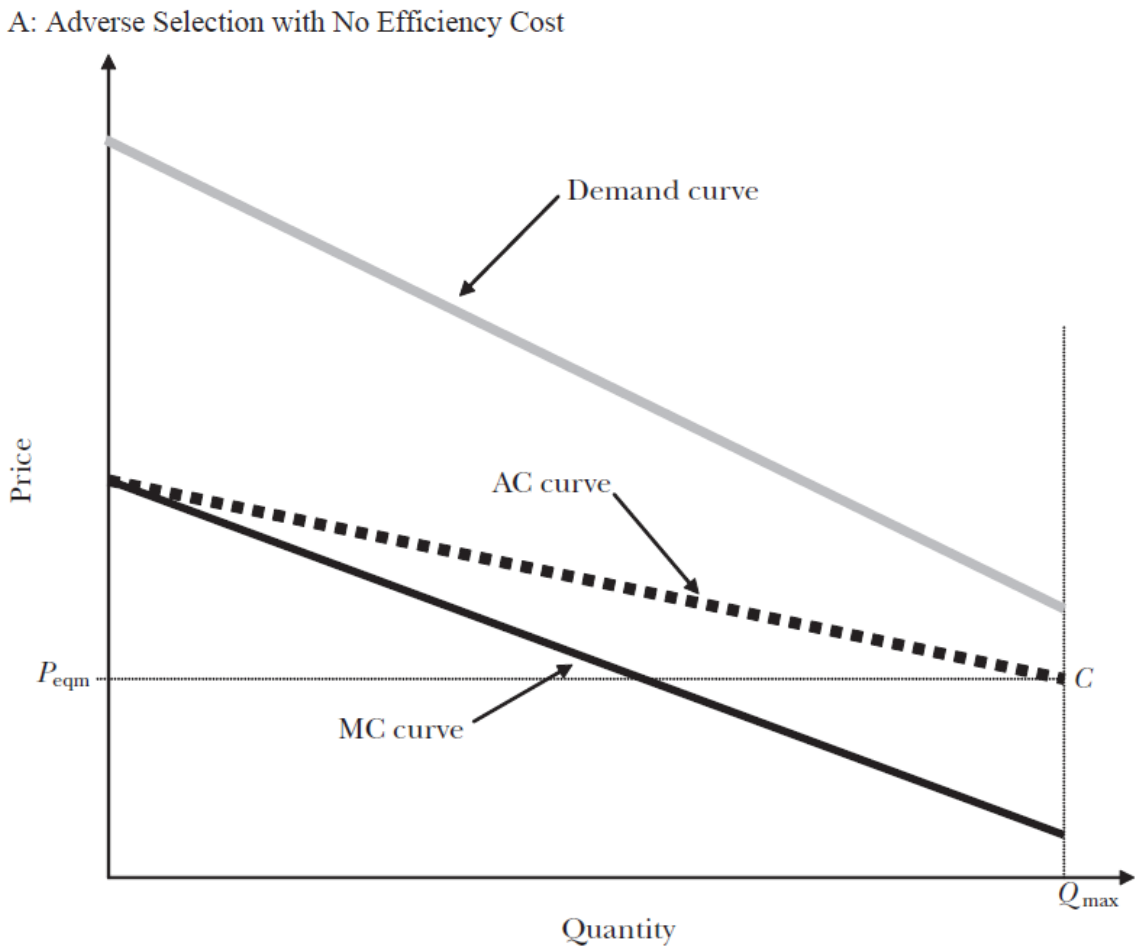


Adverse Selection

EFC-(2010)

Figure 2

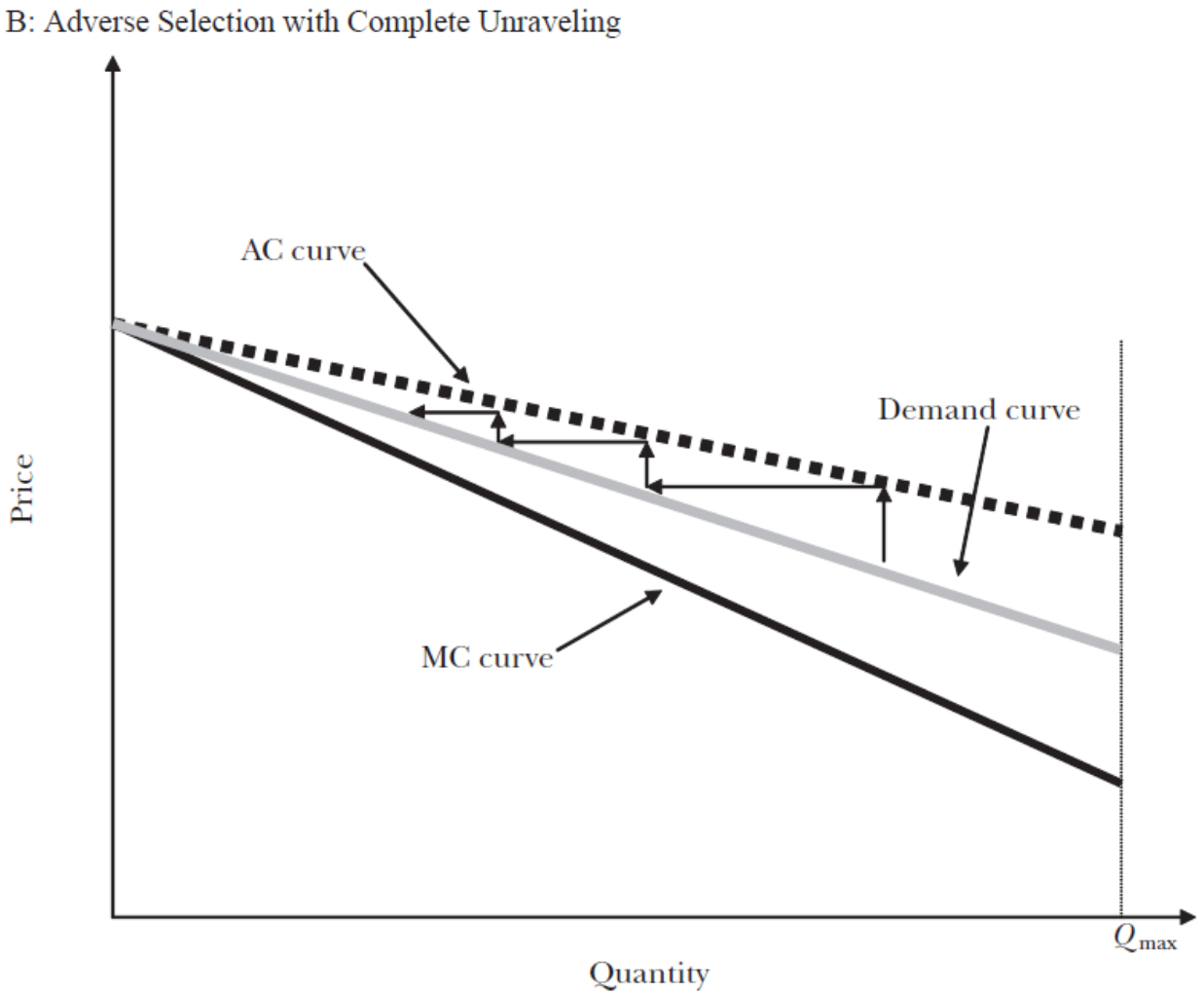
Specific Examples of Extreme Cases



Adverse Selection

EFC-(2010)

Figure 2 (continued)

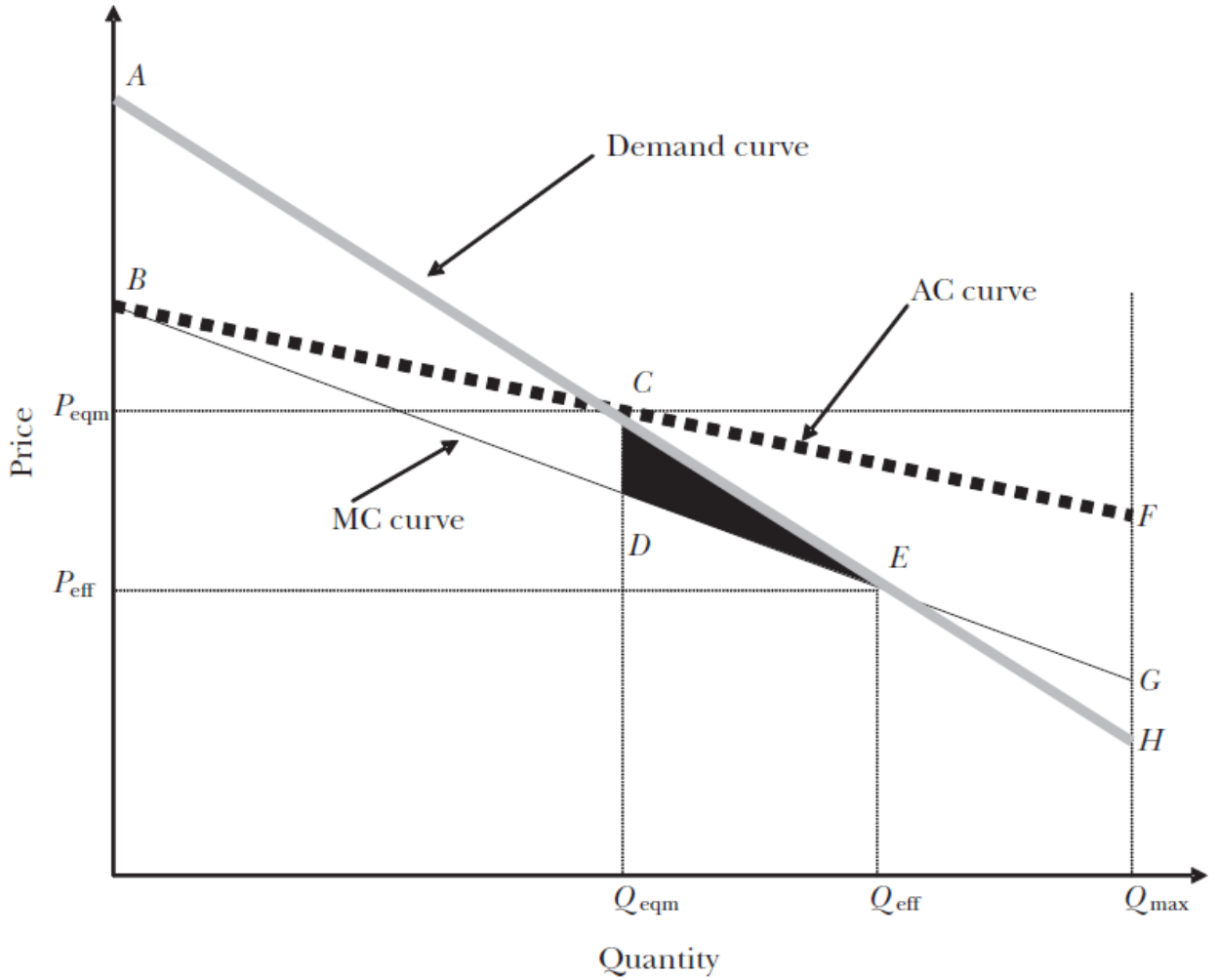


Adverse Selection

EFC-(2010)

Figure 3

Adverse Selection with Additional Cost of Providing Insurance

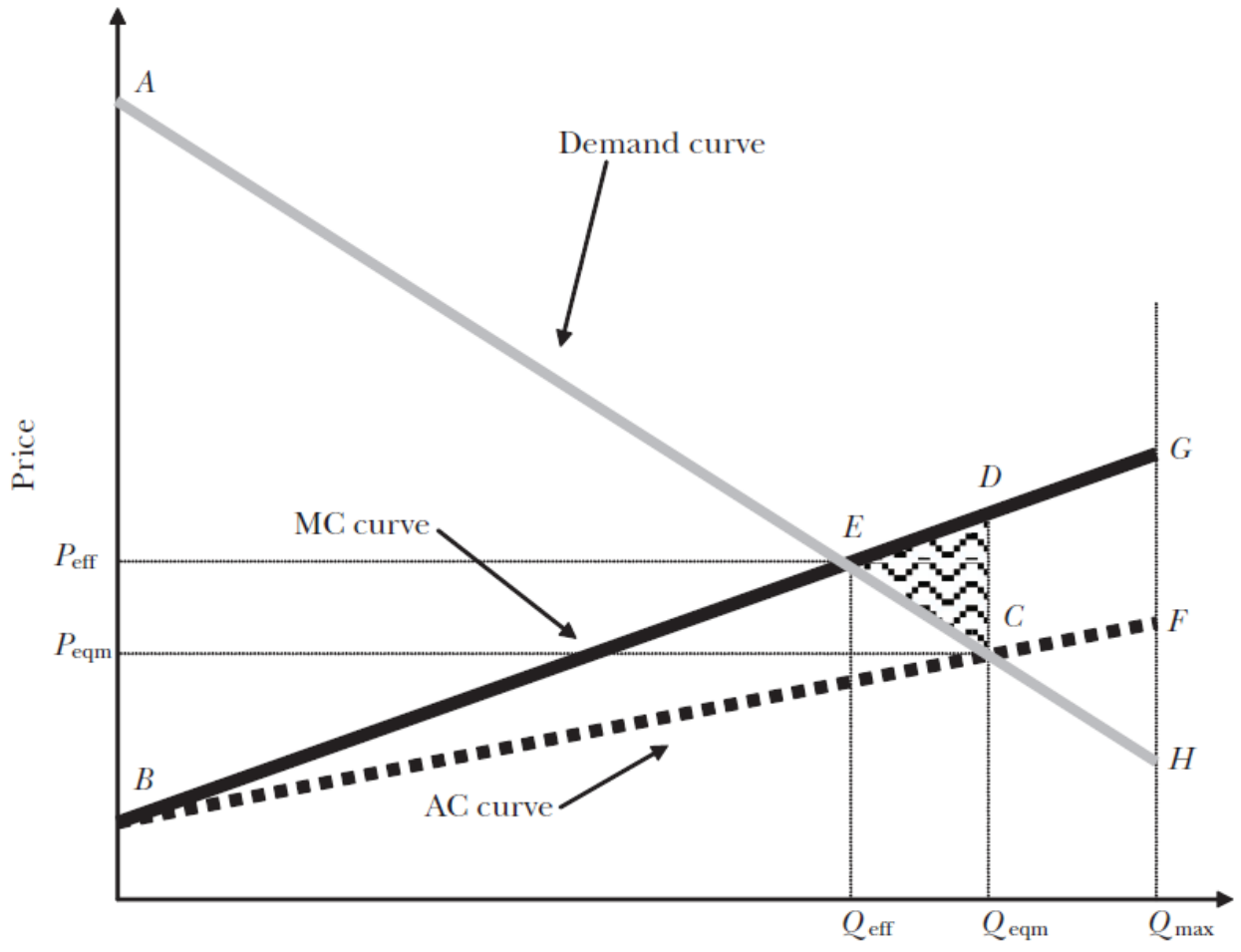


Adverse Selection

EFC-(2010)

Figure 4

Advantageous Selection



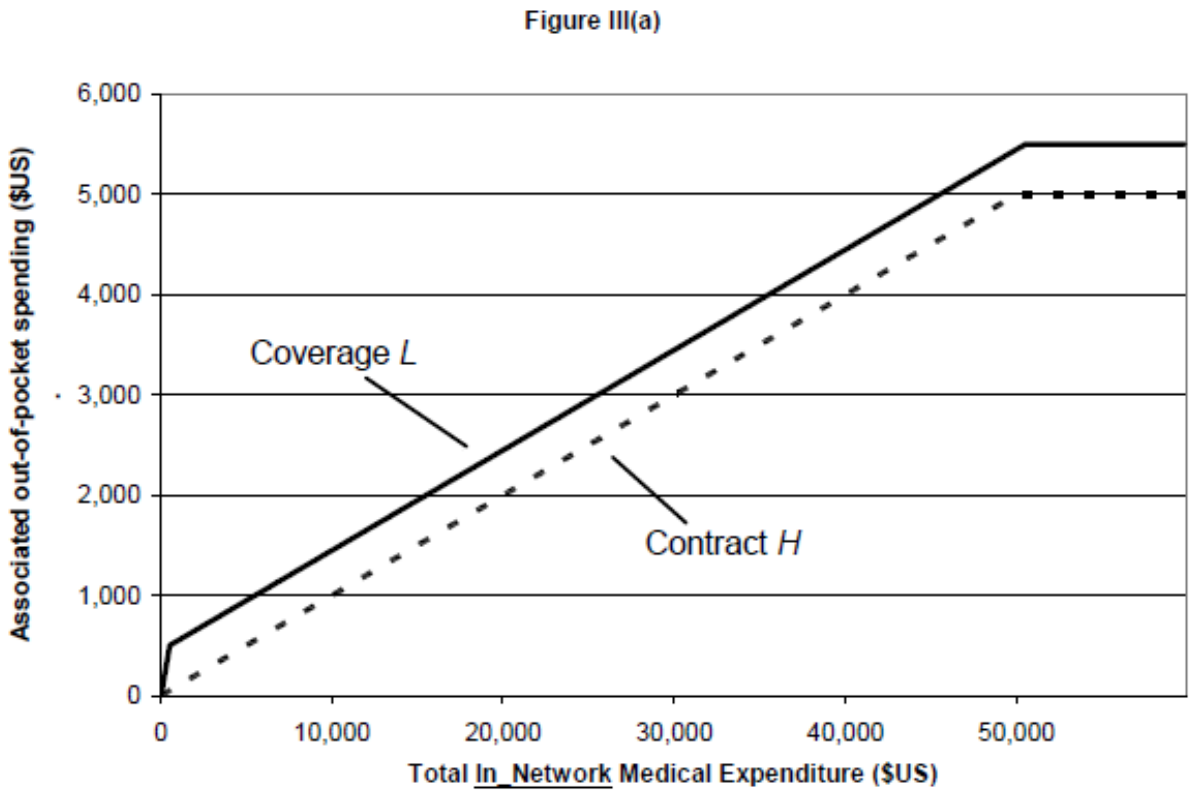
EFC (2010)

Data & Environment

- Rich individual-level panel data from Alcoa with:
  - Health claims and expenses
  - Health plan details and choices
  - Exogenous pricing variation by site (verified)
  - Detailed demographics
- 45,000 active employees in 39 states with new insurance options for 2004
- Main analysis for 4,000 employees. Thoughts?
- Data set typical of better data sets being used to study insurance questions right now

EFC (2010)

Insurance Contracts



- 0 vs. $500 deductible for H vs. L

EFC (2010)

Estimation

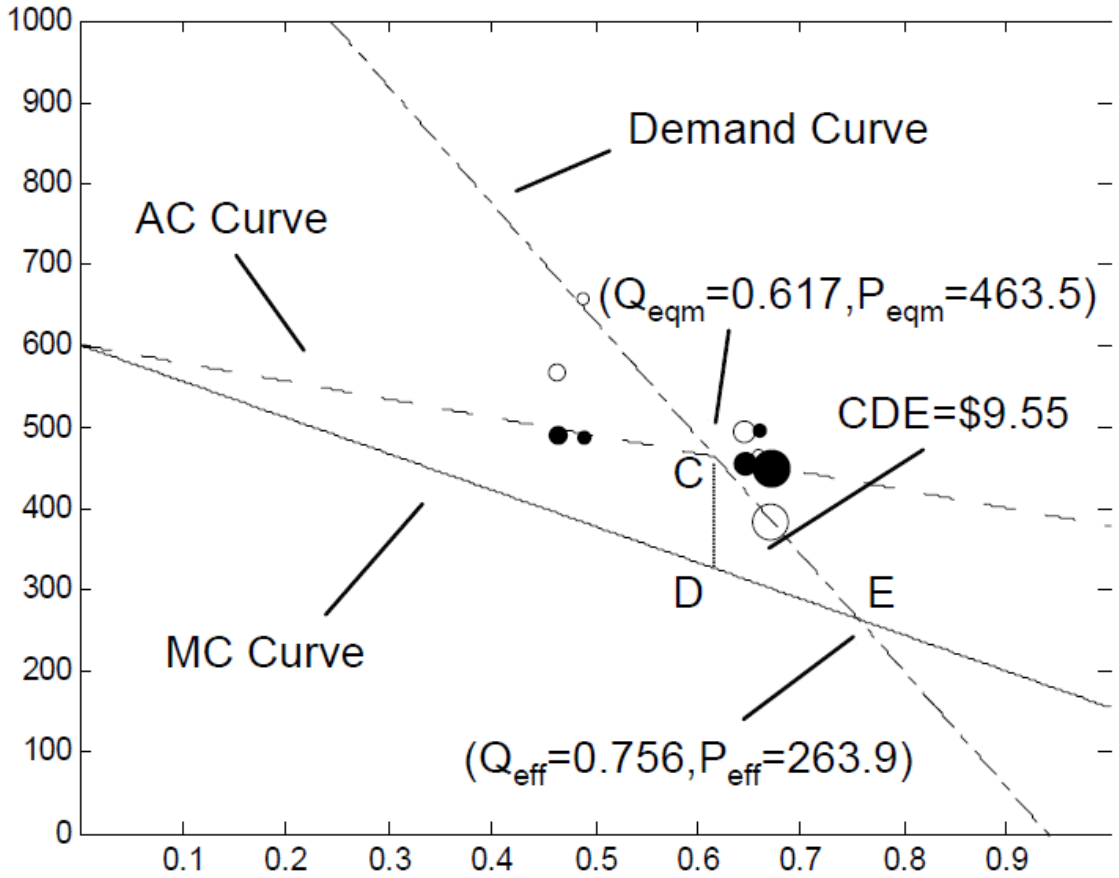
- With 'sufficient' price variation don't need parametric assumptions
- Demand and cost estimation:

$$D_i = \alpha + \beta p_i + \varepsilon_i$$
$$c_i = \gamma + \delta p_i + \mu_i$$

- Estimates translate to empirical AC, MC, D curves
- *Intentional* lack of detail to micro-foundations: answer important question in simple manner

EFC (2010)

Results



EFC (2010)

Takeaways

- Estimate increasing MC in price: adverse selection
- Quite small welfare loss. Why?
  - Conditional on contract space
  - Consumer preferences vs. information / decision-making
- Selection due primarily to pricing regulation
- Fantastic framework with simple methods delivers answer to key question
  - What questions cannot be answered?
  - What is key source of identification?

Adverse Selection

Other Examples

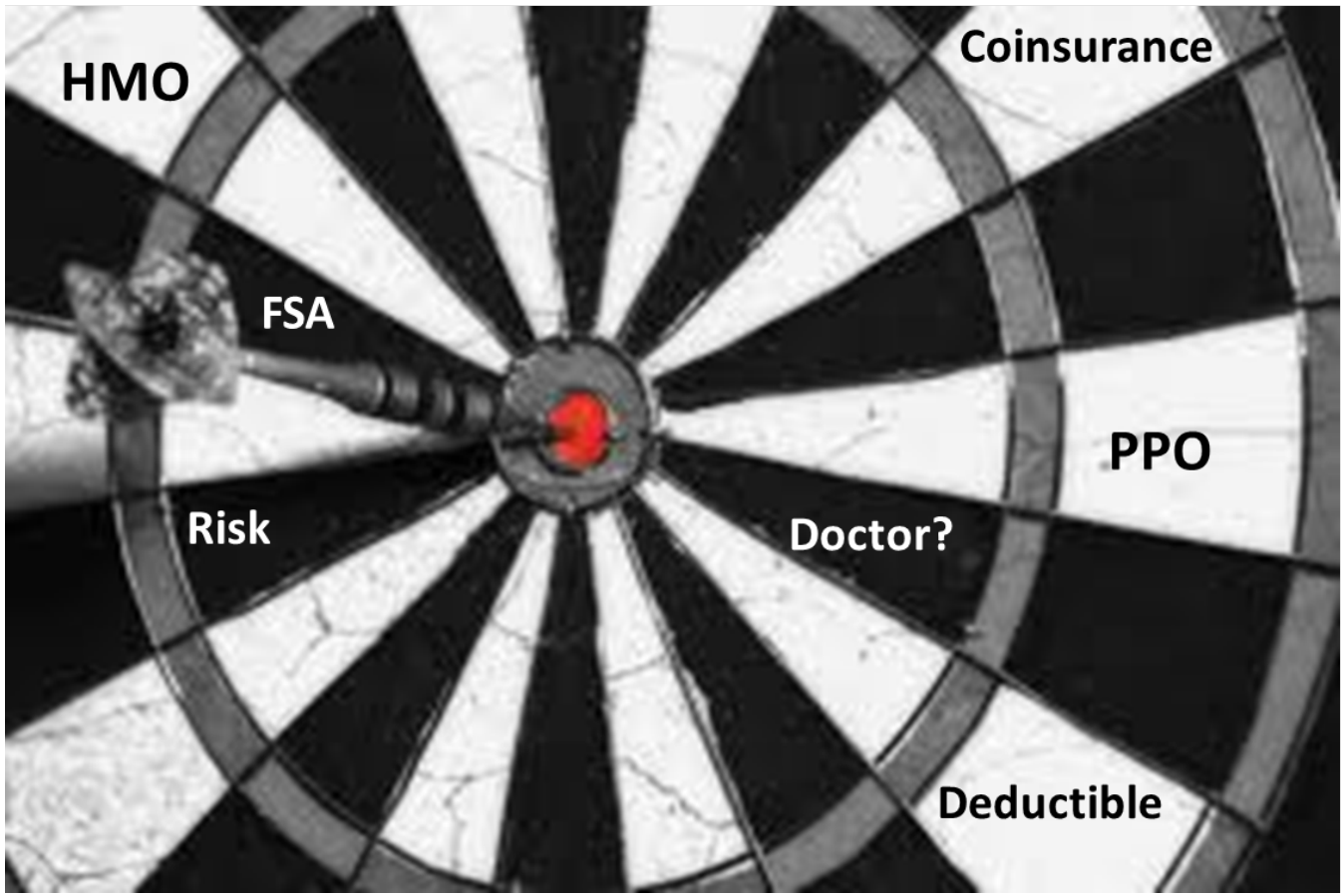
- Cutler & Reber (1998)
  - Trade-off between competition and adverse selection
  - Subsidy policy change at Harvard
  - Insurance plan risk-adjustment and community rating
- Cardon & Hendel (2001)
- Carlin & Town (2009)
- Einav, Finkelstein, Schrimpf (2010)
- Bundorf, Levin, Mahoney (2012)
  - Impact of no risk-rating on adverse selection, 2-11% welfare loss
  - Re-classification risk

Outline

- Model of Insurance Markets
- Empirics: Standard Choice Foundations
- Empirics: Adverse Selection
- Empirics: Choice Frictions

Health Insurance Choice in Reality

One way to choose.....



How Would You Choose?

Welcome to your new job....

- $\approx$ 60% people pick health, life, dental and other kinds of insurance through employer in US. Why?
  - Rationing in the 1940s
  - Aggregated bargaining / intermediary
- When you arrive at your new job you have 30 days to choose insurance
- Typical resources, if choice exists, include:
  - Open enrollment booklet for all benefits
  - Specific comparisons of medical plans
  - 'Tool' to help you pick

Let's take a look....

- Berkeley Open Enrollment Booklet
- Berkeley Medical Plan Comparison Chart
- Berkeley Online Medical Plan Choice Tool
  - https://uc2011.chooser2.pbgh.org/Pages/AboutYou.aspx

The Rational Insurance Consumer Knows....

- What medical care costs
- What a deductible is (per visit vs. full year)
- How specific services are treated differently
- FSA / HSA
- How to make optimal decisions under uncertainty....
- In vs. out of network doctors
- Family restrictions
- Time and hassle costs of each plan
- Worst case scenario

Recent work

Data, data, data....

- Work on choice adequacy and consumer information usually requires very detailed data on risk / choices
- Most work presumes consumers know everything about the options available and choice foundations
  - Implications for preference estimates
  - Implications for welfare analysis
  - CE (2007) and EFC (2010)
- Consumer lack of information and resulting decisions *could be* consistent with standard rational choice model
- If model used in practice is 'mis-specified' though, this generally matters!

Examples

- Abaluck and Gruber (2012)
  - Medicare Part D
  - Overweight premiums relative to expected costs
  - Overvalue financial characteristics relative to impacts
  - Little value on variance reduction
- Kling et al. (2012)
  - 'Comparison Friction'
  - Easy vs. hard to find information
  - Average decline $100 per year of letter recipients
- McFadden et al. (2012)
- Handel (2012)
- Handel & Kolstad (2012)

Adding Choice Frictions

- Handel (2012)
  - Adds inertia to expected utility model of insurance choice
  - Rich data with unique variation identifies inertia
  - Impact of adverse selection
- Handel & Kolstad (2012)
  - Addition of detailed economically motivated survey data
  - Choice foundations beyond standard ones
  - Welfare / policy implications

Handel (2012)

Adverse Selection & Switching Costs

- Investigates adverse selection in the presence of inertia
- Inertia and adverse selection have each been studied in *isolation* but *interaction* can also be important
- Primary questions:
  - Is inertia large?
  - Does inertia significantly impact consumer choices and markets?
  - How does the degree of adverse selection depend on inertia?
  - What is the welfare impact of reducing inertia in equilibrium?

What is Inertia?

Potential Micro-Foundations

1. Transaction costs:
   - Time / hassle costs of actually changing health plan
   - Time / hassle costs of researching alternative options
2. Learning
3. Search Costs & Biased Beliefs
   - Realized price change vs. ex ante expectations
   - Two-stage model of complex decision
4. Status-quo bias / psychological factors:
   - Persistence can result from deviations from rational behavior
   - Default option
5. Switching providers:
   - **Do not** measure these in my setting

Handel(2012): Data and Methods

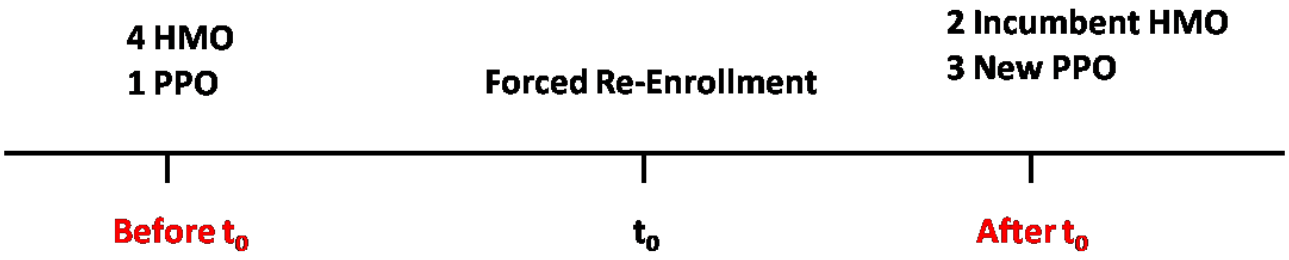
- Unique propriety panel data set on health insurance choice and utilization
  1. Forced re-enrollment into new health plan menu
  2. Detailed medical utilization data
  3. Leads to simple identification of inertia
- Descriptive evidence of inertia
- Panel discrete choice model quantifies:
  1. Inertia
  2. Ex ante health risk
  3. Heterogeneous risk preferences
- Realized utility model a la Cohen and Einav (2007) with richer state space

Data Overview

- Individual-level panel dataset provided by large employer ($\approx$ 10,000 employees) from 2004-2009:
  1. Choices: Health, FSA, HSA, dental, vision
  2. Detailed plan characteristics
  3. Demographics: Age, gender, income, family structure, time at firm, advanced degree, quantitative, zip code
- Every claim for every individual and covered dependent in PPO
  1. Medical: Diagnostic code (ICD-9), procedure code (CPT/NDC), provider id, provider specialty
  2. Financial: Total claim, insurer paid, deductible, coinsurance, copayment, claim date, network, pharmacy

Natural Experiment: Menu Change

Forced Re-Enrollment



- Forced t_0 re-enrollment:
  - Major initiative at firm to ensure 'active' choice
  - No default option at t_0
  - After t_0, employees have prior choice as default option
- 3 PPO post-t_0 only differentiated financially

Plan Characteristics

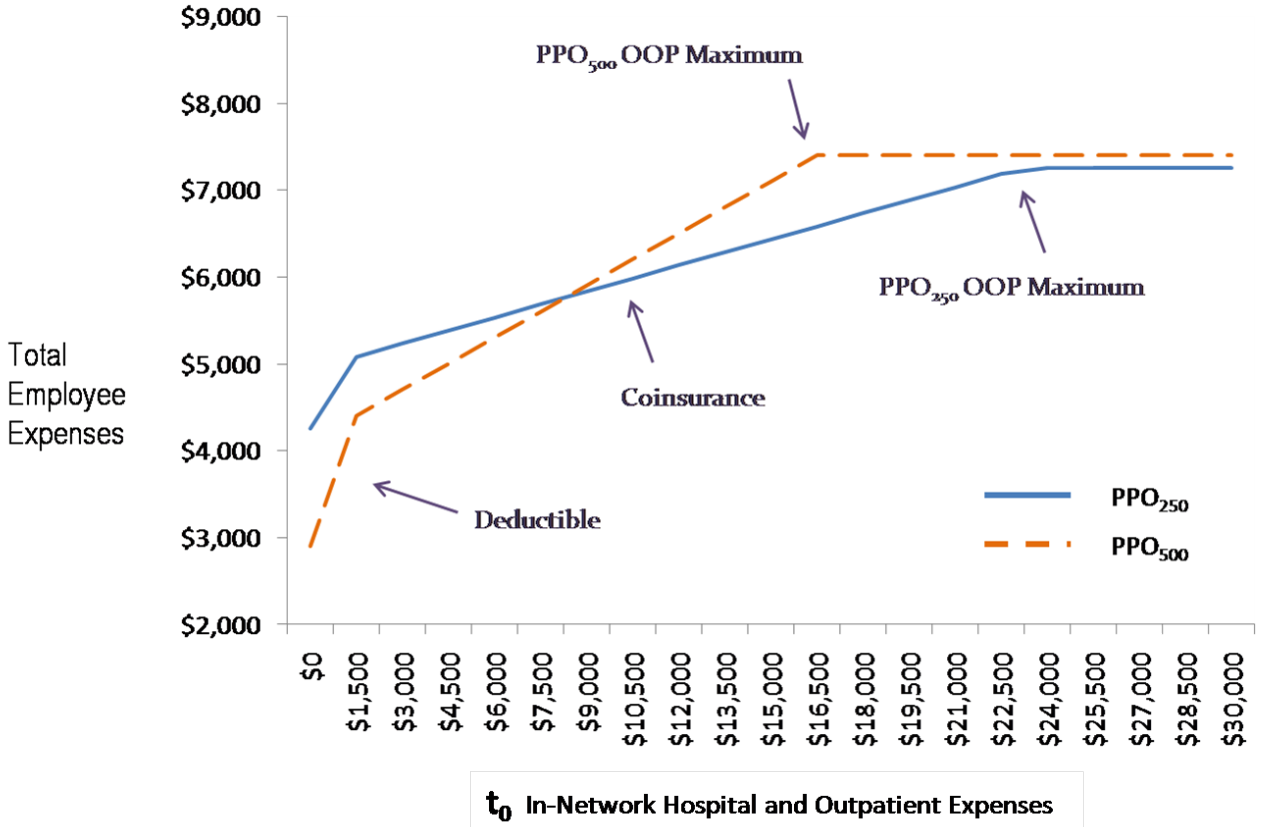
	PPO_{250}	PPO_{500}	PPO_{1200}
DEDUCTIBLE	250 (750)	500 (1500)	1200 (2400)
CO-INSURANCE	10%	20%	20%
PHY. VISIT CO-PAY	25	25	NA
ER CO-PAY	100	100	NA
MENTAL HEALTH CI	50%	50%	50%
PHARMA CO-PAY	5/25/45* (10/50/75)	5/25/45* (10/50/75)	NA NA
OUT-OF-POCKET MAX			
Inc.Tier 1	1000 (3000)	1500 (4500)	2000 (6000)
Tier 2/3	2000 (5000)	3000 (7000)	4000 (8000)
Tier 4/5	3000 (8000)	4000 (9000)	5000 (10000)

* Prescription Max of 1500 per person

** Out of Network Characteristics not Listed Above

Motivating Example: Inertia

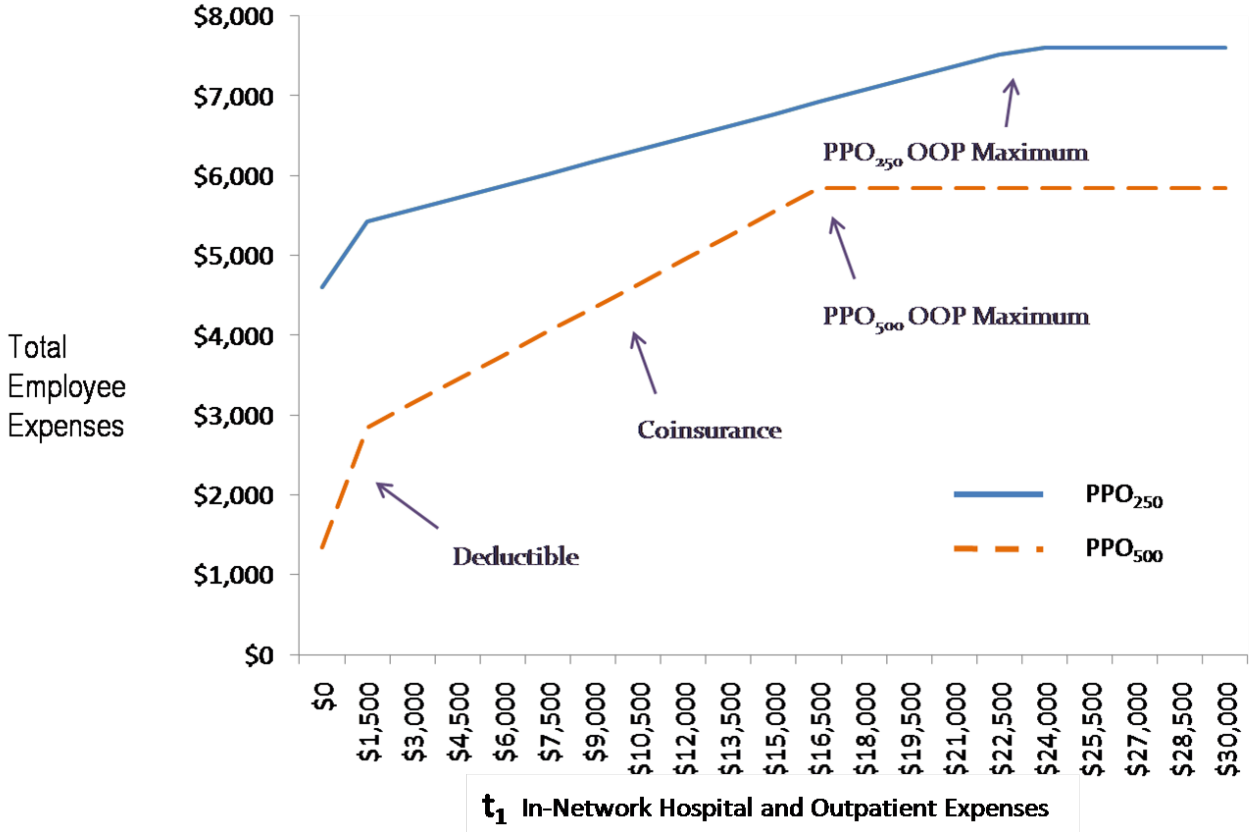
Evidence from Dominated Plan Choice



- Sick people should choose more insurance, healthy people less

Motivating Example: Inertia

Evidence from Dominated Plan Choice

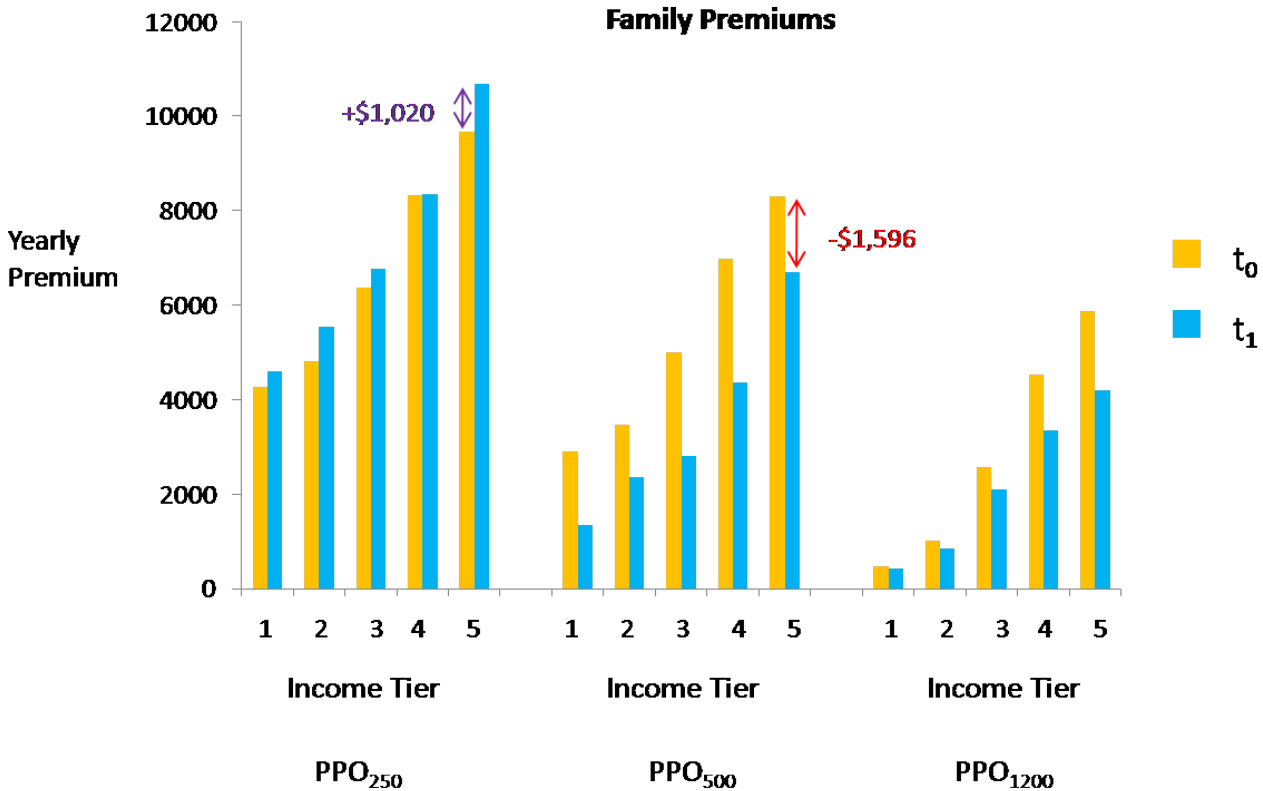


- 30 % of families had plan become completely dominanted over time. 89% of those families continue to choose plan once it is dominated.

Health Plan Premiums

Large Price Changes

- Premiums depend on covered dependents and income
- Significant price changes for years with a default option



Inertia

Evidence From New Entrants

Cohort 1
New Entrants at t_0
N = 1377

	Year t_0	Year t_1
PPO_{250}	21 %	20 %
PPO_{500}	23 %	26 %
PPO_{1200}	17 %	15 %
HMO_1	20 %	20 %
HMO_2	19 %	19 %

Cohort 2
New Entrants at t_1
N = 1305

PPO_{250}	-	11 %
PPO_{500}	-	43 %
PPO_{1200}	-	14 %
HMO_1	-	20 %
HMO_2	-	12 %

Inertia

Evidence From New Entrants

Cohort 1
New Entrants at t_0
N = 1377

	Year t_0	Year t_1
PPO_{250}	21 %	20 %
PPO_{500}	23 %	26 %
PPO_{1200}	17 %	15 %
HMO_1	20 %	20 %
HMO_2	19 %	19 %

Cohort 2
New Entrants at t_1
N = 1305

PPO_{250}	-	11 %
PPO_{500}	-	43 %
PPO_{1200}	-	14 %
HMO_1	-	20 %
HMO_2	-	12 %

Inertia

Evidence From New Entrants

		Year t_0	Year t_1
Cohort 1 New Entrants at t_0 N = 1377	PPO_{250}	21 %	20 %
	PPO_{500}	23 %	26 %
	PPO_{1200}	17 %	15 %
	HMO_1	20 %	20 %
	HMO_2	19 %	19 %
Cohort 2 New Entrants at t_1 N = 1305	PPO_{250}	-	11 %
	PPO_{500}	-	43 %
	PPO_{1200}	-	14 %
	HMO_1	-	20 %
	HMO_2	-	12 %

Inertia

Evidence From New Entrants

	Cohort 1 New Entrants at t_0 N = 1377	Cohort 2 New Entrants at t_1 N = 1305
Median age	31	31
Mean age	33	32
Income tier 1	50 %	47 %
Income tier 2	31 %	32 %
Income tier 3	10 %	12 %
Income tier 4	4 %	4 %
Income tier 5	5 %	5%

Adverse Selection

Evidence of significant adverse selection against PPO_{250}

	N	Mean Fam Size	Mean	25th pct	Median	75th pct
PPO_1	2022	2.24	13331	1257	4916	13022
PPO_{250} t_0	1328	2.18	16976	2041	6628	16135
PPO_{500} t_0	338	2.20	6151	554	2244	6989
PPO_{1200} t_0	280	2.53	6742	658	2958	8073
PPO_{250} t_1	1244	2.19	17270	2041	6651	16707
PPO_{500} t_1	461	2.19	7759	708	2659	8588
PPO_{1200} t_1	232	2.57	6008	589	2815	7191

- Table uses t_1 claims levels in all years

Choice Framework

Realized Utility Model

- Model to quantify inertia and its welfare impact in environment with adverse selection
  - Data alone provide evidence of substantial inertia
- Panel discrete choice model from t_0 to t_2 quantifies:
  1. Inertia
  2. Ex ante health risk
  3. Heterogeneous risk preferences
- Explicit estimates of expected-utility function parameters
- Simple supply-side pricing model

Consumer Expected Utility

Consumer Beliefs

- Each family k has uncertainty $F_{kjt}(OOP)$ about future health expenditures for plan j at the time t of plan choice
- Consumers maximize expected utility over set of plans J:

$$\max_{j \in J} U_{kjt} = \int_0^{\infty} u_k(m_j, OOP) f_{kjt}(OOP) dOOP$$

- Estimate $\widehat{F_{kjt}(OOP)}$ derived from separate cost model
- Consumer expenditure beliefs conform to $\widehat{F_{kjt}(OOP)}$

Empirical Setup

CARA

- Consumers have constant absolute risk aversion (CARA) utility index:

$$u_k(m_j, OOP) = -\frac{1}{\gamma_k} e^{-\gamma_k(X_k^A)(m_j - OOP)}$$

$$m_j = W_{kt} - P_{kjt} + \eta(X_k^B)\mathbf{1}_{j=j-1} + \delta_k(Y_k)\mathbf{1}_{PPO_{1200}} + a_j H_k + \epsilon_{kjt}(Y_k)$$

- W_{kt} – wealth, P_{kjt} – premium, η – inertia (value foregone), δ_k – CDHP preference, X_k – demographics, Y_k – family status, a_j – high-cost heuristic, H_k high-cost indicator
- Empirical utility:

$$\max_{j \in J} U_{kjt} = \int_0^\infty u_k(m_j, OOP) \widehat{f_{kjt}(OOP)} dOOP$$

Cost Model

Estimating F_{kjt}

- Cost model separate from choice model:
  - Assumption: No private information or moral hazard
  - Based on data analysis
- Estimate $\widehat{F_{kjt}(OOP)}$ is information set at time of plan choice.
  - Incorporates past year of medical information with ACG software
  - Consumer could have more or less information than F_{kjt}
- Potential sources of private information:
  1. Pregnancy
  2. Condition Intensity
  3. Genetic predisposition

Cost Model II

Outline of Methods

- ACG software predicts future expenditures θ using past medical information ξ and demographics ζ:

$$A : \xi \times \zeta \rightarrow \theta$$

- Divide claims into four distinct categories $c \in C$
- Group individuals into ex ante risk cells for each c
  - Estimate joint distribution over C with ex post data
- Plan-specific out-of-pocket expenditure mapping:

$$\Omega_j : C \rightarrow OOP_j$$

- Incorporate family-level restrictions

Model Identification

Menu Change

- Menu change w/ no default allows observation of same consumers in periods with and without inertia
- Unobserved heterogeneity:
  - Same within each consumer over time
  - Population distribution same over time
- Inertia vs. Unobserved Heterogeneity:
  - Inertia shifts choices only t_1 and after
  - Unobserved Heterogeneity shifts choices in all periods
  - Combination of initial choice, panel, detailed medical/cost data, and network homogeneity
- Risk Preference vs. PPO_{1200} intercept

Estimation

- Simulated maximum likelihood for choice sequence starting at t_0 for each k
- Optimization: Maximize probability of choices in data with respect to model parameters
  - Simulate draws from F_{kjt}
  - Simulate draws from preference random coefficients
  - Normalization of ϵ and U_{kjt}
  - Smoothed Accept-Reject of each sequence for given parameters
- Robustness: Utility function, unobserved heterogeneity

Results

Parameter	Base	Primary	MH Robust	γ Robust	ϵ Robust
Inertia Individual, η_s	1779 (72)	**1729** (28)	1859 (107)	2430 (116)	1944 (150)
Inertia Family, η_f	2354 (62)	**2480** (26)	2355 (113)	3006 (94)	2365 (34)
IN - FSA	- -	**-551** (56)	-669 (155)	-723 (131)	-417 (50)
IN - Income	- -	**-32** (13)	-59 (15)	-8 (43)	-7 (15)
IN - Quant	- -	**5** (138)	-40 (80)	-537 (223)	-6 (92)
IN - Manager	- -	**198** (292)	277 (164)	875 (200)	224 (244)
IN - Chronic	- -	**80** (46)	29 (67)	-221 (148)	67 (35)
IN - Salient	- -	**156** (83)	95 (60)	61 (212)	123 (54)
SC - Total Pop. Mean, η **[Pop. Standard Deviation]**	2032 [446]	2087 [286]	1886 [387]	1914 [731]	1986 [316]
Risk Aversion Mean - Intercept , μ	$3.12 * 10^{-4}$ $(1.1 * 10^{-5})$	$2.32 * 10^{-4}$ $(9.0 * 10^{-6})$	$2.31 * 10^{-4}$ $1.10 * 10^{-5}$	-8.94 (0.43)	$1.90 * 10^{-4}$ $1.0 * 10^{-5}$
Risk Aversion Mean - Income ,	$4.21 * 10^{-5}$ $(3.0 * 10^{-6})$	$2.90 * 10^{-5}$ $(4.0 * 10^{-6})$	$1.80 * 10^{-5}$ $3.00 * 10^{-6}$	0.07 (0.016)	$2.40 * 10^{-5}$ $3.00 * 10^{-6}$
Risk Aversion Mean - Age ,	- -	$2.27 * 10^{-6}$ $(1.7 * 10^{-7})$	$3.45 * 10^{-6}$ $1.80 * 10^{-7}$	0.28* (0.011)	$2.59 * 10^{-6}$ $1.50 * 10^{-7}$
Risk Aversion Std. Deviation , σ_γ	$1.88 * 10^{-4}$ $(8.0 * 10^{-6})$	$1.88 * 10^{-4}$ $(6.63 * 10^{-5})$	$1.27 * 10^{-4}$ $6.00 * 10^{-6}$	1.37 (0.06)	$1.04 * 10^{-4}$ $5.9 * 10^{-5}$

Results II

Interpretation of Risk Parameters

	Absolute Risk Aversion	Interpretation
Normal Heterogeneity		
Mean / Median Individual	$4.22 * 10^{-4}$	94.6
25th percentile	$2.95 * 10^{-4}$	96.1
75th percentile	$5.49 * 10^{-4}$	93.8
95th percentile	$7.31 * 10^{-4}$	92.2
99th percentile	$8.59 * 10^{-4}$	91.8
Log normal Heterogeneity		
Mean	$9.82 * 10^{-4}$	91.0
25th percentile	$1.53 * 10^{-4}$	97.2
Median	$3.85 * 10^{-4}$	95.0
75th percentile	$9.72 * 10^{-4}$	91.1
95th percentile	$3.70 * 10^{-3}$	72.8
99th percentile	$9.30 * 10^{-3}$	51.1
Comparable Estimates		
Cohen-Einav (2007) Benchmark Mean	$3.1 * 10^{-3}$	76.5
Cohen-Einav (2007) Benchmark Median	$3.4 * 10^{-5}$	99.7
Gertner (1993)	$3.1 * 10^{-4}$	97.0
Holt & Laury (2002)	$3.2 * 10^{-2}$	21.0
Sydnor (2006)	$2.0 * 10^{-3}$	83.3

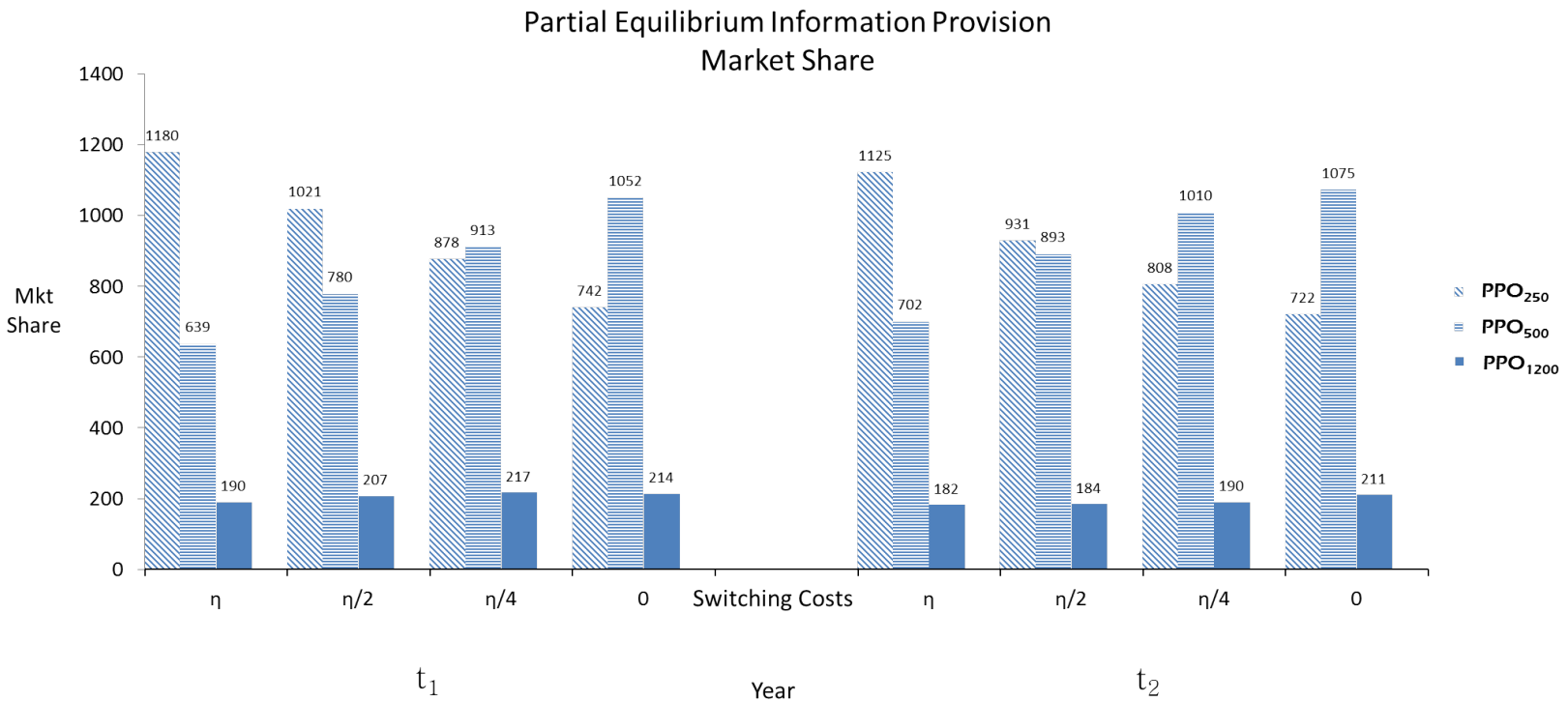
Counterfactual Analysis

Reduction in Inertia

- Investigate counterfactual environment with reduced inertia
- Price-conscious consumer choice is cornerstone of:
  - National insurance reform: health insurance exchanges
  - Large employer purchasing strategies
- Policies to reduce Inertia:
  1. Personalized plan recommendations
  2. Decision making tools
  3. Standardized /simple benefit representation
  4. Choice framing
  5. Strong oversight body for all consumer decision issues

'Naive' Pricing Policy Impact

Market Share Changes



'Naive' Policy Welfare Impact

Z = .25

	t_1	t_2
Mean Δ CEQ		
Population	\$96	\$114
Switchers Only	\$175	\$196
Mean Welfare Change: % Total Premiums		
Mean Employee Premium (MEP)	\$2,067	\$1,954
Welfare Change Population	4.6%	5.8%
Welfare Change Switchers	8.5%	10.0%
Mean Welfare Change: % Total Emp. Spending		
Mean Total Emp. Spending	\$4,373	\$4,486
Welfare Change Population	2.2%	2.5%
Welfare Change Switchers	4.0%	4.4%

Full Re-Pricing Analysis

Endogenous Insurance Pricing

- Insurance prices adjust along with new choices for $Z < 1$
- Recreate exact pricing rule
  - Close to prior work, resembles common pricing environments
- Start at given prices p_0
- Total premium lagged average cost:

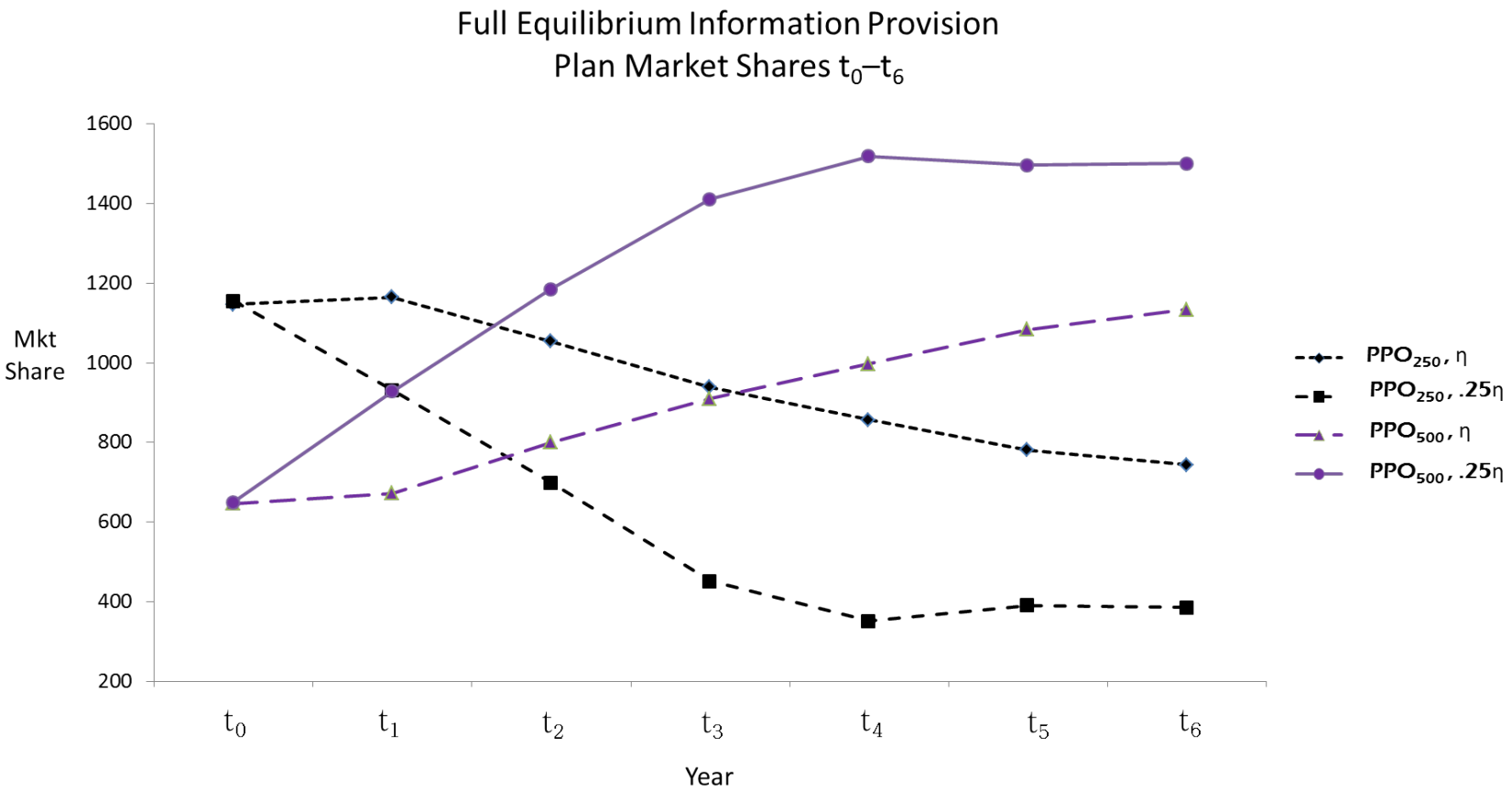
$$TP^y_{jt} = AC_{K^y_{j,t-1}} + L$$

- Firm gives subsidy for all j as % of PPO_{1200} premium:

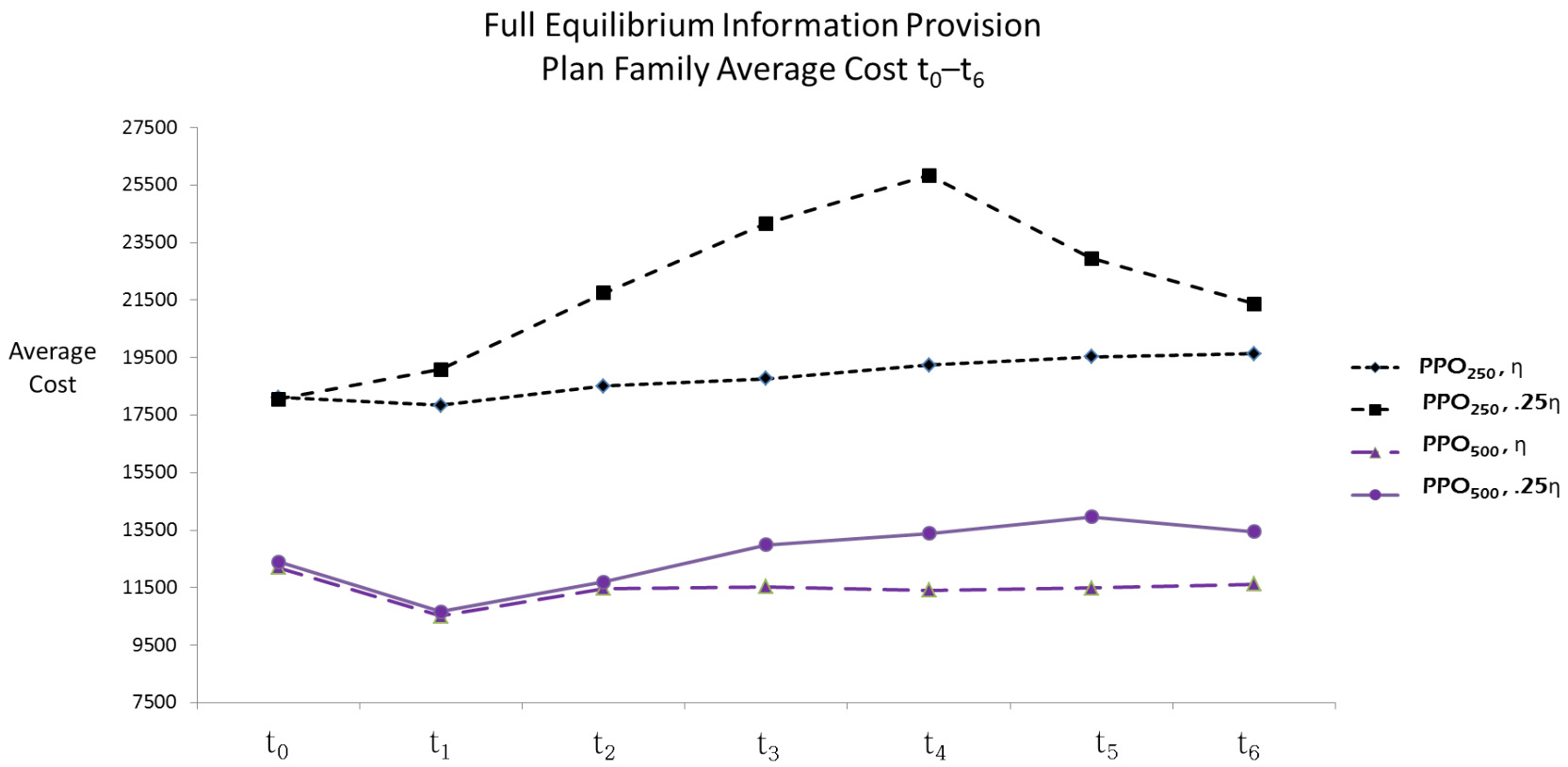
$$P_{kjt} = TP^y_{jt} - S(X_k)\, TP^y_{PPO_{1200}t}$$

Impact of Policy on Market Share

Death Spiral?



Impact on Plan Prices



Full Equilibrium Welfare Impact

When Nudging Hurts.....

	t_1	t_2	t_4	t_6	**Avg.** t_1-t_6
Mean Δ CEQ					
Population	-$63	-$104	-$144	-$118	-$115
Switcher Pop. %	51%	49%	48%	53%	49%
Switchers Only	$86	$175	$ 245	$242	$186
Non-Switchers Only	-$205	-$391	-$555	-$432	-$442
Welfare Change: % Premiums					
Mean Employee Premium	$1,471	$1,591	$1,455	$1,259	$1,500
Welfare Change Population	-4.8%	-6.5%	-9.9%	-9.4%	-7.7%
Welfare Change Switchers	5.6%	11.0%	16.9%	19.2%	12.4%
Welfare Change Non-Switchers	-13.9%	-24.6%	-38.1%	-34.3%	-29.4%
Welfare Change: % Total Spending					
Mean Total Emp. Spending	$3,755	$4,097	$4,022	$3,862	$4,015
Welfare Change Population	-1.7%	-2.5%	-3.6%	-3.06%	-2.9%
Welfare Change Switchers	2.3%	4.3%	6.1%	6.3%	4.6%
Welfare Change Non-Switchers	-5.5%	-9.5%	-13.8%	-11.2%	-11.0%

Full Equilibrium Welfare Impact

Policy Effectiveness & First Best

	First-Best	Baseline	.75η	.5η	.25η	0
Mean Δ CEQ (% of Premiums)						
Population	$123 (8.2%)	- (-)	-$41 (-2.7%)	-$73 (-4.9%)	-$115 (-7.7%)	-$107 (-7.1%)
Switchers	-$538 (-35.9%)	- (-)	$1,017 (67.8%)	$766 (51.0%)	$186 (12.4%)	$118 (7.9%)
Non-Switchers	$953 (63.5%)	- (-)	-$249 (-16.6%)	-$371 (-24.8%)	-$442 (-29.4%)	-$382 (-25.4%)
Single	-$683 (-45.5%)	- (-)	-$153 (-10.2%)	-$295 (-19.7%)	-$319 (-21.2%)	-$286 (-19.0%)
Family	$826 (55%)	- (-)	-$54 (3.6%)	$119 (7.9%)	$61 (4.1%)	$47 (3.1%)

Handel (2012)

Takeaways

- Inertia can have a substantial impact on choice and market allocation in insurance markets
- When consumers have substantial inertia, sorting is less acute and there can be less adverse selection
- Not Considered: Impact of reduced inertia on competition
- Analysis shows that in general policy context interaction *can* be important
  - In insurance markets, better individuals decisions does not mean higher welfare
- Implications for Medicare Part D, insurance exchanges

Handel (2012)

Takeaways

- Use of descriptive evidence to support structural analysis
- Internal validity vs. external validity
- Impact of improved data on potential questions
- Insurance is a complex product!

Handel-Kolstad (2012)

Consumer Choice Foundations

- Difficult factors to model in health insurance:
  - Information / uncertainty about health plan features
  - Information / uncertainty about personal health risk
  - Hassle costs of plan administration and use
  - Behavioral / heuristic decision-making
- Why do we care about non-standard foundations?
  - More precise choice predictions in observed / counterfactual settings
  - More precise characterization of standard foundations
  - Welfare / policy analysis

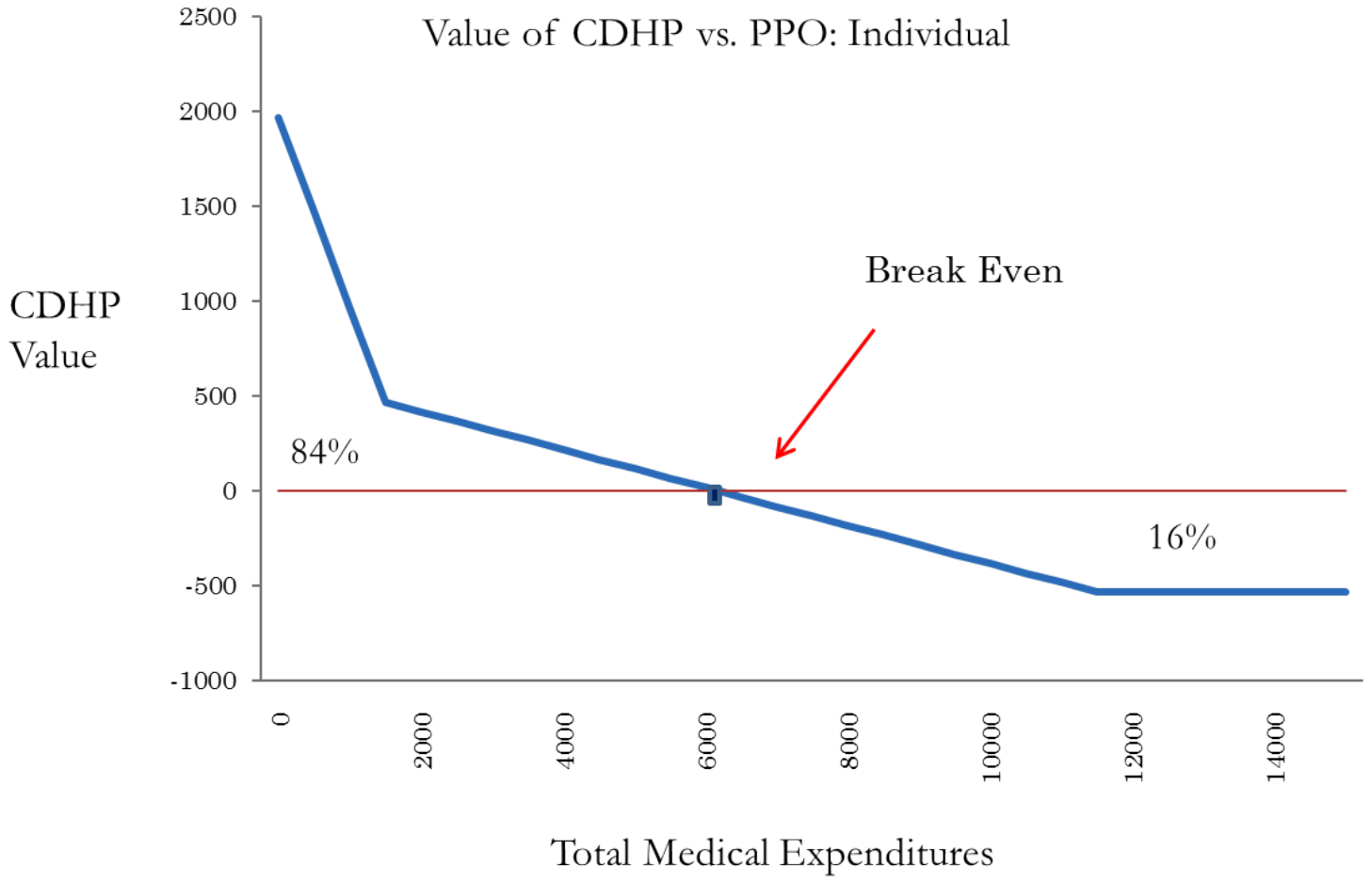
Administrative Data

Claims and Choices

- Study investigates proprietary linked data 2009-pres.
  - Benefits data on health plan choices
  - Detailed health claims / utilization data
  - Detailed survey for random subset of consumers
- Detailed administrative data for US employees of large firm with approx. 60,000 US employees covering 120,000 lives
  - Insurance choices / design features
  - Demographic / organizational data
  - Health claims
  - ACG medical software output, medically relevant predictive metrics
- Difficult to answer crucial questions on benefits choice / satisfaction without both data sources

Plan Design

Individual Ex-Post Break Even



- Free PPO vs. more complex HDHP plan

Puzzling Choices?

Give Up Value with PPO

- Simple model of ex-post value of actual choices assumes risk neutrality / perfect foresight:
  - 73% of employees should choose HDHP (100% HSA value)
  - With 50 (0) % HSA value, 60 (35) % should choose HDHP
  - $665 mean HDHP surplus, $4,590 max, -$1,828 min
- *Puzzle:* 7% choose HDHP in 2011, 15% in 2012
  - Very high risk coefficients necessary to rationalize
  - Must be other things going on: what are they?

Linked Consumer Survey

- Custom survey designed and given to 3 distinct cohorts:
  - 2012 PPO enrollees
  - 2012 new HDHP enrollees
  - 2012 multi-year HDHP enrollees
- Survey sent to 1500 per cohort, $\approx$ 38% response rate overall
  - 511 PPO, 571 new HDHP, 579 old HDHP
- Cohort design permits testing of certain hypotheses:
  - Learning about HDHP and HSA benefits
  - Knowledge of TME conditional on HDHP experience
  - 9 focus groups with over 200 employees total

Non-Standard Choice Foundations

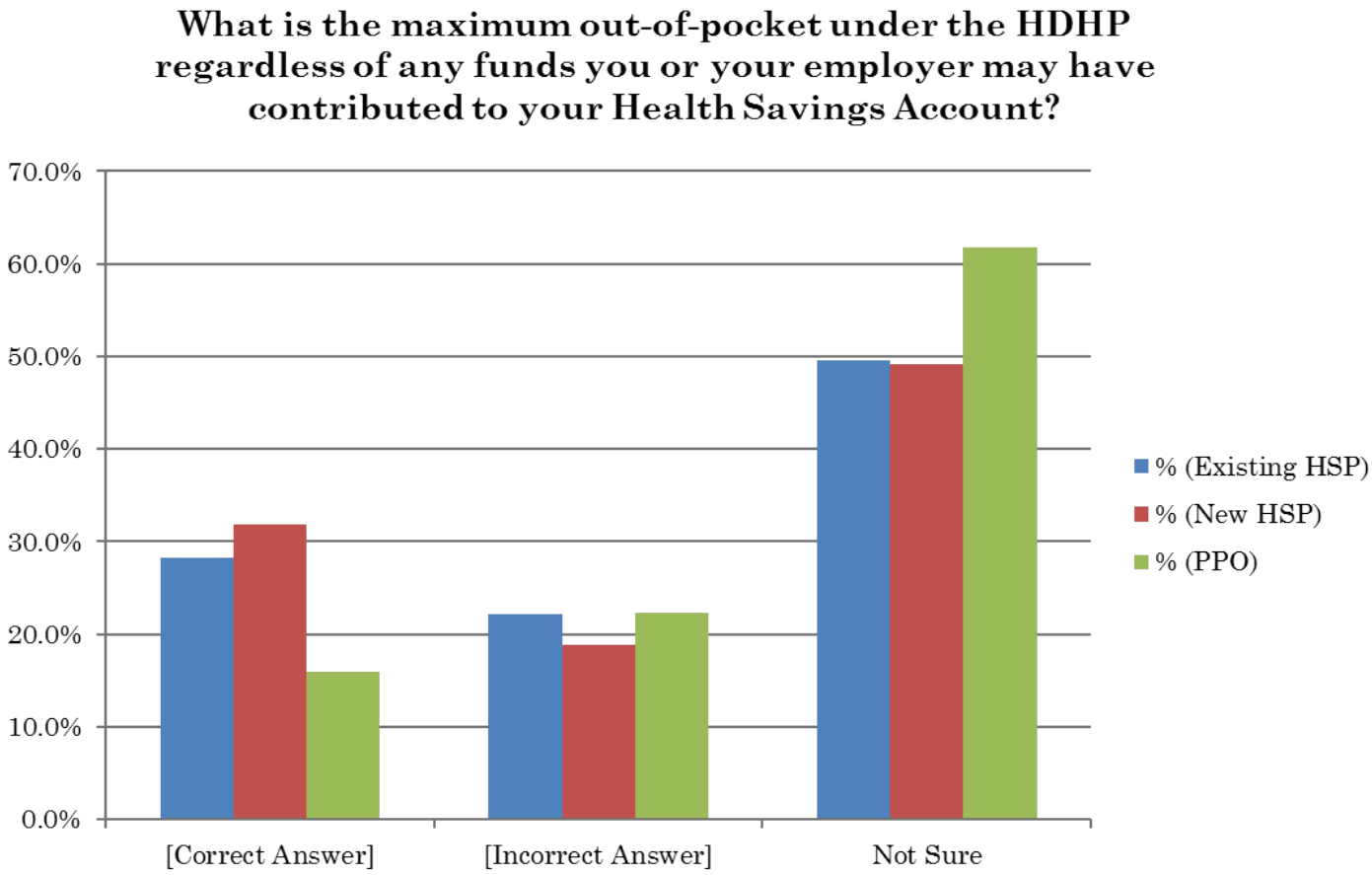
Survey Questions

- Survey questions target existence of, and learning about following phenomena:
  - Knowledge / understanding of benefit design
  - Knowledge / beliefs about own TME
  - Hassle / time costs of plan administration
  - Provider network knowledge
  - Switching costs / inertia
  - Tax preferences
  - Computational ability / cognition
  - Mental account / savings
  - Distaste for cost-sharing in medical decisions
- How much do risk preferences / epsilon proxy for these factors in standard structural specifications?

HDHP Downside Risk

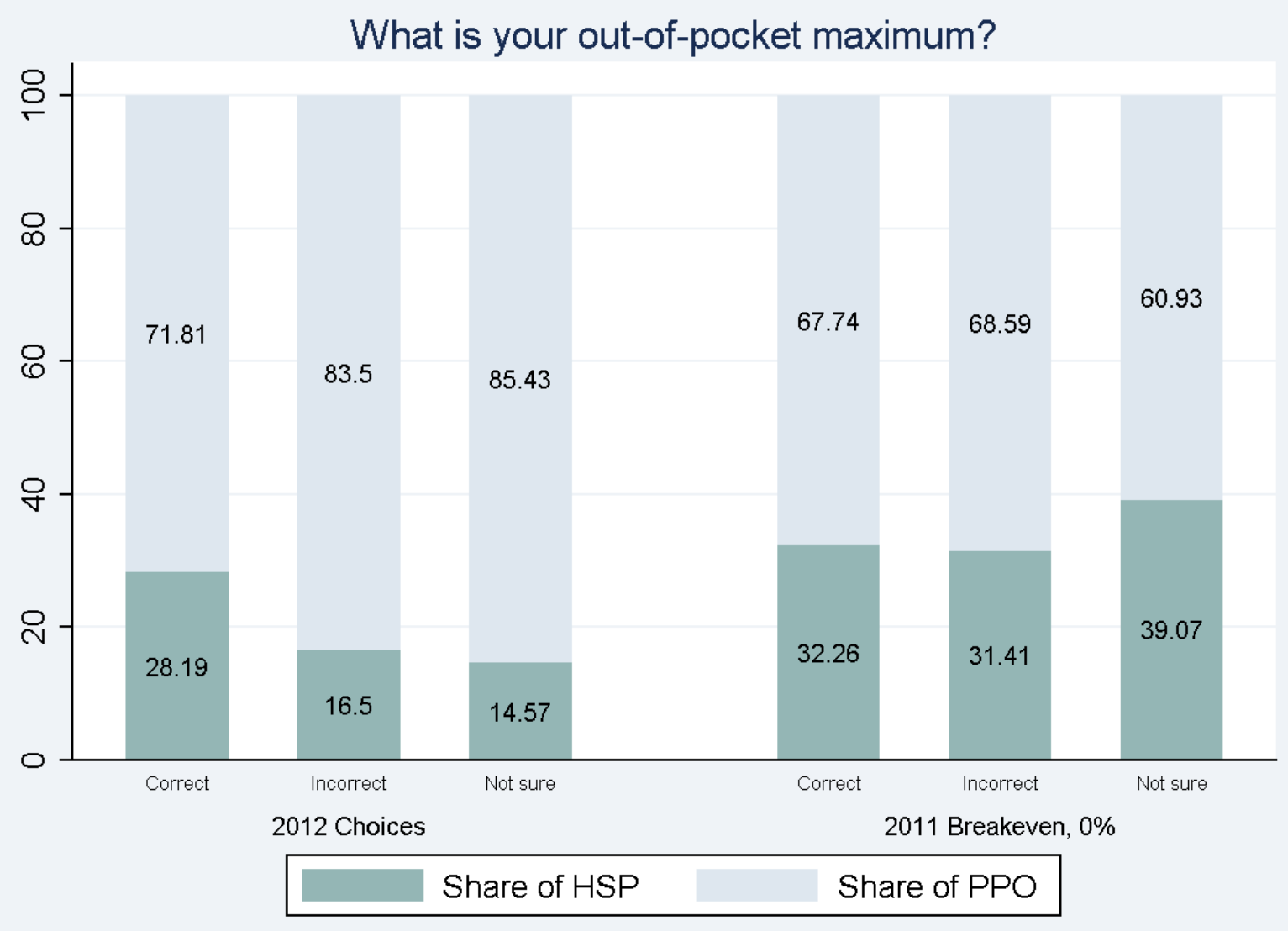
Limited Information / Understanding

- Small HDHP OOP risk relative to income
- Confusion increases uncertainty, decreases satisfaction



Plan Choice Shares

Function of Survey Answers



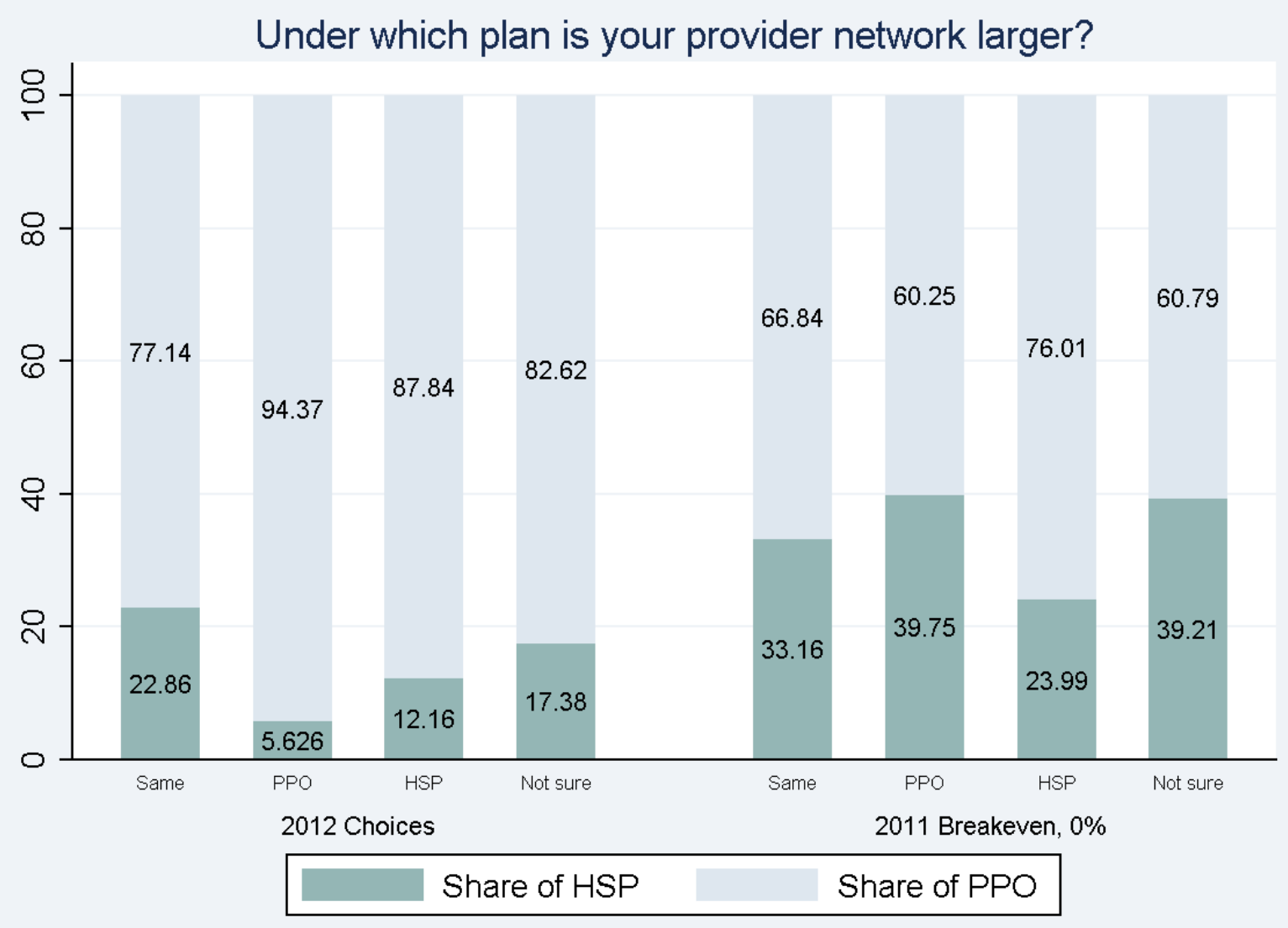
Provider Network Knowledge

Networks the same!

- There is legitimate uncertainty about whether one can access the same providers / have same treatments in the PPO and HDHP
- Networks / Services identical: this is mentioned directly in OE materials
- For each survey cohort *less than 50%* know that one can access the same providers in both plans:
  - Existing HDHP – 41.3%
  - New HDHP– 49.4%
  - PPO – 32.1%
- Most others answer 'not sure' though 15% of PPO enrollees think PPO has more providers
- Uncertainty can have major impact on choice / satisfaction

Plan Choice Shares

Function of Survey Answers



Overview of Models

- Purpose of model is to understand underlying choice motivations / mechanisms, which can then be used for counterfactual prediction / welfare
- Incremental addition of non-traditional choice foundations to illustrate how estimates of risk preferences change

1. Baseline or 'Standard' structural approach
   - Full population
   - Survey re-sampled population
2. Identification of Inertia / Switching Costs
   - New employees, Full Population
3. Full model
   - All non-traditional foundations
   - Imposed Inertia from Baseline Estimates

Full Model

Additional Choice Foundations

- Model builds on baseline model:

$$u_k(m_j, OOP) = -\frac{1}{\gamma_k} e^{-\gamma_k(X_k^A)(m_j - OOP)}$$

$$m_j = W_{kt} - P_{kjt} + \eta(X_k^B)\mathbf{1}_{j_t = j_{t-1}} + \Sigma_{s=1}^{S} \beta_s I_s * I_{HDHP} + \epsilon_{kjt}$$

- S reflects number of binary variables added from survey questions for non-traditional choice foundations
  - I_s is indicator variable for each effect
  - Impacts utility for HDHP relative to PPO
  - Inertia not estimated here: imposed from full population baseline specification

- Non-structural implementation, but impacts key structural foundations

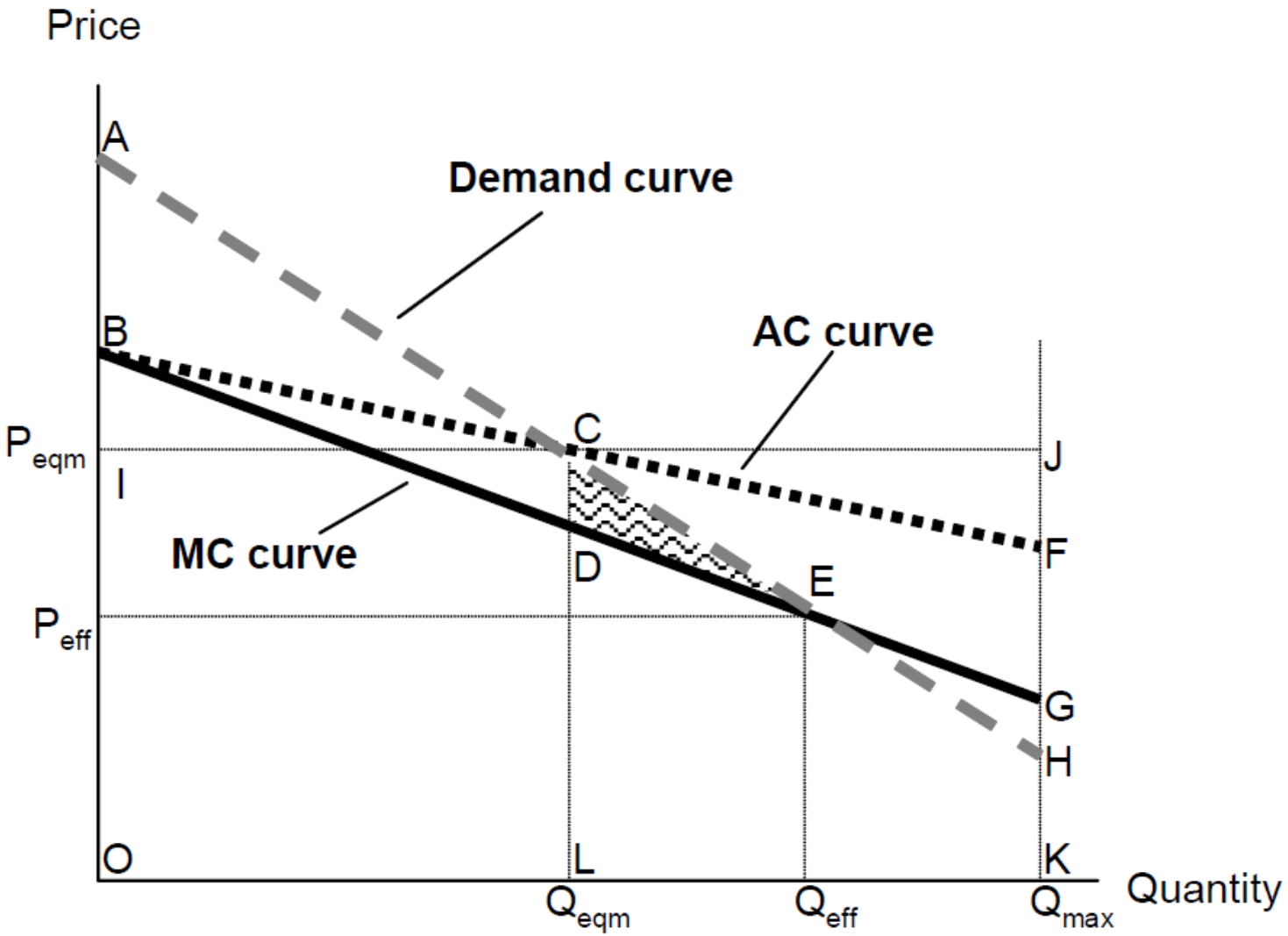
Handel-Kolstad (2012)

Results

- Inclusion of survey effects reduces risk preference estimates
  - Welfare consequences of forced move to HDHP
  - Welfare consequences of adverse selection
  - Impact on adverse selection with information provision
- High potential for using new types of data combined
- Advantage of structural approach

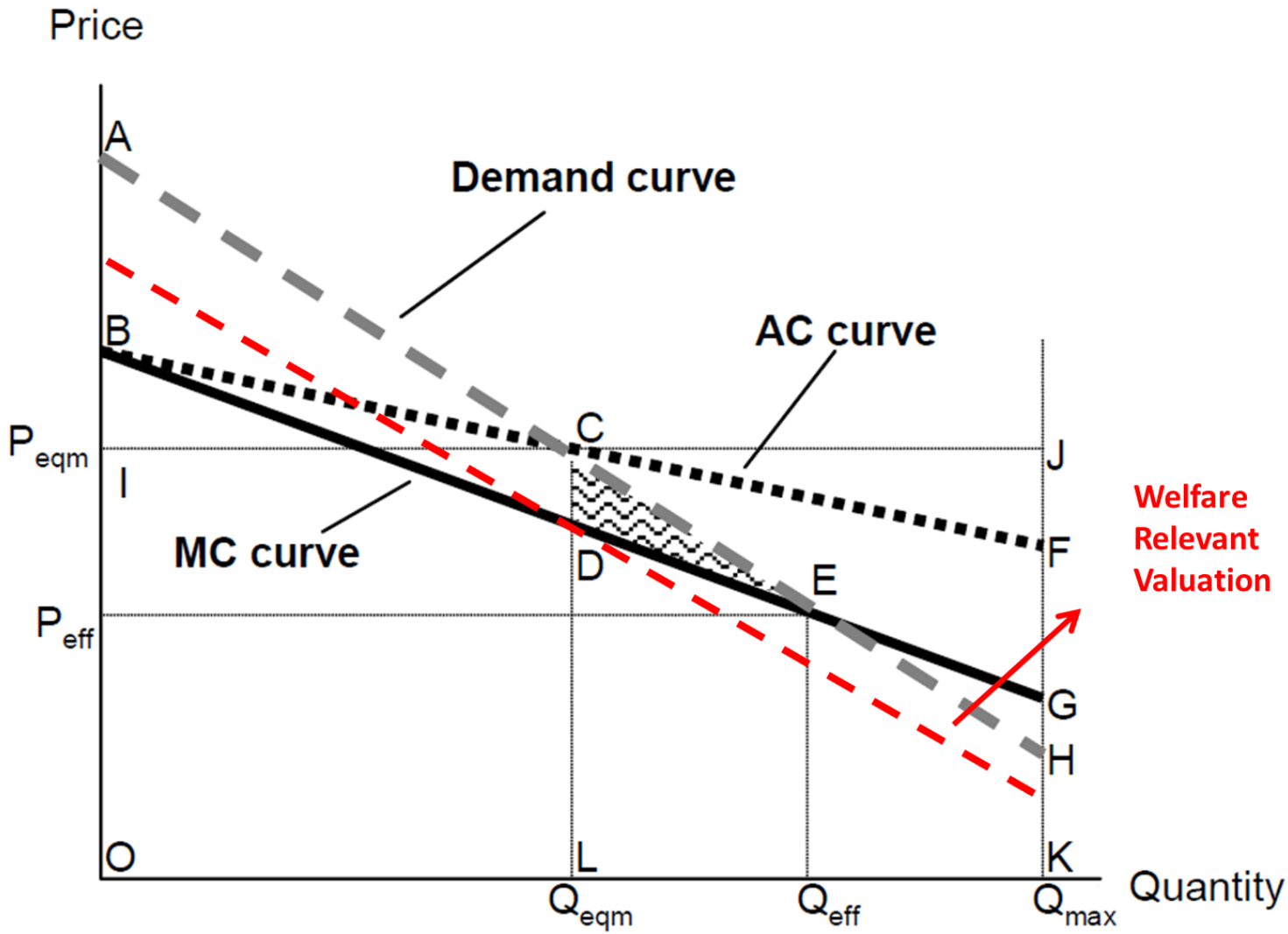
Adverse Selection

Welfare Loss Observed Setting



Adverse Selection

Welfare Loss Observed Setting



Empirical Analysis of Insurance

Final Thoughts

- Empirical analysis of insurance built on rich theoretical literature
- Empirical work on consumer choice foundations, adverse selection has made major advances
- Fewer advances for competition with choice frictions / adverse selection, market design
- Focus on health insurance today, but opportunities to study many kinds of insurance / credit markets

Adverse Selection

Imperfect Information

- Akerlof (1970) is canonical example of adverse selection
- Application to the used car market
- Model where price is a signal of used car quality (known by seller but not buyer)
  - Buying insurance at price is signal of health risk
- Illustrates market unraveling from selection, and potential negative welfare consequences of adverse selection
  - Rational behavior of agents implies negative externality

Akerlof (1970)

Model of Used Car Market

- Two groups of traders, buyers and sellers
- Sellers have N cars, ordered w/ uniform quality x on $[0, 2]$
- Sellers have perfect information about quality x, cars look identical to buyers
- Seller utility function:

$$u(y, n) = y + \int_n^N x(t)dt$$

- Define $x(t)$ as *density of quality per unit*, y is income
- Sellers maximize utility subject to sales $y = p * n$

Akerlof (1970)

Model of Used Car Market

- Group two owns no cars to start, utility function:

$$V(y,n) = y + \int_0^n \frac{3}{2} x(t)dt$$

- *Key to model:* Buyers get greater utility from cars then sellers
  - It is efficient to sell all cars
  - Property of equilibrium built into utility specification
- Consumers maximize $E[V(y,n)]$ subject to $y + pn = m$

Akerlof (1970)

Model of Used Car Market

- Seller maximization implies supply relationship:

$$p = \frac{2n}{N} \Rightarrow n = \min\{\frac{pN}{2}, N\}$$

- Mean quality on the market, given p, is $\frac{p}{2}$
- Given this, buyer utility conditional on p is $y + \frac{3p}{4}n$
- With BC and supply condition optimality inserted utility for any p is $m - \frac{n^2}{2N}$
  - Always have option utility is m so no price at which purchasing occurs!
  - Model set up with constant MRS, so 'all or nothing' purchase of used cars

Akerlof (1970)

Final Thoughts

- Distributional assumptions on quality matter: mean quality conditional on price p is $\frac{p}{2}$.
- If mean quality offered subject to price greater than $\frac{2}{3}p$, cars are sold.
  - Depends on *hazard rate* of distribution
- If consumers have greater preferences for cars relative to sellers, more likely trade occurs (here ratio is $\frac{3}{2}$
- Consumers know nothing, sellers know everything. What about when both know nothing?
- Though highly stylized, intuition extends to general information settings, preferences, quality distributions