Adverse Selection and Switching Costs in Health Insurance Markets: When Nudging Hurts

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http://www.depot.northwestern.edu/~brh956/indexjm.html

Introduction
Adverse Selection & Switching Costs

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- Two potential impediments to efficient health insurance markets:
  1. Switching Costs
  2. Adverse Selection
- Switching costs and adverse selection have each been studied in *isolation* but *interaction* can also be important
- Primary questions:
  - Are switching costs large?
  - Do switching costs significantly impact consumer choices and markets?
  - How does the degree of adverse selection depend on switching costs?
  - What is the welfare impact of reducing switching costs in equilibrium?

What are Switching Costs?

Broad Definition

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1. Transaction costs:
   - Time / hassle costs of actually changing health plan
   - Time / hassle costs of researching alternative options
2. Fixed Re-Optimization Cost
   - Realized price change vs. ex ante expectations
3. Status-quo bias / inertia:
   - Persistence can result from deviations from rational behavior
   - Transactions costs low, still persistence
   - Default option
4. Switching providers:
   - **Do not** measure these in my setting

Health Insurance

Industry Overview

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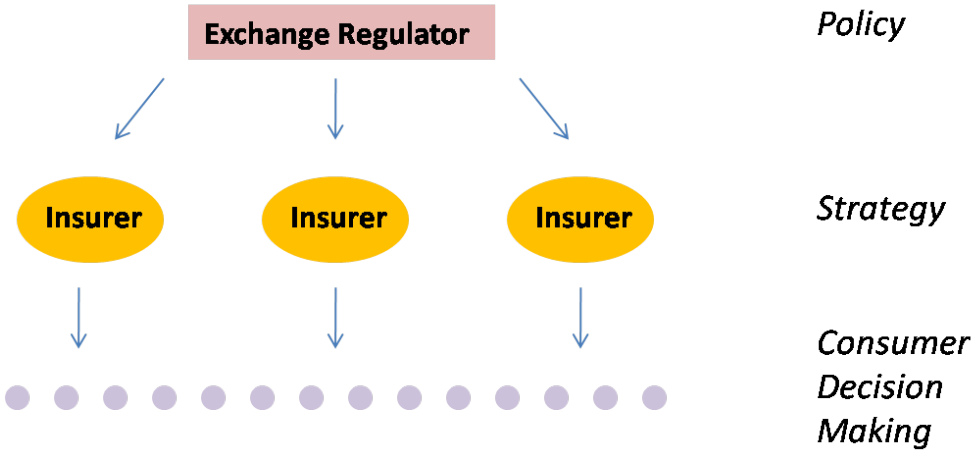
- Covers $ 2 trillion dollars in medical expenditures every year
- Current structure:
  - 57 % Employer provided private insurance
  - 23 % Government insurance
- Health Insurance Exchanges:



Data and Methods

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- Unique propriety panel data set on consumer health plan choice and utilization from large firm
  1. Natural experiment: Forced re-enrollment into new health plan menu
  2. Detailed medical utilization data
  3. Leads to simple identification of switching costs
- Panel discrete choice model quantifies:
  1. Switching Costs
  2. Ex ante health risk
  3. Heterogeneous risk preferences

Main Results

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1. Large switching costs lead to poor choices as market changes
2. Partial equilibrium counterfactual: Policy that eliminates switching costs increases consumer welfare by 10%
3. Full equilibrium counterfactual: Same policy improves choices conditional on prices but exacerbates adverse selection, leading to 6% decrease in consumer welfare.

Related Literature

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- Switching costs and choice inadequacy:
  1. Farrell & Klemperer (2006)
  2. Dube et al. (2009), Shum (2004), Shcherbakov (2009)
  3. Madrian & Shea (2001), Samuelson & Zeckhauser (1988)
- Adverse selection and insurance choice:
  1. Einav et al. (2009), Carlin & Town (2009)
  2. Levin et al. (2010), Lustig (2009), Cutler & Reber (1998)
  3. Abaluck & Gruber (2009)

Outline

Motivating Example: Switching Costs

Evidence from Dominated Plan Choice

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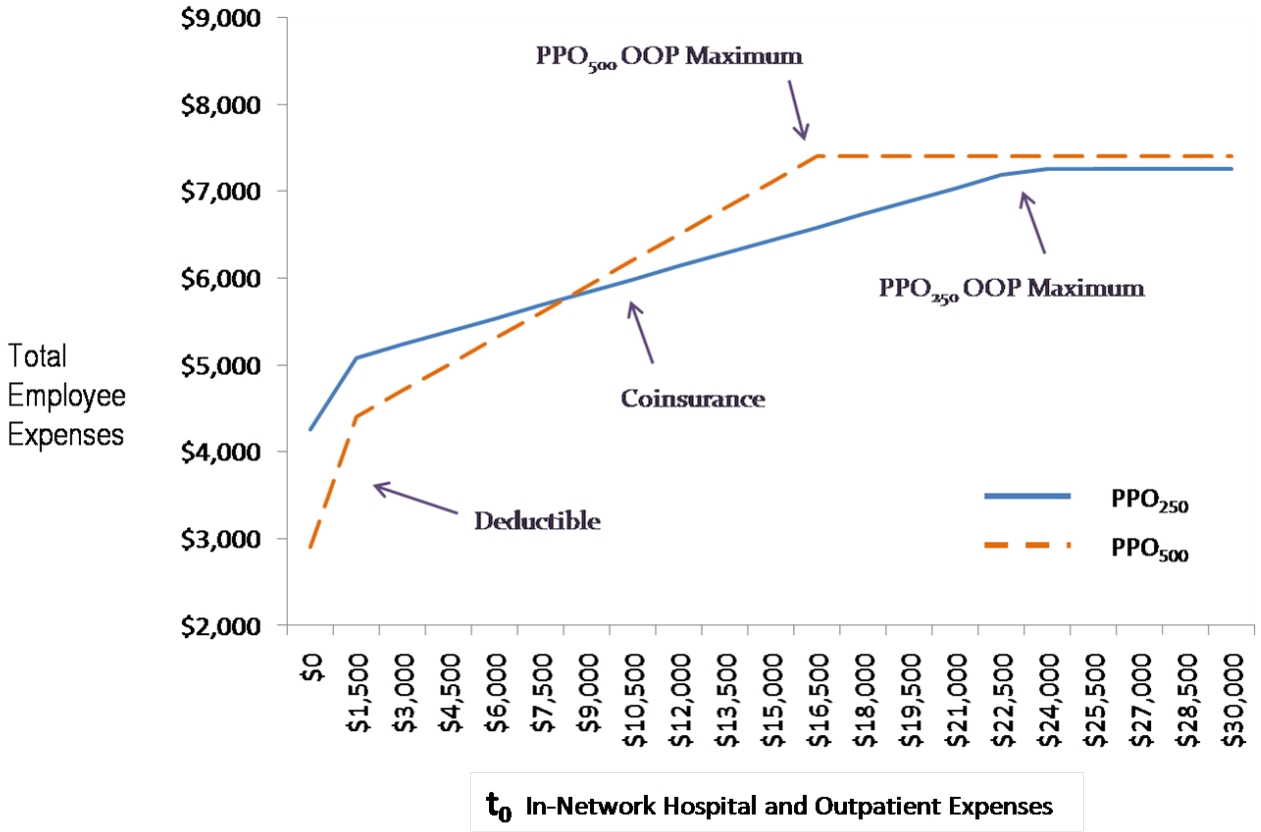

- Sick people should choose more insurance, healthy people less

Motivating Example: Switching Costs

Evidence from Dominated Plan Choice

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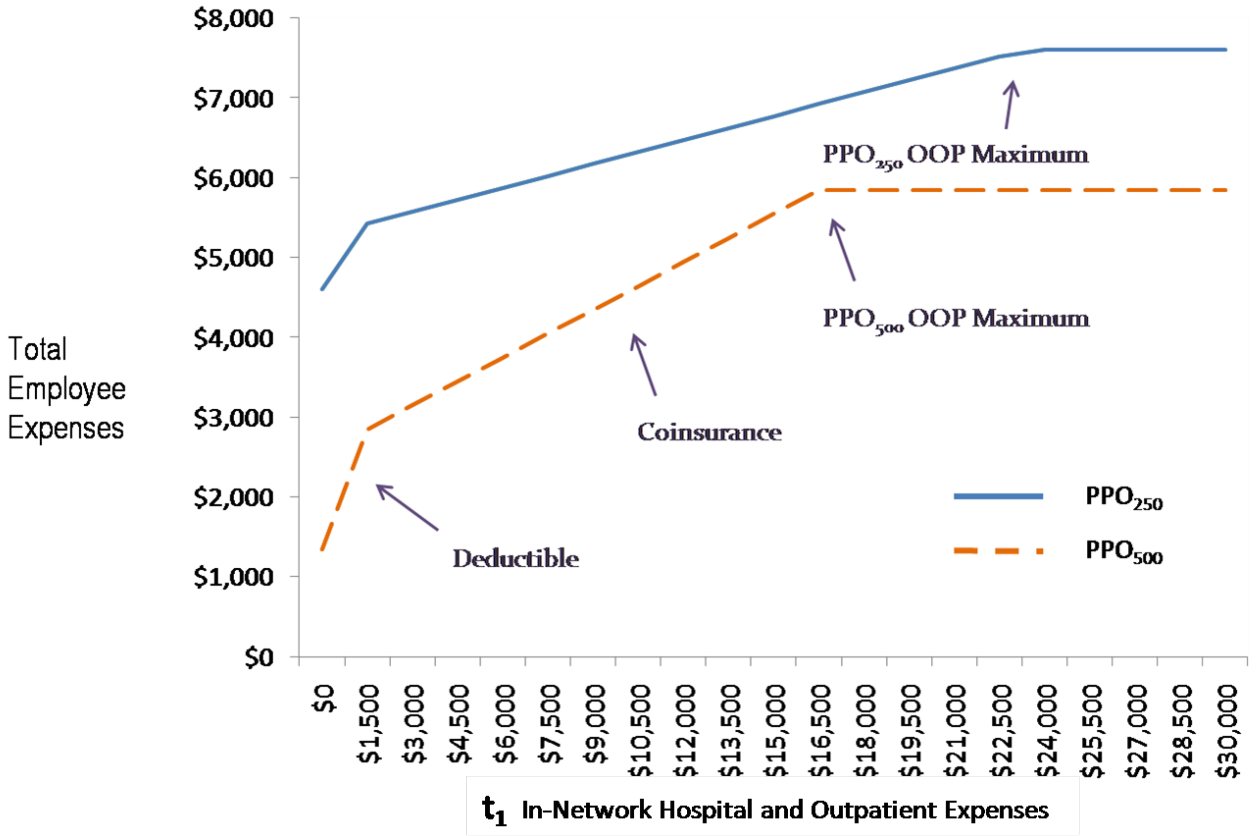

- 35 % of families had plan become completely dominanted over time. 89% of those families continue to choose plan once it is dominated.

Data Overview

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- 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

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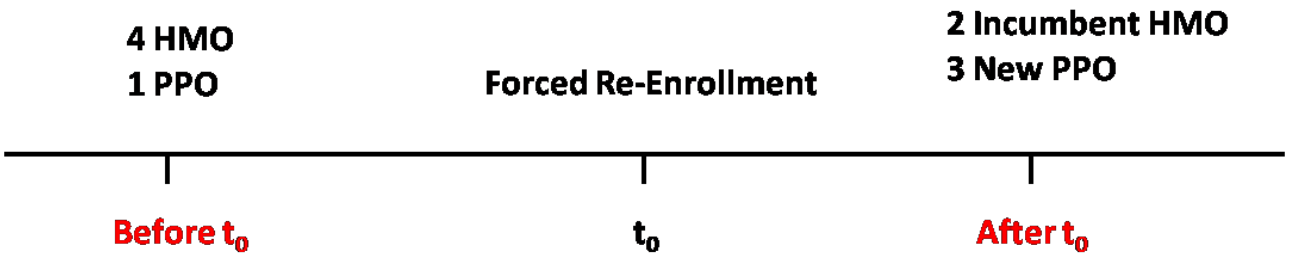

- Forced t_0 re-enrollment:
  - Major initiative at firm to ensure 'active' choice
  - No default option at t_0
  - After t_0, employees have prior choice as default option
- 3 PPO post-t_0 only differentiated financially

Natural Experiment: Menu Change

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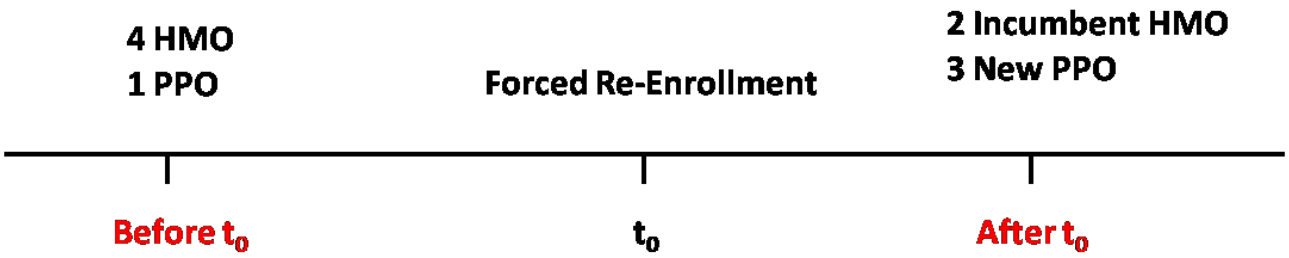

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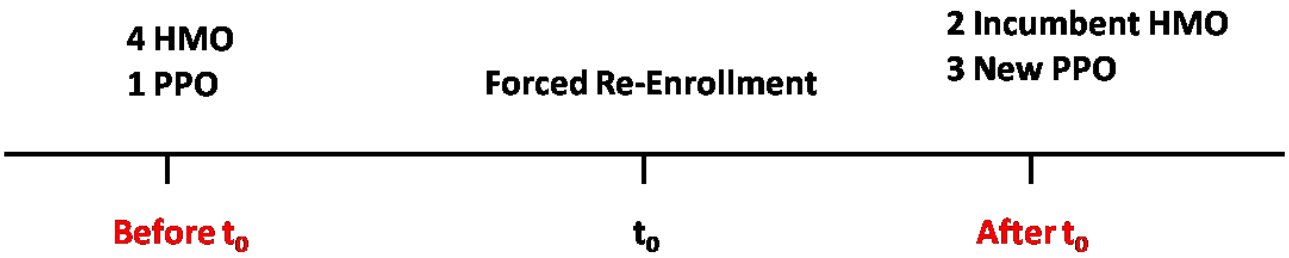

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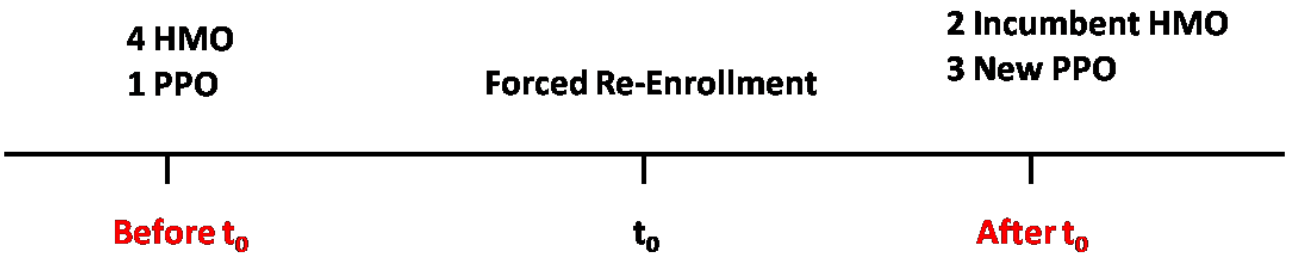

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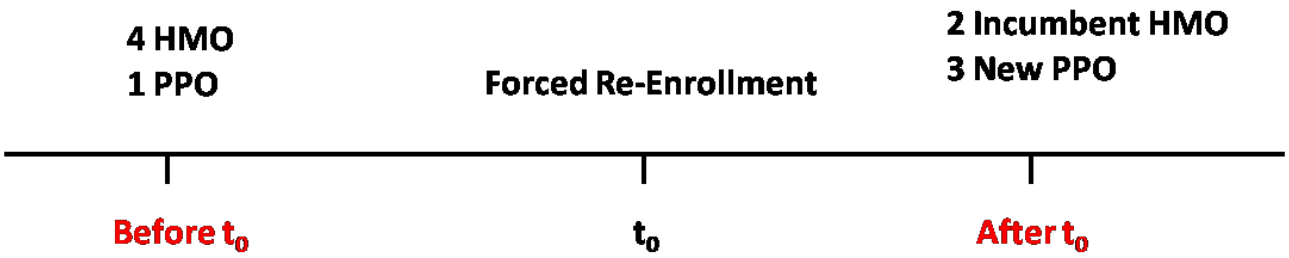

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Plan Characteristics

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	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)

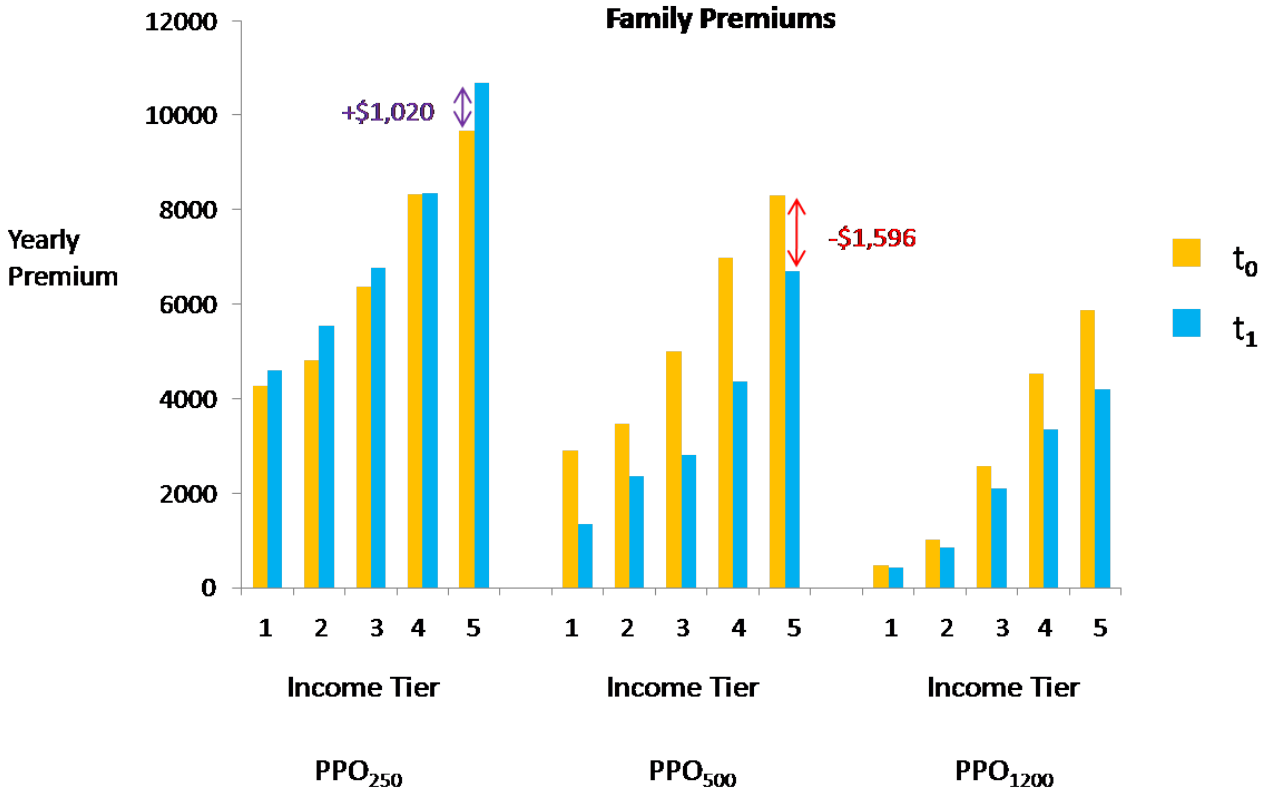
* Perscription Max of 1500 per person

** Out of Network Characteristics not Listed Above

Health Plan Premiums

Large Price Changes

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



Switching Costs

Evidence From New Entrants

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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 %

Switching Costs

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Switching Costs

Evidence From New Entrants

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	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%

▸ Active Choice Pattern

Sample Composition

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- Only consider choice among PPO options
  - Benefit: Observe detailed medical data
  - Cost: Potential for selection bias
  - Benefit and Cost: Switching costs exclude costs of changing providers
- Restriction that employee continuously enrolled over 3 years t_{-1} through t_2
  - Benefit: Past year of medical data for all choices
  - Cost: Specific population not necessarily representative
  - Cost: Lose 'new entrant' population

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Summary Statistics

Sample Demographics

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	All Employees	PPO Ever 04-09	Final Sample
EMPLOYEES	14,248	6,398	2,022
GENDER (MALE %)	47.4%	45.9%	48.5%
AGE	39.9 (37)	39.9 (37)	46 (46)
INCOME			
Tier 1	31.3%	31.7%	20.3%
Tier 2	36.6%	39.4%	41.4%
Tier 3	17.3%	18.5%	23.9%
Tier 4	6.5%	5.6%	7.5%
Tier 5	8.3%	4.8%	6.9%
FAMILY SIZE			
1	59.9 %	57.1 %	44.5 %
2	15.5 %	18.4 %	21.2 %
3	10.4 %	10.7 %	13.9 %
4+	14.2 %	13.8 %	27.9 %
STAFF GROUPING			
MANAGER	25.7%	24.3%	34.3%
WHITE-COLLAR	46.1%	47.5%	43.1%
BLUE-COLLAR	28.3%	27.9%	21.7%

Adverse Selection

Evidence of significant adverse selection against PPO_{250}

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	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

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

Consumer Expected Utility

Rational Expectations

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- 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
- Consumers have rational expectations

Empirical Setup
cara

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

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

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

- W_{kt} – wealth, P_{kjt} – premium, η – switching cost, δ_k – CDHP preference, 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}

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- Cost model separate from choice model:
  - Assumption: No private information or moral hazard
  - Based on data analysis

▸ Details

- Estimate $F_{kjt}(\widehat{OOP})$ 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 inforamtion:
  1. Pregnancy
  2. Condition Intensity
  3. Genetic predisposition

Cost Model II

Outline of Methods

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- 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

Choice Model

Unobserved Heterogeneity

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- Risk preferences normally distributed conditional on income X_k:

$$\gamma_k(X_k) \Rightarrow N(\mu_\gamma(X_k))$$
$$\mu_\gamma(X_k) = \mu_0 + \beta X_k$$

- Other assumptions:
  - δ_k normally distributed $N(\mu_\delta(Y_k), \sigma^2_\delta(Y_k))$
  - ϵ_j normally distribued $N(0, \sigma^2_{\epsilon_j})$
- Switching costs are constant conditional constant on Y_k

Model Identification

Menu Change

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- Menu change w/ no default allows observation of same consumers in periods with and without switching costs
- Unobserved heterogeneity:
  - Same within each consumer over time
  - Population distribution same over time
- Switching Costs vs. Unobserved Heterogeneity:
  - Switching costs shifts choices only t_1 and after
  - Unobserved Heterogeneity shifts choices in all periods
- Risk Prefernce vs. PPO_{1200} intercept:
  - γ determines choices between all plans
  - δ determines choices between PPO_{1200} and other two

Estimation

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- 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 paramaters
- Robustness: Utility function, unobserved heterogeneity

Estimation

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- Simulated maximum likelihood
- Q draws from each F_{kjt}
- Z draws of preferences conditional on parameters:

$$\theta \equiv (\mu, \beta, \sigma_\gamma, \mu_\delta(Y_k), \sigma_\delta(Y_k), \alpha_j(Y_k), \sigma_{\epsilon_j}, \eta(Y_k)).$$

- Smoothed Accept-Reject for each choice given θ

$$Pr(j = j^*) = \frac{\left(\frac{\frac{1}{-U_{kj^*t}}(\cdot)}{\sum_J \frac{1}{-U_{kjt}}(\cdot)}\right)^\tau}{\sum_{\hat{j}} \left(\frac{\frac{1}{-U_{k\hat{j}t}}(\cdot)}{\sum_J \frac{1}{-U_{kjt}}(\cdot)}\right)^\tau}$$

- Maximize probability that predicted choice *sequences* $\hat{P}_k^{j^3}$ match actual ones d_{kj^3}:

$$SLL(\theta) = \Sigma_{k \in K} \Sigma_{j^3 \in J^3} d_{kj^3} ln \hat{P}_k^{j^3}$$

Results
Large Switching Costs

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Parameter	Normal γ	Log-Normal γ
Switching Cost Individual, η_f	1570 (132)	1991 (165)
Switching Cost Family, η_s	2507 (160)	2637 (201)
Risk Aversion Mean - Intercept , μ	$4.73 * 10^{-4}$ $(4.4 * 10^{-5})$	-8.61 (0.23)
Risk Aversion Mean - Income Slope , β	$7.71 * 10^{-5}$ $(9.0 * 10^{-6})$	0.24 (0.02)
Risk Aversion Std. Deviation , σ_γ	$3.33 * 10^{-4}$ $(3.6 * 10^{-5})$	1.22 (0.10)
PPO_{1200}-Mean Individual	-4993 (190)	-3613 (175)
PPO_{1200}-Std. Error Individual	1797 (151)	1310 (140)
PPO_{1200}-Mean Family	-5148 (201)	-5519 (283)
PPO_{1200}-Std. Error Family	2148 (130)	2256 (155)

▸ More

Results II

Interpretation of Risk Parameters

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	Absolute Risk Aversion	Interpretation
Normal Heterogeneity		
Mean / Median Individual	$6.94 * 10^{-4}$	93.6
25th percentile	$4.69 * 10^{-4}$	94.0
75th percentile	$9.19 * 10^{-4}$	91.5
95th percentile	$1.24 * 10^{-3}$	88.9
99th percentile	$1.47 * 10^{-3}$	86.6
Log normal Heterogeneity		
Mean	$7.88 * 10^{-4}$	92.6
25th percentile	$1.64 * 10^{-4}$	97.1
Median	$3.74 * 10^{-4}$	95.2
75th percentile	$8.52 * 10^{-4}$	92.0
95th percentile	$2.79 * 10^{-3}$	78.1
99th percentile	$6.40 * 10^{-3}$	60.5
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 Switching Costs

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- Investigate counterfactual environment with reduced switching costs
- Price-conscious consumer choice is cornerstone of:
  - National insurance reform: health insurance exchanges
  - Large employer purchasing strategies
- Policies to reduce switching costs:
  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

Partial Equilibrium Analysis

Holding Prices Fixed

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- Similar to previous analyses studying choice inadequacy
  - Consumer welfare can only increase
- Switching costs reduced to $\eta_k - Z$:

$$U_{kjt}(P_{kjt}, \eta_k - Z) = \int_0^\infty u(OOP, P_{kjt}, \eta_k - Z) f_{kjt}(OOP) dOOP$$

- Choose plan to maximize expected utility in each t
- Use certainty equivalent metric to quantify welfare change

Partial Equilibrium Policy Impact

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Market Share Changes

	$Z = 0$ (Benchmark)	$Z = \frac{\eta}{2}$	$Z = \eta$ (No SC)
t_2 **Choices**			
PPO_{250}	1,160	1,037	797
PPO_{500}	573	702	994
PPO_{1200}	185	179	126
t_2 **Family Average Cost**			
PPO_{250}	27,796	31,154	31,265
PPO_{500}	17,563	18,415	20,496
PPO_{1200}	16,922	17,681	16,579

▸ Details

Welfare Analysis

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- Certainty equivalent CEQ_{kjt} makes consumer indifferent between certain CEQ_{kjt} and risky payoff from j
  - CEQ calculated *net* of switching costs (depends on *source*)
  - Denote CEQ for choice with policy Z as CEQ^Z_{kjt}
- Individual level consumer welfare impact:

$$\Delta CS_{kjt} = CEQ^Z_{kjZ\,t} - CEQ_{kjt}$$

- Mean change in consumer welfare:

$$CS_t = \frac{1}{\|K\|}\Sigma_k \ \Delta CS_{kjt}$$

- Population welfare change comes from risk preference matching

Partial Equilibrium Welfare Impact

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$z = \eta$

	t_1	t_2
Mean Δ CEQ		
Population	192	215
Switchers Only	367	394
Mean Welfare Change: % Total Premiums		
Mean Employee Premium (MEP)	2,233	2,078
Welfare Change Population	8.6%	10.3%
Welfare Change Switchers	16.4%	19.0%
Mean Welfare Change: % Total Emp. Spending		
Mean Total Emp. Spending	4,305	4,375
Welfare Change Population	4.5%	5.1%
Welfare Change Switchers	8.5%	9.0%

▸ Details

Full Equilibrium Analysis

Insurance Pricing

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- Insurance prices adjust along with new choices for $Z > 0$
- Recreate exact pricing rule
  - Close to prior work, not sophisticated
- Start at given prices p_0
- Total premium lagged average cost:

$$TP_{jt}^{y} = AC_{K_{j,t-1}^{y}} + L$$

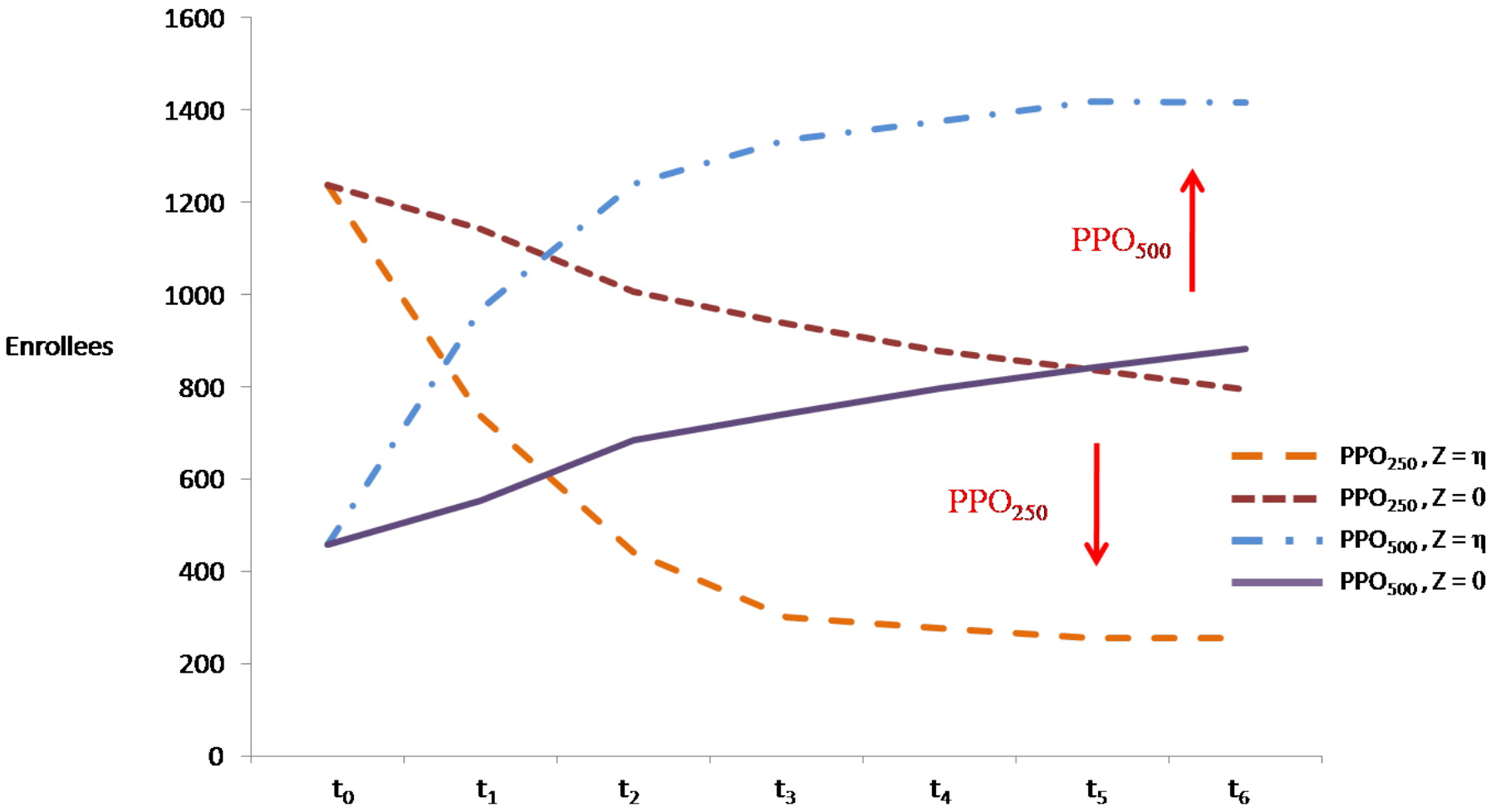
- Firm gives subsidy for all j as % of PPO_{1200} premium:

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

Impact of Policy on Market Share

Death Spiral?

▸ Skip slide



Impact on Plan Prices

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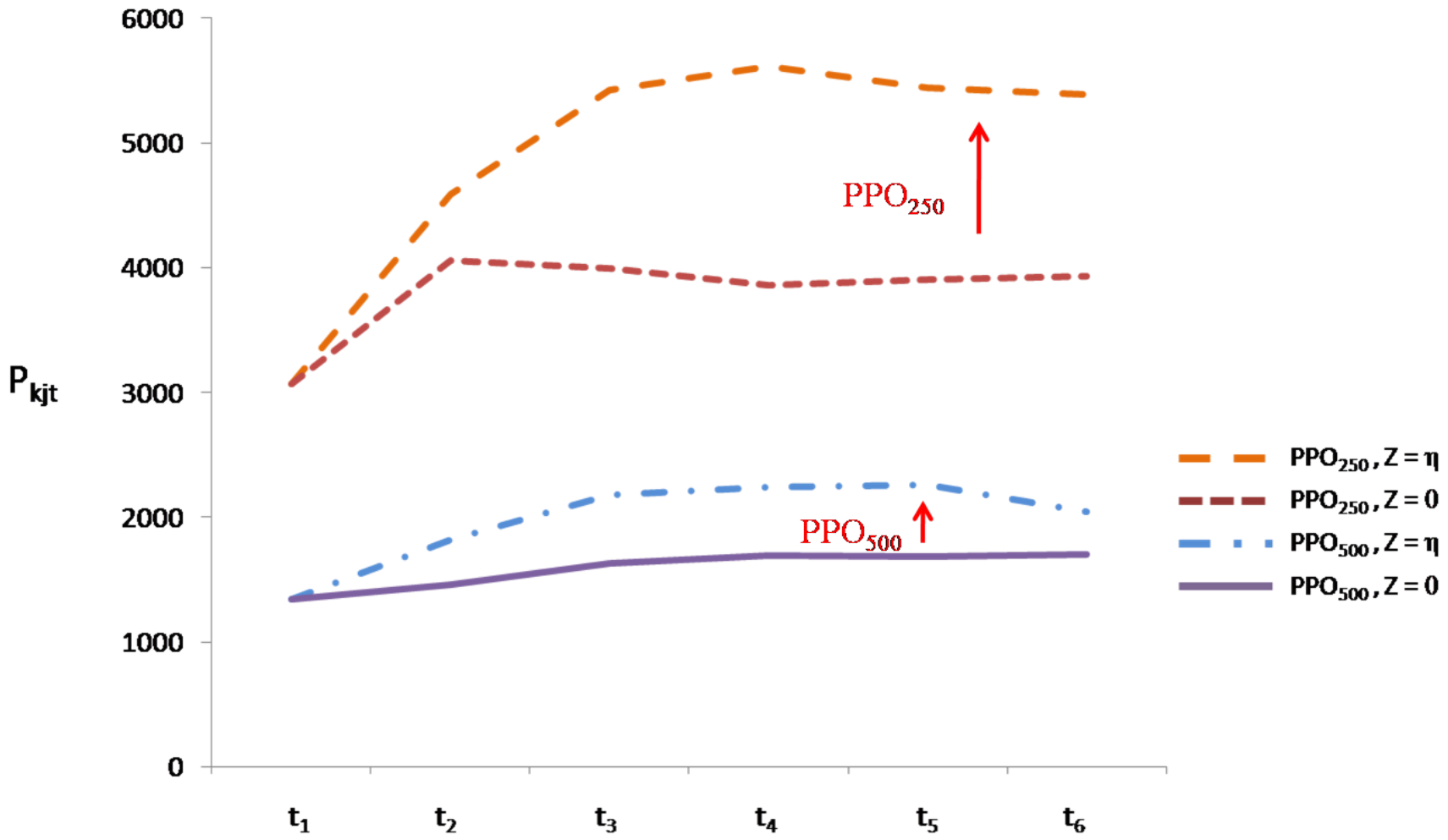

▸ Average Cost

Full Equilibrium Welfare Impact

When Nudging Hurts.....

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	t_1	t_2	t_4	t_6
Mean Δ CEQ				
Population	$170	$117	-$120	-$132
Switcher Pop. %	30%	53%	52%	49%
Switchers Only	$567	$580	$ 360	$289
Non-Switchers Only	-$1	-$409	-$569	-$592
Mean Welfare Change: % Total Premiums				
Mean Employee Premium (MEP)	2,133	2,326	2,342	2,218
Welfare Change Population	7.9%	5.0%	-5.1%	-5.9%
Welfare Change Switchers	26.6%	24.9%	15.4%	13.0%
Welfare Change Non-Switchers	0%	-17.6%	-24.3%	-26.7%
Mean Welfare Change: % Total Emp. Spending				
Mean Total Emp. Spending	4,253	4,678	4,739	4,646
Welfare Change Population	4.0%	2.5%	-2.5%	-2.8%
Welfare Change Switchers	13.3%	12.4%	7.6%	6.2%
Welfare Change Non-Switchers	0%	-8.7%	-11.9%	-12.7%

▸ More

Policy Implications

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- Policies to improve choices and combat adverse selection considered independently
- Ignoring link between switching costs and adverse selection can have large welfare consequences
- Conditional on push to improve choices re-evaluate following for insurance exchanges:
  - Contract characteristic regulation
  - Subsidy policy
  - Choice framing
  - Who is in risk pool?
- Re-evalute similar issues for large employers

Conclusions

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- Evidence of large switching costs
  - What are the sources?
- Link between switching costs and adverse selection
  - Large welfare impact
  - Policy implications
  - Sophisticated firm pricing models ?
- Second-best analysis with behavioral decision makers
- Other Improvements:
  - Test of dynamic choice / forward-looking consumers
  - Inclusion of HMO options
  - Moral hazard / private information

Pattern of Active Choice

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	PPO_{250} Switchers	PPO_{250} All	All Switchers	Full Sample
Sample Size	129	1916	502	3725
FSA 2008 Enrollee	53%	29%	36%	24%
Dental Switch	9.5%	3.6%	13.2%	4.6%
Mean Income Tier	2.2	2.4	2.1	2.2
Quantitative Manager	11%	18%	14%	18%
Mean Age	40.8	46.8	38.4	32.4
Single	57%	43%	59%	55%

- FSA choice is back to zero default

▸ Return

- Use exogenous menu change to study 'before' and 'after' utilization
- PPO_{-1} in t_{-1}, similar to PPO_{250} after menu change. Return
- Study two populations:
  - Control group: Individuals enrolled in PPO_{250} in t_0
  - Treatment group: Individuals enrolled in PPO_{500} or PPO_{1200} in t_0
- If moral hazard exists then:

$$\frac{Claims_{t_0}^{250}}{Claims_{t_{-1}}^{250}} > \frac{Claims_{t_0}^{500}}{Claims_{t_{-1}}^{500}}$$

Moral Hazard / Private Information: Aggregated Evidence

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	Control			Treatment		
	t_{-1}	t_0	%	t_{-1}	t_0	%
Aggregate Expenses						
25th Pctile	\$2,371	\$2,591	9%	\$808	\$994	23%
Median	\$6,985	\$7,564	8%	\$2,852	\$3,130	10%
75th Pctile	\$16,827	\$17,909	7%	\$8,020	\$9,442	17%
Mean	\$17,531	\$17,156	-3%	\$6,816	\$8,493	21%
Count	1344			642		

Moral Hazard: Diagnostic Level Evidence

	$\text{Med}^{250}(t_{-1})$	Ratio^{250}	Ratio^{500}	ΔRatio	MH
Diagnostic Category					
Benign / Uncertain Neoplasm	\$297	5.7%	26.8%	-21.11%	NO-MH
Diabetes	\$ 290	-8.2%	22.3%	-30.6%	NO-MH
Ears, Nose & Throat	171\$	-1.1%	20%	-21.17%	NO-MH
Eyes	\$170	16.5%	28.5%	-12.1%	NO-MH
Gastrointestinal	\$447	-13%	-52%	39%	MH
Genital System	\$186	-5.4%	30.5%	-35.9%	NO-MH
Heart	\$272	1.1%	-34.2%	35.3%	MH
Hematological	\$159	-25.8%	80.7%	-106.7%	NO-MH
Infectious	\$129	8.5%	51.5%	-43%	NO-MH
Injury / Poisoning	\$714	-8.4%	-9.45%	1.1%	N
Lung	\$130	10.8%	6.1%	4.6%	N
Malignant Neoplasm	\$1,777	-33.7%	16.1%	-49.9%	NO-MH
Mental	\$1,233	-10.3%	-26.9%	16.6%	N
Musculoskeletal	\$860	2.1%	-7.3%	9.5%	N
Nutritional / Metabolic	\$170	1.2%	35.5%	-34.3%	NO-MH
Preganancy	\$4,246	12%	-73%	85%	MH
Screening	\$339	23.3%	19.3%	4%	NO-MH
Skin	\$171	6.4%	10.8%	-4.4%	N
Symptoms / Signs	\$468	2.6%	-2.7%	5.3%	N
Urinary System	\$128	-3.9%	31.7%	-35.6%	NO-MH

Moral Hazard: Regression Analysis

- Quantile regression that applies to people who have expenditures in a given diagnostic category for two consecutive year
- Denote an individual i and diagnostic category d

$$log^0(Claims_{id}) = \delta_d + \beta log^{-1}(Claims_{id}) + \alpha log^{-1}(Claims_{id})\mathbf{1}_{500} + \epsilon_{id}$$

- **Results:**
  - $\beta = 0.42$ (T = 41.07)
  - $\alpha = -0.017$ (T = -2.87)