An Experimental Investigation of the Demand for Private Insurance and of Health Systems Outcomes under a Mixed System of Public and Private Finance

Neil J. Buckley[1] David Cameron[2] Katherine Cuff[2]
Jeremiah Hurley[2,3] Logan McLeod[4] Stuart Mestelman[2]

[1]Department of Economics, York University

[2]Department of Economics, McMaster University

[3]Centre for Health Economics and Policy Analysis, McMaster University

[4]Department of Public Health Sciences, University of Alberta

IRDES Workshop, Paris, France
June 24, 2010

The 2010 IRDES WORKSHOP on Applied Health Economics and Policy Evaluation
www.irdes.fr/Workshop2010

Background

- This paper is part of a larger project that focuses on the application of experimental economics methods to investigate issues of efficiency and equity in health care financing and funding.
- The project employs both stated-preference and revealed preference experiments, but we are particularly interested in the use of revealed-preference experiments.

Background

Today's paper is the lastest in a three-paper series:

1. Cuff et al. (2010) sets out a theoretical model of parallel public/private health care finance upon which today's empirical paper is based.

   Cuff, K. et al. 2010. "Public and Private Health Care Financing with Alternate Public Rationing Rules" February.

2. Buckley et al. (2009) investigates non-strategic behaviour within the Cuff et al. framework, focusing on individual willingness-to-pay for private insurance.

   Buckley et al. 2009. "Willingnesss-to-pay for Parallel Private Insurance: Evidence from a Laboratory Experiment." September.

3. Today's paper investigates the equilibrium predictions of the Cuff et al. framework.

Motivation

Parallel Private Health Insurance Debate

- Both sides in the debate agree that relaxing constraints on private insurance will beget a larger private insurance sector, but disagree on the impact.
  - Advocates: reduce wait times, reduce fiscal pressure, increase access, increase quality
  - Opponents: increase public wait times, reduce resources in public system, reduce access for low income individuals, reduce quality in public system
- Empirical evidence is absent or mixed, and suffers from a number of inferential problems (e.g., endogeneity, selection problems, generalizability)
- Use a revealed-preference experiment to test some hypotheses about the impact of parallel private finance.

Motivation

Wanted to capture the following aspects of parallel public/private insurance:

- Public and private insurers compete for the same supply health care resources.
- Public insurers allocate health care using some type of non-price mechanism
- Private insurers allocate according to willingness-to-pay

The model:

- shows that equilibrium in the parallel private insurance system depends on how public health care resources are allocated.
- makes specific predictions regarding who gets treatment, the market price of insurance, and the size of the private insurance sector

Model Structure and Assumptions

Individuals

- continuum of individuals; population size normalized to unity
- individuals differ in two dimensions:
  - Income, $Y \in [\underline{Y}, \overline{Y}]$
  - Severity of illness, $s \in [0, 1]$
- income and severity are *independently* distributed (can be relaxed)
- illness can be fully treated instantaneously with one unit of health care
  - if not treated, individuals lose income equal to sY
  - if treated, restored to full health and lose no income due to illness
- preferences separable in health status and income
- marginal utility of income is constant (can be relaxed)

Model Structure and Assumptions

Health Care Resources (H)

- one unit of health care resources produces one treatment
- fixed supply of health care resource, $H < 1$
  - H individuals can be treated
  - $1 - H$ individuals remain untreated

Insurance

- Public insurance: care is free, but does not guarantee access to care
- Private insurance: costly, but guarantees treatment

Model Structure and Assumptions

Public Insurer

- exogenously determined budget B
- maximum ability to pay for H health care resources is B/H
- objective: treat as many people as possible irrespective of person's income
  - *Who gets treated by the public insurer depends on public allocation rule.*

Public Allocation Rules

- Needs-based Allocation
- Random Allocation
  - *Reality lies somewhere between these two extremes.*

Parallel Public and Private Health Care Financing

Timing

1. At start of period, individuals know income but not random severity. Each individuals formulate their WTP for insurance.
2. Public and private insurers submit bids for health care resource
   - Public insurer bids based on budget, B
   - Private insurer bids based on individuals' willingnesses-to-pay
3. Health care resources allocated to sectors according to the submitted bids; a market-clearing price is determined.
4. Individuals' severities revealed
5. Treatments allocated to people:
   - those with private insurance receive treatment privately
   - public insurer allocates treatments to those without private insurance according to its allocation rule. Some do not get treated.

Individual Willingness to Pay for Private Insurance

Random Allocation

$$WTP^R = (1 - \pi^R)E(s)Y \tag{1}$$

- increasing in income Y and expected loss if not treated, $E(s)$
- decreasing in probability of public treatment, π^R

Needs-Based Allocation

$$WTP^N = (1 - \pi^N)E(s|s < s_m)Y \tag{2}$$

- increasing in income, Y, and expected loss if not treated $E(s|s < s_M)$
- decreasing in probability of public treatment, $\pi^N = 1 - F(s_m)$.

Equilibrium Predictions

Severities

- Random Allocation: $\bar{s}_{treated} = \bar{s}_{untreated} = E(s)$
- Needs-based Allocation: $\bar{s}_{pub,treated} > \bar{s}_{priv,treated} > \bar{s}_{untreated}$

Income

- For both allocation rules, the mean income of those with private insurance is greater than the mean income of those without private insurance.

Equilibrium Predictions, cont'd

Price (P): $P_{random} > P_{need}$.
Treatment Probability (π): $\pi_{random} < \pi_{need}$.

Increase in Health Care Resources, H

- For both allocation rules: $\mathrm{dP}/\mathrm{dH} < 0$, $\mathrm{d}\pi/\mathrm{dH} > 0$

Increase in Public Insurer's Budget, B

- For both allocation rules: $\mathrm{d}\pi/\mathrm{dB} > 0$
- Ambiguous effect on the equilibrium price.
  - Direct effect: increase in B, increases P
  - Indirect effect: decrease P through decreases in WTPs.

Taking the model to the Lab....

Question: How do changes in public allocation rule, public budget, and supply of health care resources affect equilibrium price and probability of public treatment?

- Full factorial design with two values for each of allocation rule (random or needs-based), public budget ($B = \$430$ or $B = \$720$), and health care resource supply ($H = 5$ or $H = 8$)
- Between-subject design (each subject saw only one allocation rule, budget and quantity of health care resource)
- 32 experimental sessions, each with 30 decisions periods and 10 subjects (students); conducted October 2008 - March 2009
- Subjects told they were workers in a small country, all workers get sick and need health care to avoid missing work time.
- Subjects also participated in a non-strategic risk-preference elicitation exercise at the end of the experiment
- Approved by McMaster University Research Ethics Board

Taking the model to the Lab....

- Each subject randomly assigned an income between \$L50 and \$L950 in increments of \$L100 (individual incomes constant across periods)
- Severity drawn from uniform distribution on [.01,1] by increments of .01 (new severity draw each period)
- Each period subjects reminded of the allocation rule, public budget and fixed supply of health care resources
- each period subjects told the number of individuals treated privately and publicly and their own severity previous period
- Each period, before severity was known, each subject asked to state *willingness to pay for private insurance*
- Public system bid according to its ability to pay
- Market price determined as mid-point between highest rejected bid and lowest accepted bid.

Data Analysis

1. Descriptive Analysis:
   - mean severities and mean incomes of those treated and not treated
   - mean equilibrium P and π
2. Regression Analysis:
   - mean equilibrium market price
   - mean equilibrium probability of treatment
   - willingness to pay.

Focus today on predicted directional changes.

Mean Severity Levels by Treatment Status

Public Budget (B)	Quantity of Health Care Resource (H)	Allocation Rule	Treated Publicly	Treated Privately	Not Treated
430	5	Need	0.852	0.491	0.423
		Random	0.451	0.539	0.505
430	8	Need	0.654	0.512	0.209
		Random	0.506	0.483	0.507
720	5	Need	0.806	0.516	0.356
		Random	0.487	0.506	0.502
720	8	Need	0.621	0.529	0.183
		Random	0.499	0.474	0.546

- Need-based: $\bar{s}_{pub,treated} > \bar{s}_{priv,treated} > \bar{s}_{untreated}$
- Random: $\bar{s}_{treated} = \bar{s}_{untreated} = E(s) = 0.505$.

Mean Income Levels by Treatment Status

Public Budget (B)	Quantity of Health Care Resource (H)	Allocation Rule	Treated Privately	Treated Publicly
430	5	Need	$727	$379
		Random	$720	$364
430	8	Need	$622	$441
		Random	$606	$423
720	5	Need	$777	$406
		Random	$725	$409
720	8	Need	$715	$448
		Random	$689	$408

- Average income in the experiment is $L500.
- Higher income individuals access private health care.

Market Price for Health Care Resources

Treatment	Nash Eq'm Predictions	Observed Mean (All Periods)
Overall	143.65	173.27
Need Allocation	115.93	163.07
Random Allocation	171.36	183.48
B = 430	147.59	157.73
B = 720	139.70	188.82
H = 5	203.79	238.68
H = 8	83.50	107.86

- Absolute level of price higher than predicted
- $P_{need} < P_{random}$
- $P_{720} > P_{430}$
- $P_8 < P_5$

Probability of Public Treatment

Exp. Treatment	Nash Eq'm Predictions	Observed Mean (All Periods)
Overall	0.549	0.480
Need Allocation	0.598	0.501
Random Allocation	0.500	0.459
B = 430	0.483	0.440
B = 720	0.615	0.520
H = 5	0.335	0.261
H = 8	0.763	0.699

- Absolute probability lower than predicted
- $\pi_{need} > \pi_{random}$
- $\pi_{720} > \pi_{430}$
- $\pi_8 > \pi_5$

Analysis of Individual Willingness-to-pay

	Dep Var: WTP/Income	
Variables	**Full Sample**	**Incomes >=L$450**
Need-based Allocation	-0.085*	-0.061*
High B (B=720)	-0.018	-0.038
High H (H=8)	-0.201***	-0.211***
H-L Risk Aversion	0.014	0.015**
Income	-0.001***	-0.001
Income Squared	0.000*	0.000
Lagged Severity	0.011	0.014
Need x High B	0.021	0.043
Need x High H	0.087	0.034
High B x High H	0.069	0.063
Need x High B x High H	-0.107	-0.068
Constant	0.612***	0.633**
N	3,200	1,600
Adj. R-squared	0.22	0.34

*p < 0.10; **p < 0.05 ***p< 0.01; Analysis based on periods 21-30.

- WTP/Y predicted to be constant; decreases in income
- Lag severity not significant
- Risk aversion significant for sub-sample

Conclusion

- Though challenging to implement, for certain settings revealed-preference experiments offer a promising method for investigating the impact of institutional arrangements in health sector
- Important to have a theoretical framework for an experiment.
- Found support for theoretical predictions and predicted treatment effects of changes in the public allocation rule, size of the public budget and the amount of health care resources within a parallel system of health care financing.

Next steps:

- Analyze individual bids in more detail.
  - Individual WTP not monotonic in income (group averages are) but still obtained predicted treatment effects in equilibrium.
  - Need to further examine what is driving individuals' willlingnesses-to-pay.
- Investigate supply-side responses under parallel finance