Health Plan Differentiation and Adverse Selection

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and

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VERY PRELIMINARY, PLEASE DO NOT QUOTE WITHOUT AUTHORS’ PERMISSION
Introduction

Health care plans compete for patients by offering several medical treatments. In exchange, they receive of constant premium.

Examples:
Health Maintenance Organizations in the US
MUFACE in Spain (85% public servants)
PPP versus BUPA in the UK (10% population but ↓)
Ireland: 34% population → VHI. (1994 → Competition)
Netherlands, Germany: Substitute Statutory HI for rich)

Specific issue
What is the result of competition when patients have better knowledge than health plans on the true risks? (Asymmetric information or adverse selection) (Note: ≠ Cream-skimming, where information is symmetric: Frank et al (2000))
Main questions in the literature:

1. Can we make predictions? (Existence of an equilibrium)

2. When an equilibrium exists,
   
a. is there cross subsidization across types? (Low risk subsidizes the high risk?)

   b. is there room for public intervention (further cross subsidization to palliate distortions)? Is the equilibrium 2nd best?
General: competition under adverse selection

Rotschild-Stiglitz (1976): Firms are not allowed to offer menus of contracts.

1. ON EXISTENCE

   a. Pooling equilibria do not exist: if a CE exists it must be a separating equilibrium

   b. A competitive equilibrium does not exist if the proportion $\gamma$ of low risks is low enough. (Intuition)
   How low is "low enough"?

   Example: Utility functions $u(x) = \log(x)$ and $u(x) = x^{1/2}$ High risks contract illness
   with 5 times more probability
   $\gamma$ must be below 87%
2. ON CROSS-SUBSIDIZATION

a. Menus are not allowed, so there is no role for cross-subsidization

b. What if menus ARE allowed? Then

   i. Profits *must* be Zero across types in equilibrium. Hence there is no cross-subsidization in equilibrium. (Intuition: it is very easy to dump the bad type)

   ii. Conditions for existence are more stringent (*new ways to deviate*). In the previous example maximum $\gamma$ falls to 83% (to 74% for $\log(x)$)

3. ON EFFICIENCY

a. Efficiency at the bottom, distortion at the top

b. However, if an equilibrium exists, it IS 2nd best!
New equilibrium notion: Wilson Equilibrium


1. a. Equilibrium always exists
   
   b. In some equilibria, there is cross-subsidization (CS).
      (Importance)
   
   c. These equilibria are second best

Critique
Our approach: Introduce product differentiation

1. Exogenous differentiation: geographical
   a. No true competition (partial/partial analysis)
   a. Do not emphasize existence ($\gamma$ fixed at $1/2$)
   b. Agents are risk-neutral (but liability constrained)
   c. Focus on exclusion (some locations are not served): True Cream-skimming or “dumping”
4. OUR RESULTS:

a. ON EXISTENCE: Although our model converges towards RS as 
   \( t \to 0 \),

   i. Without resorting to the Wilson equilibrium notion, obtain 
      existence for values of \( \gamma \) much closer to unity (0.9) for quite 
      low transportation costs 
      \((t = 0.05)\)
      
      \([t = 33.78\% \text{ of equilibrium profits,} \]
      which tend to 0; or \( t = 1.5 \% \) of low risk utility. The critical value for \( \gamma \) when \( t = 0 \)
      is 0.8322.]

   ii. All equilibria imply that at least 
      one firm offers a menu of 
      separating contracts that 
      attracts both types. That is, 
      there do not exist equilibria 
      with full specialization. This is 
      an extension to the “no pooling 
      equilibrium” result
b. ON CROSS-SUBSIDIZATION: We also get some equilibria with cross-subsidization

c. ON EFFICIENCY:
   i. Conjecture: Only equilibria without cross-subsidization (i.e., $\Pi(high\ risk) > 0$) may be 2nd best optimal
   
   ii. There exist equilibria with cross-subsidization (i.e., $\Pi(high\ risk) < 0$ but $\Pi(low\ risk)$ is sufficiently large to compensate) that are NOT 2nd best optimal

Intuition: CS implies $\Pi(high\ risk) < 0$. By improving welfare unilaterally one attracts these types. Hence in equilibrium welfare is low. Suppose a planner comes in: she will improve welfare at all firms, so any given firm does not attract any additional high types.
d. OTHER EMPIRICAL IMPLICATIONS: Much richer set of empirical implications. Characterize the symmetric separating candidate. (KT cond. evaluated at symmetry)

i. - Unit profits always positive-
   As in RS, efficiency at the bottom, distortion at the top
   - Unit profits derived from high risks lower than those derived from low risks
   - This is despite high risk contract is distorted

iii. Comparative statics on $t$. In simulations we observe cases where overall welfare, measured by utilitarian welfare function, increases with $t$. Intuition: as $t$ increases distortion of G contract diminishes. However most rents are extracted by Firms

Health Economics Literature


b. *Ignore this issue*: Glazer and McGuire (2000): Optimal risk adjustment of premia when some publicly observed signal is available (historic costs): Should overpay historically high costs and underpay historically low costs

The model

Based on Glazer and McGuire (2000) and Villas-Boas and Schmidt-Mohr (1999)

Two health plans: Firm 0 and Firm 1. A single hospital each. Hospitals located at the two extremes of a straight line of length 1

Two continua of patients. High risk (bad type, B) and Low risk (good type, G). Uniform distributions. Proportions \((1 - \gamma)\) and \(\gamma\)

Plans are compensated by premium \(r\), independent of type (types are unobservable)

Two treatments. Treatment \(M\) is needed by both types of agents with probability one. (Chronic)

Treatment \(N\) is needed with probabilities
0 < p_G < p_B < 1. (Acute)
Per capita profits derived by firm 0 from G-type

$$\Pi_{0g} = r - m_{0g} - p_Gn_{0g}$$

$$\Pi_{0b}, \Pi_{1g}, \text{ and } \Pi_{1b}$$ are defined analogously.
Overall profits of Firm 0

$$\gamma D_{0g} \Pi_{0g} + (1 - \gamma)D_{0b} \Pi_{0b}.$$ 

Shorten notation: $$w_{i,j} = (m_{ij}, n_{ij})$$ for all $$i = 0, 1$$ and $$j = g, b.$$
Figure 2. The separating equilibrium candidate under symmetry.

Important remark:  
*Per-capita* profits can be read in the horizontal axis intercept of isoprofits:  
\[ r - m - pn = k \]  
and  
\[ n = 0 \]  
imply  
\[ m = r - k. \]

Nothing in the figure suggests that *per-capita* profits are larger for good types.
Definitions

Definition 1 If a contract $w_{ij}$ satisfies $m_{ij} = n_{ij}$, we say that it is efficient.

Definition 2
1. A vector $\{[w_{0g}, w_{0b}], [w_{1g}, w_{1b}]\}$ is said to be an equilibrium if neither firm gains additional profits by offering an alternative menu of contracts $[\overline{W}_g, \overline{W}_b]$.

2. The equilibrium is said to be pooling if by observing any agent’s actions one cannot infer the true type of that agent even if one observes its location.

3. The equilibrium is said to be separating otherwise. In addition, the equilibrium is said to be hemi-separating if some but not all agents’ types can be inferred from their observed actions. Otherwise we say that the equilibrium is fully separating.

4. The equilibrium is said to be symmetric if $[w_{0g}, w_{0b}] = [w_{1g}, w_{1b}]$. 
Proposition 1: No Pooling equilibrium exists.

Separating equilibria

Fix \((m_{1b}, n_{1b}, m_{1b}, n_{1b})\)

\[
\max_{(m_{0b}, n_{0b}, m_{0b}, n_{0b}) \in \mathbb{R}_+^4} \gamma \Pi_{0g} D_{0g} + (1 - \gamma) \Pi_{0b} D_{0b}
\]

subject to \(U_{0g}^G \geq U_{0b}^G\),

\(U_{0b}^B \geq U_{0g}^B\).
Proposition 2

1. In any equilibrium (be pooling or separating), at least one ICC is binding, and its associated Lagrangian multiplier is not zero.

2. In a symmetric separating equilibrium candidate

   a. the bad type ICC is binding and the good type ICC is not.

   b. $w_{0b}$ is efficient while $w_{0g}$ overinvests in $m$ and underinvests in $n$ as compared to $w_{0b}$. That is, $n_{0g} < m_{0b} = n_{0b} < m_{0g}$. (No distortion at the bottom).

   c. Per-capita profit derived from a good type is larger. That is, $\Pi_{0g} > \Pi_{0b}$. 
1. As in RS:

   Fully insure the type that would have incentives to lie in the first best

   Preserve separation: must offer $G$ a contract that is distorted.

   Overprovide quality for the sure illness $M$.

   Underprovide quality for the other treatment.

   Since $p_G < p_B$, G’s are the only ones that are willing to bear lower quality in $N$. 
2. Differences with RS:

a. $\Pi_{0g} > \Pi_{0b}$ (and $\Pi_{0g} > 0$). This is despite good type contracts are distorted.

b. $\Pi_{0b}$ may be negative $\Rightarrow$ Should consider exclusion of one of the types when looking for best response to candidate. Most importantly: CROSS SUBSIDIZATION

c. Important consequence of $\Pi_{0g} > \Pi_{0b}$: residual cream skimming/dumping incentives: would like to increase $\gamma$, perhaps trough rationing.
Are there other ways to get full separation? Yes, specialization. But never in equilibrium:

**Proposition 3**

There does not exist an equilibrium where firms are fully specialized, that is, where both firms offer a (different) single contract each, such that each firm attracts exclusively one of the types.

**Existence of separating:**

**Simulations**

Constant across the examples: \( r = 10 \), \( p_B = 0.8 \), and \( p_G = 0.2 \).

TABLES NEXT
## Results simulations

### Ln(x), t = 0.005

<table>
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<tr>
<th>CANDIDATE</th>
<th>( \gamma = 0.3 )</th>
<th>( \gamma = 0.7404 )</th>
<th>( \gamma = 0.8 )</th>
<th>( \gamma = 0.9 )</th>
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<td>1254.46%</td>
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The critical \( \gamma \) under perfect competition is between 0.7404 and 0.7403 when firms are allowed to break the equilibrium using menu of contracts.
The critical $\gamma$ under perfect competition is between 0.7404 and 0.7403 when firms are allowed to break the equilibrium using menu of contracts.

<table>
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<tr>
<th>CANDIDATE</th>
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$$\sqrt{x}, \ t = 0.005$$

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The critical $\gamma$ under perfect competition is between 0.8322 and 0.8222 when firms are allowed to break the equilibrium using menu of contracts.
\[ (x)^{1/2}, \ t = 0.05 \]

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The critical \( \gamma \) under perfect competition is between 0.8322 and 0.8222 when firms are allowed to break the equilibrium using menu of contracts.
Other examples of equilibrium

**gamma = 0.9, x^{1/2}**

![Graph of gamma = 0.9, x^{1/2}]

**gamma = 0.9, ln(x)**

![Graph of gamma = 0.9, ln(x)]
CONCLUSIONS

1. Richer set of empirical implications: Cross subsidization, residual cream-skimming incentives.

2. Better existence results without resorting to ad-hoc equilibrium notions. More important when there exist signals correlated with types (as in Glazer-McGuire).

3. Convergence to RS. Our model is not so different and yet differentiation changes results even when \( t \) is near 0.