Health Plan Differentiation and Adverse Selection

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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 γ of low risks is low enough. (Intuition)
   How low is ”low enough”?
   Example: Utility functions $u(x) = \text{Log}(x)$ and $u(x) = x^{1/2}$High risks contract illness with 5 times more probability
   γ 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 γ 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

Definition. Miyazaky (1978), Spence (1978). Allow for menus. Obtain:

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
2. Frank, Glazer, and McGuire (2000)
    a. No true competition (partial/partial analysis)
3. Villas-Boas and Schmidt-Mohr (1999)
    a. Do not emphasize existence (γ 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 γ much closer to unity (0.9) for quite low transportation costs ($t = 0,05$)

[$t = 33,78\%$ of equilibrium profits, which tend to 0; or $t = 1,5\,\%$ of low risk utility. The critical value for γ 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

ii. Suppose analyst observes patients' locations. New interpretation of separation: types revealed through hospital choice (not contract) if demand for firm A varies with type. Requires existence of asymmetric equilibria. Current work.

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

1. **a**. *Address existence issue*: other sources of imperfect competition: Encinosa and Sappington (1997), Jack (2002)

   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

c. Encinosa (2001,2002), Neudeck and Podzeck (1996): Mandatory insurance/Minimum coverage. Choice of equilibrium notion becomes again crucial

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 γ

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

$$\Pi_{0g} = r - m_{0g} - p_G n_{0g}$$

Π_{0b}, Π_{1g}, and Π_{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 $j = g, b$.

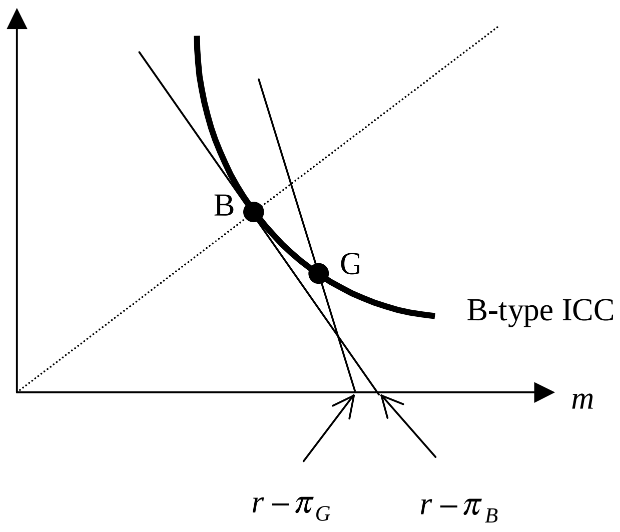


Figure 2. The separating equilibrium candidate under symmetry.

Important remark:
Per-capita profits can be read in the 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 $(m_{1b}, n_{1b}, m_{1b}, n_{1b})$

$$\max_{(m_{0b},n_{0b},m_{0b},n_{0b})\in\Re^4_+} \gamma\Pi_{0g}D_{0g} + (1-\gamma)\Pi_{0b}D_{0b}$$

$$\text{subect to } U^G_{0g} \geq U^G_{0b},$$

$$U^B_{0b} \geq U^B_{0g}.$$

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. Π_{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 γ, 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

CANDIDATE	$\gamma = 0.3$	$\gamma = 0.7404$	$\gamma = 0.8$	$\gamma = 0.9$
m_{0g}	9.3670	9.3634	9.3617	9.3543
n_{0g}	2.8766	2.8949	2.9036	2.9411
$m_{0b} = n_{0b}$	5.5427	5.5572	5.5640	5.5935
Π_g	0.0577	0.0575	0.0576	0.0575
Π_b	0.0231	-0.0029	-0.0152	-0.0682
$E\Pi$	0.0167	**0.0209**	**0.02154**	**0.0224**

DEVIATION	$\gamma = 0.3$	$\gamma = 0.7404$	$\gamma = 0.8$	$\gamma = 0.9$
m_{0g}	Same up to 5th decimal	Same up to 5th decimal	8.7845	8.1948
n_{0g}			4.0925	5.8442
$m_{0b} = n_{0b}$			6.2558	7.0517
D_{0g}			1	1
D_{0b}			1	1
$E\Pi$	Same up to 11th decimal	Same up to 12th decimal	**0.0655**	**0.3034**
Increase %	0	0	204,09%	1254,46%

The critical γ under perfect competition is between 0.7404 and 0.7403 when firms are allowed to break the equilibrium using menu of contracts.

Ln(x), t = 0.05

CANDIDATE	$\gamma = 0.3$	$\gamma = 0.7404$	$\gamma = 0.8$	$\gamma = 0.9$
m_{0g}	8.8699	8.8413	8.8282	8.7731
n_{0g}	2.9382	3.1046	3.1815	3.5017
$m_{0b} = n_{0b}$	5.4283	5.5528	5.6089	5.8328
Π_g	0.5423	0.5376	0.5355	0.5265
Π_b	0.2290	0.0048	-0.0960	-0.4991
$E\Pi$	0.1615	**0.1996**	**0.2046**	**0.2120**

DEVIATION	$\gamma = 0.3$	$\gamma = 0.7404$	$\gamma = 0.8$	$\gamma = 0.9$
m_{0g}	Same up to 5^{th} decimal	Same up to 5^{th} decimal	Same up to 6^{th} decimal	8.2933
n_{0g}				5.1767
$m_{0b} = n_{0b}$				6.7261
D_{0g}				0.71
D_{0b}				1
$E\Pi$	Same up to 11^{th} decimal	Same up to 11^{th} decimal	Same up to 14^{th} decimal	**0.2234**
Increase %	0	0	0	5,38%

The critical γ under perfect competition is between 0.7404 and 0.7403 when firms are allowed to break the equilibrium using menu of contracts.

$(x)^{1/2}$, t = 0.005

CANDIDATE	$\gamma = 0.3$	$\gamma = 0.8322$	$\gamma = 0.85$	$\gamma = 0.9$
m_{0g}	9.5520	9.5478	9.5471	9.5440
n_{0g}	2.0574	2.0788	2.0822	2.0978
$m_{0b} = n_{0b}$	5.5437	5.5576	5.5597	5.5697
Π_g	0.0364	0.0363	0.0363	0.0363
Π_b	0.0211	-0.0036	-0.0075	-0.0256
$E\Pi$	0.0128	**0.0148**	**0.0149**	**0.0150**

DEVIATION	$\gamma = 0.3$	$\gamma = 0.8322$	$\gamma = 0.85$	$\gamma = 0.9$
m_{0g}	Same up to 5th decimal	Same up to 5th decimal	9.2198	8.7818
n_{0g}			3.0105	4.4228
$m_{0b} = n_{0b}$			6.0420	6.6617
D_{0g}			1	1
D_{0b}			1	1
$E\Pi$	Same up to 10th decimal	Same up to 11th decimal	**0.0199**	0.1011
Increase %	0	0	33%	**85.16%**

The critical γ under perfect competition is between 0.8322 and 0.8222 when firms are allowed to break the equilibrium using menu of contracts.

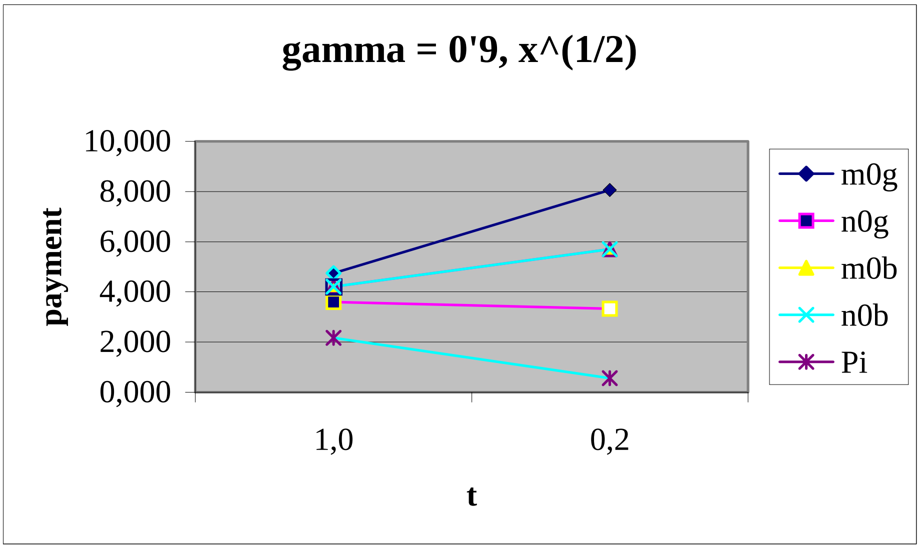
$(x)^{1/2}$, t = 0.05

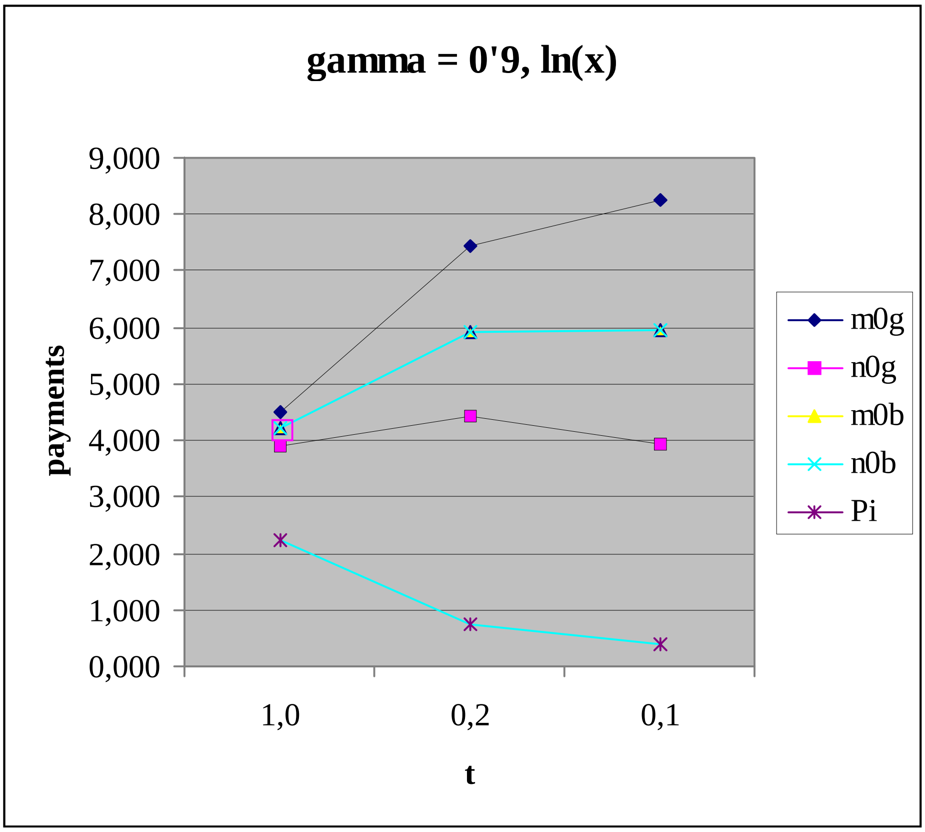
CANDIDATE	$\gamma = 0.3$	$\gamma = 0.8322$	$\gamma = 0.9$	$\gamma = 0.99$
m_{0g}	9.2222	9.1852	9.1538	8.7247
n_{0g}	2.1058	2.3064	2.4759	4.7709
$m_{0b} = n_{0b}$	5.4385	5.5634	5.6653	6.8213
Π_g	0.3565	0.3534	0.3509	0.3310
Π_b	0.2105	-0.0142	-0.1975	-2.2783
$E\Pi$	0.1271	**0.1459**	**0.1480**	**0.1475**

DEVIATION	$\gamma = 0.3$	$\gamma = 0.8322$	$\gamma = 0.9$	$\gamma = 0.99$
m_{0g}	Same up to 5th decimal	Same up to 6th decimal	Same up to 5th decimal	8.1672
n_{0g}				7.3925
$m_{0b} = n_{0b}$				7.8181
D_{0g}				0.6099
D_{0b}				1
$E\Pi$	Same up to 11th decimal	Same up to 14th decimal	Same up to 11th decimal	**0.1732**
Increase %	0	0	**0**	17%

The critical γ 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





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.