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Welfare Impacts of Genetic Testing in Health Insurance Markets

Will Cross-Subsidies Survive?

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Personalized Medicine Workshop, Montréal, 14-15 March 2019

1. Introduction

- "Personalized medicine: the use of an individual's genetic profile to guide decisions made in regard to the prevention, diagnosis, and treatment of disease" (Collins, 2010).
- Genetic tests give the probability of developing disease and allow to better tailor
  - primary prevention (decrease probability of getting sick),
  - secondary prevention (decrease severity of illness),
  - treatment (cancers, auto-immune diseases, ...)

Current situation

- Little actionable health information for prevention, except for very specific diseases, or very costly prevention actions: Snyder (2016).
- Low genetic test take-up rates.
- Pooling health insurance contracts (with cross-subsidies between genetic types).

(Near) Future

- Further decreases in genetic tests costs.
- Increase in test informativeness, as measured by efficiency/cost ratio of prevention.
- Should increase the genetic test take-up rates.

Questions addressed by this paper

- Will pooling contracts survive? Or will we move to separating contracts without cross subsidies?
- More generally: what are the welfare impacts of
  - Higher test take-up rates?
  - More informative genetic tests?

Literature

- Doherty and Thistle (1996): incentives to gather information in insurance markets with adverse selection. They stress the importance of what is observable: status (tested or not) and type (good or bad genetic background).
- Subsequent literature has added prevention to this setting:
  - Primary prevention: Hoel and Iverson (2002), Peter *et al* (2017), Bardey and De Donder (2013),...
  - Secondary prevention: Crainich (2017), Barigozzi and Henriet (2011)

- These papers share two assumptions:
  - All individuals are *ex ante* identical (benefits and costs of testing) $\Rightarrow$ they all either test or do not test at equilibrium.
  - Concentrate on separating contracts à la Rothschild-Stiglitz
- Exceptions:
  - Hoel *et al* (2006) : heterogeneity in psychological costs. See also Hoy, Peter and Richter (2014).
  - Hoy (2006), Hoy *et al* (2003) and Crainich (2017): consider pooling equilibria
- To the best of our knowledge, no paper with both (i) test take-up rate intermediate and (ii) both pooling and separating contracts considered.

Outline of talk

1. Introduction
2. Wilson's approach
3. Set-Up
4. Separating contracts
5. Pooling contracts
6. Equilibrium contract: separating or pooling?
7. Welfare analysis
8. Conclusion

2. Wilson's approach: from separating to pooling equilibrium

- Simple setting with two types: L (low probability of damage) et H (high probability), and two states of the world: 1 for the good one (no damage) and 2 for the bad one (damage occurs).
- Figure 1 (Hoy, 2006) : Separating equilibrium à la Rothschild-Stiglitz
- Figure 2 (Hoy, 2006) : Pooling equilibrium à la Wilson.

Conclusion:

- If large proportion of bad types: separating equilibrium.
- Otherwise: pooling equilibrium.

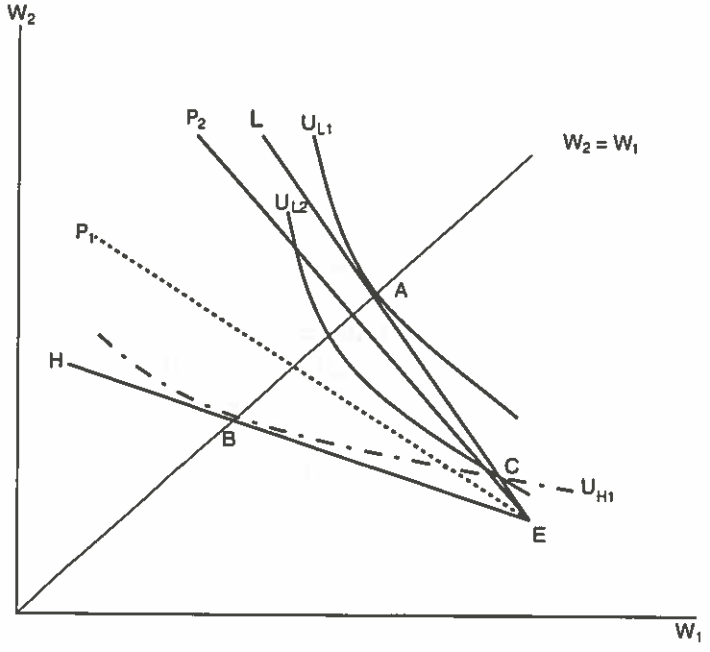


Figure 1. Rothschild–Stiglitz separating equilibrium.

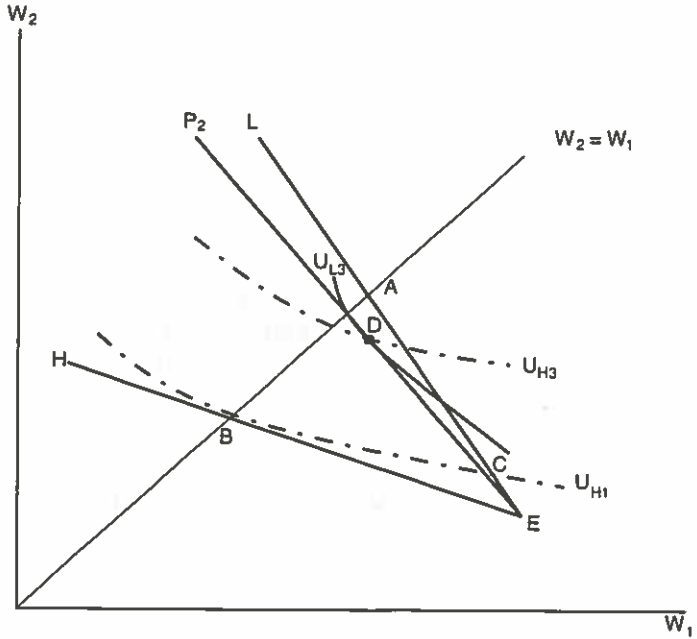


Figure 2. Wilson anticipatory (E2) pooling equilibrium.

3. Set-Up

- Two types of agents:
  - Type L: low probability p_L of illness, proportion $1 - \lambda$;
  - Type H: high probability p_H, proportion λ.
- If no information: type U with:

$$p_U = (1 - \lambda)p_L + \lambda p_H.$$

- Exogenous proportion k of agents are informed (by a genetic test) about their type L or H , $1 - k$ are of type U.

- Disease: same financial damage for all sick individuals.
- Binary prevention effort:
  - Reduces the probability for type H,
  - No impact for type L.

$\Rightarrow$ Reduces the probability for type U only with probability λ.

- Prevention cost: ϕ.

Regulation and observability of information/actions

- Competitive fringe of insurers
- Prevention is observable (and contractible) by insurers (no moral hazard).
- *Consent Law* regulation: may reveal one's type, but not obliged

$\Rightarrow$ adverse selection (as in *Strict Prohibition*)

$\Rightarrow$ L-type reveals his test, does not do effort and receives a complete coverage at a fair price.

- Insurers either pool types U and H, or they separate them using Rothschild-Stiglitz contracts.

4. Separating equilibrium contract

- H-type receives a complete coverage at a fair price.
- Two ways to prevent H-types from mimicking U-types:
  - Usual way: under-provide insurance to U-type.
  - Require a different prevention effort for types U and H.
- Equilibrium:
  - Separating contract S^{11} where U and H types do effort, if $\phi < \phi_{\min}$.
  - Separating contract S^{01} where only H undertakes effort, if $\phi_{\min} < \phi < \phi_{\max}$.
  - Separating contract S^{00} where nobody undertakes effort, if $\phi > \phi_{\max}$.

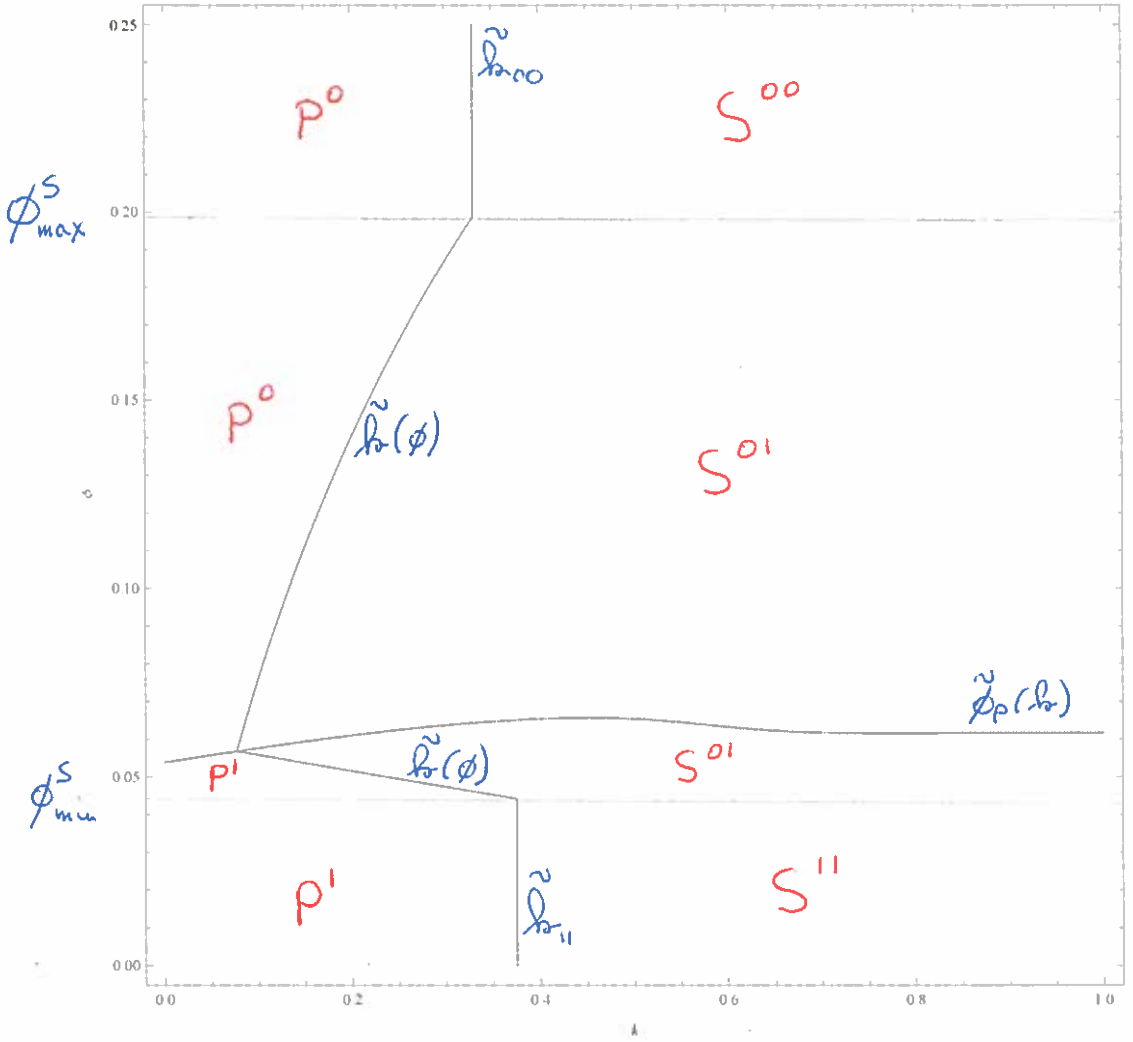
5. Pooling equilibrium contract

- H and U types have the same effort decision $i \in \{0, 1\}$. Two possible pooling equilibriums: P^0 and P^1.
- Coverage rate chosen by type U.
- Both k and ϕ affect the pooling equilibrium.
- Equilibrium:
  - Pooling contract P^1 if $\phi < \tilde{\phi}(k)$
  - Pooling contract P^0 if $\phi > \tilde{\phi}(k)$

6. Equilibrium contract: separating or pooling?

- 3 types of separating contracts: S^{00}, S^{01} and S^{11}, according to ϕ.
- 2 types of pooling contracts: P^0 and P^1, according to ϕ and k.
- In the (k, ϕ)-space, we choose the type of contract (S or P) that yields the highest level of utility to U-type.
- For any value of ϕ, there is a unique value of k, denoted by $\tilde{k}(\phi)$, with pooling equilibrium if $k < \tilde{k}(\phi)$ and separating if $k > \tilde{k}(\phi)$.

Figure 1 : Separation between P^1, P^0, S^{11}, S^{01} and S^{00} contracts in the (k, ϕ) space



7. Welfare analysis

Utilitarian welfare:

$$W = (1-k)V_U + k\lambda V_H + k(1-\lambda)V_L$$

7.1. Increase in k

- If pooling contract
  - Increase in contract's price $\Rightarrow$ decreases V_U, V_L and W
  - Composition effect: more types L and types H, fewer types U. Increases W
  - Net impact is ambiguous...

- If separating contract
  - Only composition impact $\Rightarrow$ Increases W
- At $k = \tilde{k}(\phi)$ (from Pooling to Separating)
  - V_U is continuous.
  - V_H decreases discontinuously as one moves from P to S (price effect>coverage effect)

So, increasing k has ambiguous impact on welfare if pooling and is especially bad for H types when going from P to S.

Also, global maximum for welfare may be reached at $k = 0$ and P^1 or at $k = 1$ and S^{11}

7.2. Decrease in ϕ

No composition effect.

- If pooling contract
  - No impact if P^0.
  - Increases V_U, V_H and W if P^1.
- If separating contract
  - No impact if S^{00}.
  - Increases V_U, V_H and W if S^{01} or S^{11} (direct impact + higher coverage)

- At $k = \tilde{k}(\phi)$ (from Pooling to Separating)
  - Continuity of V_U
  - V_H decreases discontinuously as one moves from P^0 to S^{01} (but upward jump from P^0 to P^1 and from S^{01} to P^1)

So, decreasing ϕ is bad for type H (and welfare) when moving from P^0 to S^{01}.

7.3. Simultaneous increase in k and decrease in ϕ

- Numerical example with P^0 then S^{01} then P^1.
- From P^0 to S^{01} especially bad for type H.
- Global maximum of welfare at high k/low ϕ.

Figure 8 : Utility of U (blue) and H (red) as a function of k when ϕ[k] = 0.29 – 0.8 k

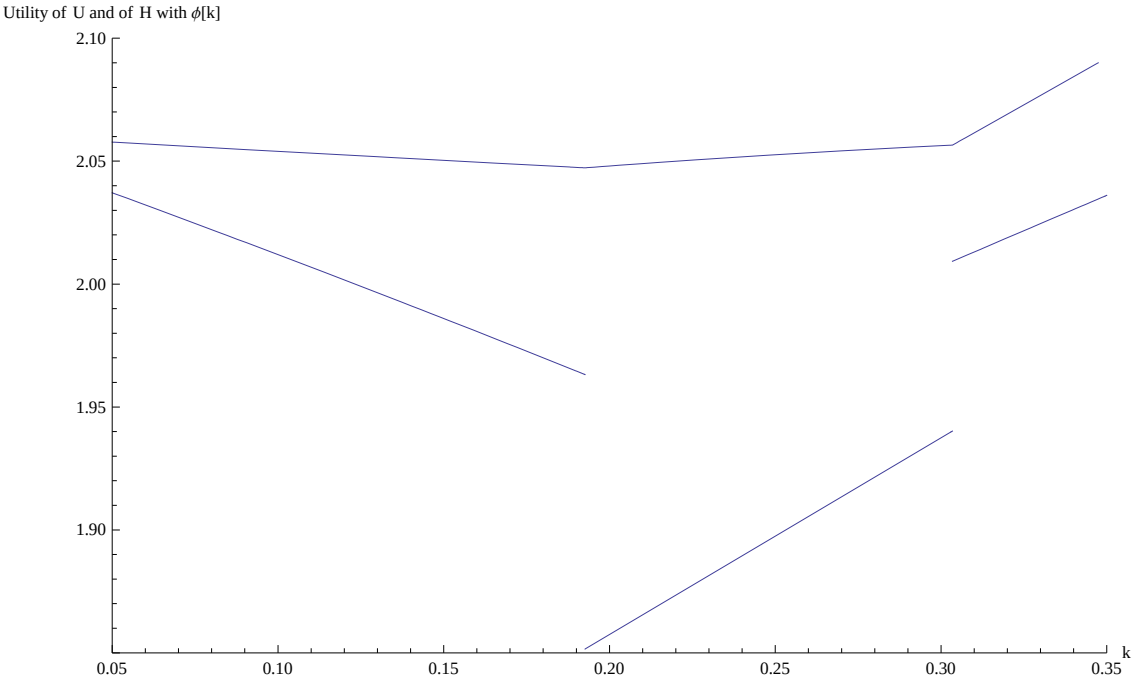
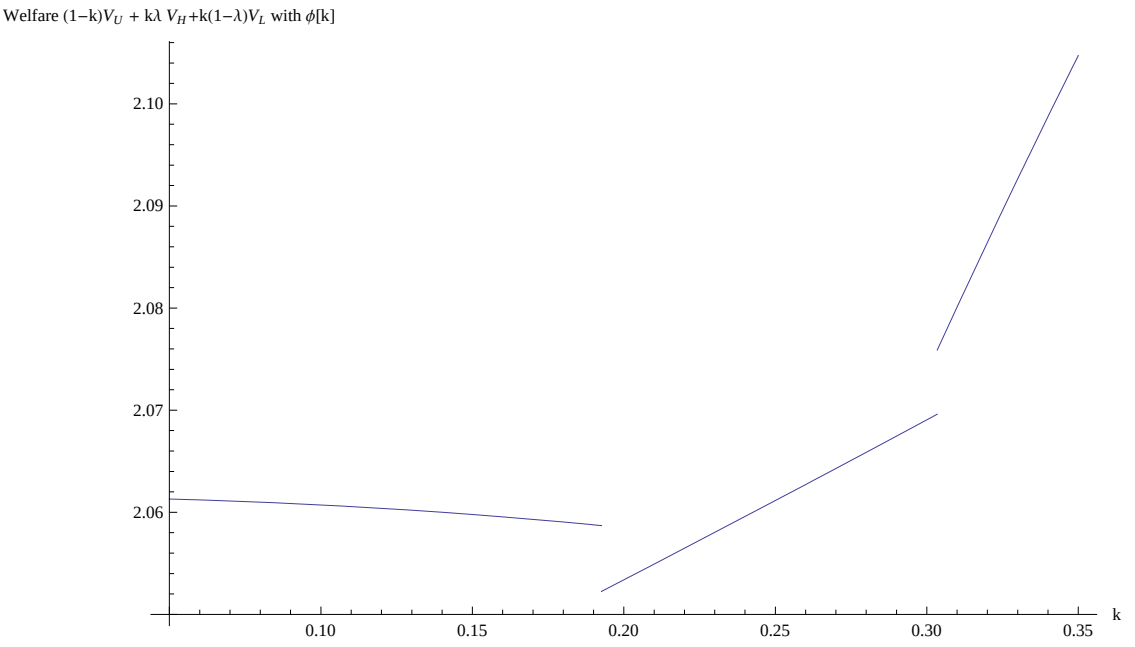


Figure 9 : Aggregate Welfare as a function of k when ϕ[k] = 0.29 – 0.8 k



8. Conclusion

Two main messages about impact of increase in take-up rates and in informativeness of tests

1. Short run impact of higher take-up rate

- Increase in take-up rate bad for U and H in Pooling contract (and maybe for welfare)
- Moving from Pooling to Separating is especially detrimental to type H (and welfare)

$\Rightarrow$ encouraging individuals to take a test tends to decrease welfare in short run

2. Long run impact of higher take-up rate

Even if move from Pooling to Separating at some point, in the long run a large enough increase in test informativeness (decrease in ϕ) may move us back in pooling with prevention effort.

$\Rightarrow$ Importance of increasing actionable health information from tests, and not only focus on increasing take-up rate