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Insights from social choice for risk adjustment

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INTRODUCTION

- this is NOT an original paper
- insights from social choice to tackle two (important?) questions in risk adjustment:
  - defining “acceptable costs”

    responsibility-sensitive egalitarianism
  - “rationing” if budget is too small

    claims (bankruptcy, estate division) problem

- institutional background: Belgium
  - limited set of variables in Royal Decree: medical supply, self-employed?
  - risk adjustment within a fixed health care budget, set in the beginning of the year

Structure

1. Acceptable costs and the impossibility of perfect risk adjustment
    a. The omitted variables problem
    b. The impossibility of perfect risk adjustment
    c. Intermediate solutions

2. Allocating a fixed budget
    a. The claims problem
    b. Solutions
    c. Axioms and results
    d. Parametric rules

Conclusion

1. ACCEPTABLE COSTS AND THE IMPOSSIBILITY OF PERFECT RISK ADJUSTMENT

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- In practice: risk-adjusted premium subsidies usually derived from observed expenditures.
- In principle: risk-adjusted premium subsidies should reflect “acceptable costs”: “costs generated in delivering a specified basic benefits package, containing only medically necessary and cost-effective care “(van de Ven and Ellis, 2000).
- Therefore: many factors which do have an influence on observed expenditures, should NOT be used for calculating the risk-adjusted premium subsidies.

1. ACCEPTABLE COSTS AND THE IMPOSSIBILITY OF PERFECT RISK ADJUSTMENT

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	NL	G	B	IS	SW
Life style variables	N	N	N	N	N
Insurance status	N	N	Y	N	N
Supply prices	N	N	N	N	N
Are there differences?	Y	Y	N	Y	N
Region	N	N	Y/N*	N	N
Premium differentiation?	Y	N	N	N	Y
Self-employed	Y	N	Y	N	N
Provider characteristics	N	N	Y/N*	N	N

Conventional approach

- Estimate a (linear) regression equation with only the “relevant” (legitimate, acceptable) risk adjusters included.
- Calculate “acceptable” costs as the predicted value of that equation (basically neglecting the disturbances).

- Apply a proportional adjustment (a) if total acceptable costs are larger than a given budget; and/or (b) if one wants to have part of the acceptable costs financed through premiums.

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a. The omitted variables problem

- Suppose the “true” model is:

$$x_i = \alpha a_i^C + \beta a_i^R + \varepsilon_i$$

- “Conventional” risk adjustment estimates

$$x_i = \alpha a_i^C + \varepsilon_i$$

and calculates acceptable costs as

$$\widetilde{c}_i = \widetilde{\alpha} a_i^C$$

- “Explicit” risk adjustment estimates complete model and calculates acceptable costs as:

$$c_i = \widehat{\alpha} a_i^C + \widehat{\beta} \overline{a^R}$$

Some results

- (Schokkaert and Van de Voorde, Annales d'Economie et Statistique, 2006)

1. If community rating is imposed by the regulator, the explicit model removes the incentives for risk selection. The conventional model does not.

2. If premium differentiation on the basis of the "illegitimate" risk adjusters is allowed, both approaches lead to higher premiums for high-responsibility individuals/insurers. In the explicit approach there are no incentives for risk selection left, in the conventional approach there are.

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b. The impossibility of perfect risk adjustment

- The relevance of good risk adjustment is that in the (theoretical) case of perfect risk adjustment there is no need for any of the other strategies, each of which confronts policymakers with severe tradeoffs. The better the risk-adjusted equalization payments are adjusted for relevant risk factors, the less severe are these tradeoffs.

ex post cost-based compensations;
premium rate restrictions

refers to availability of information

The setting (Schokkaert et al., 1998)

- Health care expenditures: $x = f(a_i)$
- Total amount of premium subsidies:

$$\omega (= \sum_i \omega_i)$$

- Monetary gain made on an individual *i* if premium = 0

$$\pi_i = \omega_i - x_i$$

or, alternatively, "premium" of individual *i*

$$p_i = x_i - \omega_i$$

- **"Responsibility cut**" (to be decided by policy maker):

$$x_i = f(a_i^C, a_i^R)$$

"Neutrality" (equal treatment of equals)

NEUTRALITY: for any two individuals i and j with $a_i^C = a_j^C, \omega_i = \omega_j$

Implication. $\forall i, j$ with $a_i^C = a_j^C$ and $a_i^R > a_j^R$, it holds that $\pi_i < \pi_j$ and $p_i > p_j$

Solidarity

NO INCENTIVES FOR RISK SELECTION UNDER COMMUNITY RATING:

for any two individuals i and j with $a_i^R = a_j^R, \pi_i = \pi_j$

NO PREMIUM DIFFERENTIATION ON THE BASIS OF LEGITIMATE RISK ADJUSTERS:

for any two individuals i and j with $a_i^R = a_j^R, p_i = p_j$

Implication. $\forall i, j$ with $a_i^R = a_j^R$ and $a_i^C > a_j^C$, it holds that $\omega_i > \omega_j$

The impossibility of perfect risk adjustment

PROPOSITION (Bossert and Fleurbaey, 1996; Fleurbaey, 2008, Fairness, responsibility and welfare, OUP):

If the medical expenditure function is not additively separable in the variables a^C and a^R, then NO risk adjustment scheme can satisfy both neutrality and solidarity, i.e. a “perfect” risk adjustment system does not exist.

Illustration 1

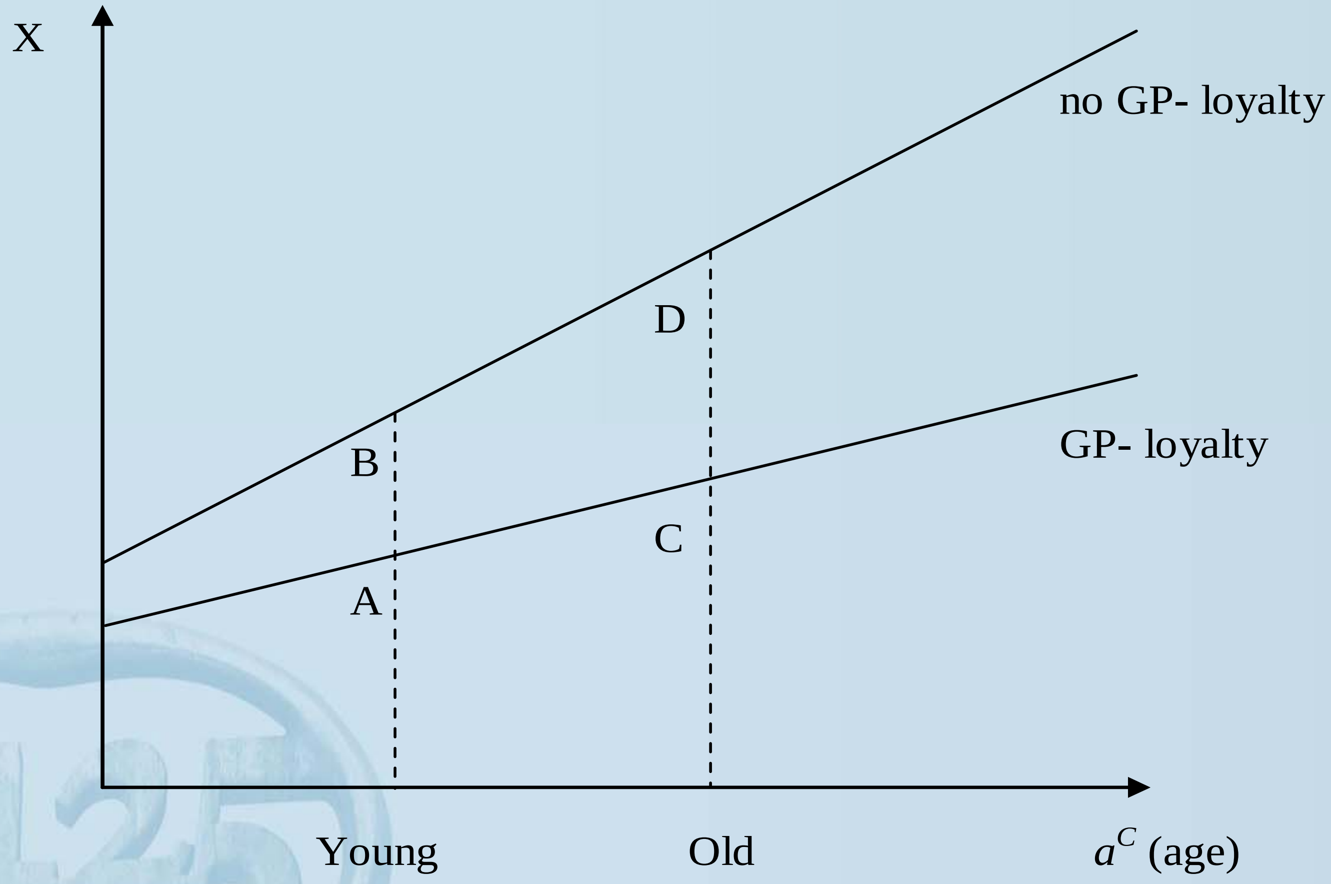
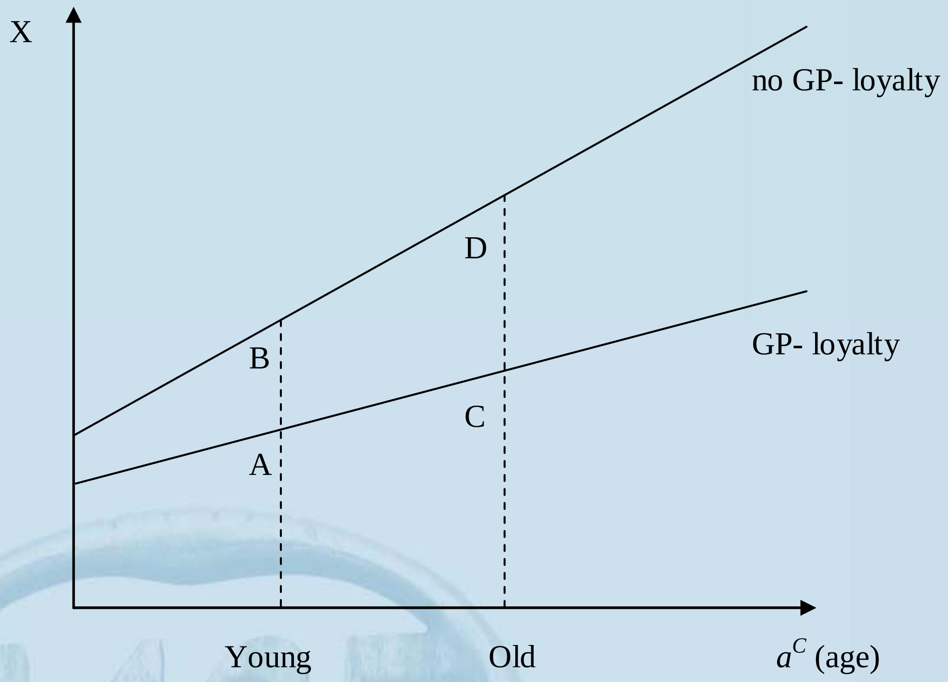


Illustration 1



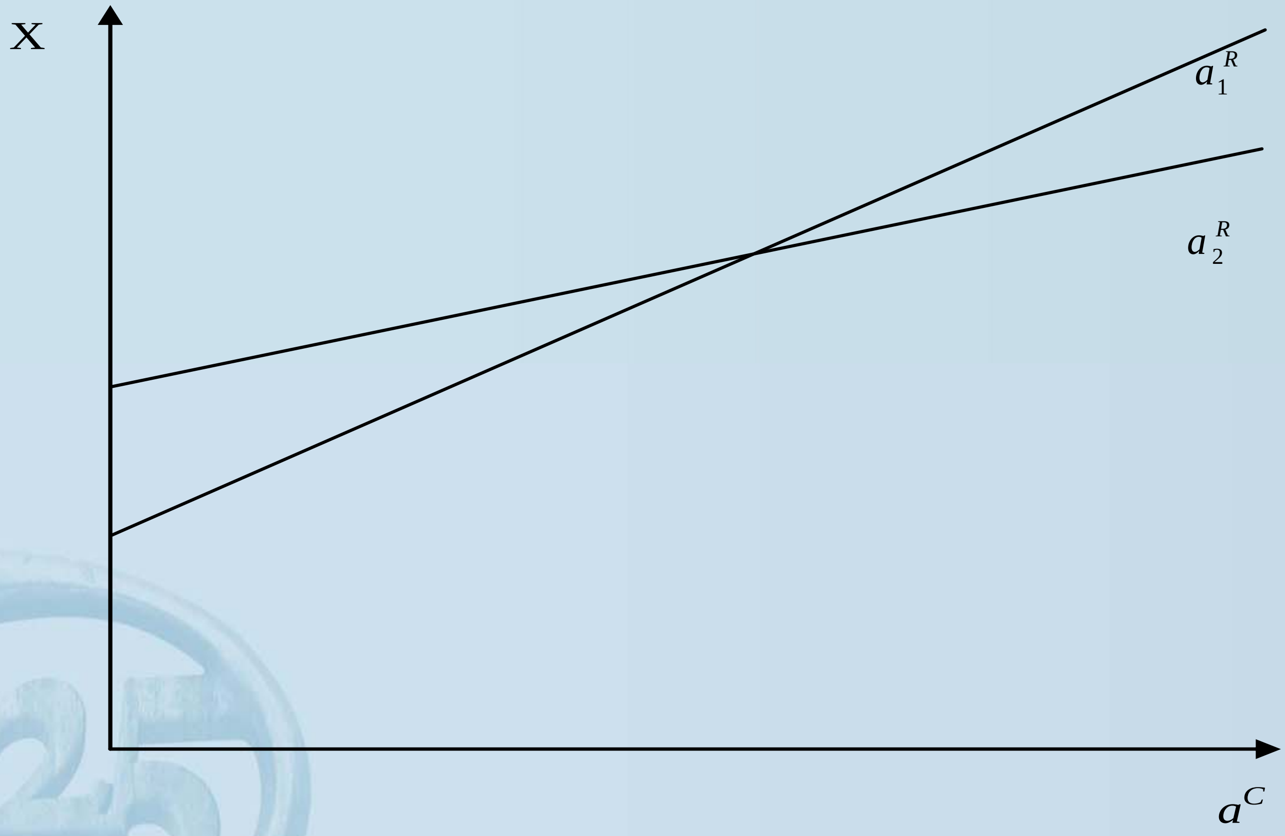
- NEUTRALITY:

$$\omega_A = \omega_B$$
$$\omega_C = \omega_D$$

- SOLIDARITY:

$$x_A - \omega_A = x_C - \omega_C$$
$$x_B - \omega_B = x_D - \omega_D$$

Illustration 2



The natural solution

PROPOSITION. If the medical expenditure function can be written $(\forall i)$ as

$$f(a_i^C, a_i^R) = g(a_i^C) + h(a_i^R)$$

then the following mechanism satisfies "neutrality" and "solidarity":

$$\omega_i = \frac{\omega}{n} + g(a_i^C) - \frac{1}{n}\sum_k g(a_k^C)$$

Interpretation

- "Acceptable cost":

$$c_i = g(a_i^C) + \frac{1}{n}\sum_k h(a_k^R)$$

- Total acceptable costs:

$$\sum_i c_i = TC = \sum_i g(a_i^C) + \sum_i h(a_i^R)$$

- Implementing the budget constraint:

$$\omega_i = c_i - (TC - \omega)/n$$

- Natural solution:

$$\omega_i = \frac{\omega}{n} + g(a_i^C) - \frac{1}{n}\sum_k g(a_k^C)$$

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c. Intermediate solutions

- In general, one will have EITHER to drop neutrality, OR to go for a solution which does not satisfy solidarity.

- The first option does not seem very realistic, the second one is unfortunate.

- Link with direct and indirect standardization (Schokkaert and Van de Voorde, 2009).

Conditional egalitarian – indirect standardization

- Acceptable costs: $c_i^{CE} = f(a_i^C, \tilde{a}^R)$

- Correction for budget constraint:

$$\omega_i^{CE} = f(a_i^C, \tilde{a}^R) + \left[(\omega/n) - \tfrac{1}{n}\textstyle\sum_k f(a_k^C, \tilde{a}^R)\right]$$

or:

$$\omega_i^{CE} = \lambda^{CE} + f(a_i^C, \tilde{a}^R)$$

$$p_i^{CE} = x_i - f(a_i^C, \tilde{a}^R) - \lambda^{CE}$$

- This is equivalent to INDIRECT STANDARDIZATION (with "standard average treatment"), after taking into account a^R.

Egalitarian-equivalent, direct standardization

- Acceptable costs: $c_i^{EE} = (\omega/n) + x_i - f(\widetilde{a}^C, a_i^R)$

- Correction for budget constraint:

$$\omega_i^{EE} = (\omega/n) + x_i - f(\widetilde{a}^C, a_i^R) - \frac{1}{n}\sum_k (x_k - f(\widetilde{a}^C, a_k^R))$$

or:

$$\omega_i^{EE} = \lambda^{EE} + x_i - f(\widetilde{a}^C, a_i^R)$$

$$p_i^{EE} = f(\widetilde{a}^C, a_i^R) - \lambda^{EE}$$

- This is equivalent to DIRECT STANDARDIZATION (with "standard needs profile").

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2. ALLOCATING A FIXED BUDGET

- How to go from "acceptable costs" to "premium subsidies"?

- Netherlands: *proportional* adjustment (50% of costs to be covered by premiums – in the past 15%)
- Belgium: *additive* adjustment

$$\omega_i = c_i - (TC - \omega)/n$$

- How to choose between these two?

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a. The claims problem

An amount $\omega \in \mathbb{R}_+$ has to be divided among a set $N = \{1, 2, \ldots, n\}$ of individuals with claims adding up to more than ω. Let $c_i \in \mathbb{R}_+$ denote individual i's claim and $c = (c_1, c_2, \ldots, c_n)$ the claims vector. Claims are ordered so that $c_1 \leq c_2 \leq \cdots \leq c_n$. The total claim $\sum_{i \in N} c_i$ is assumed to be positive and is denoted by TC. A claims problem is a pair (c, ω) with $C \geq \omega$. The set $\mathcal{C}$ collects all claims problems.

- My presentation of the theory is largely based on the survey paper by William Thomson, Mathematical Social Sciences, 2003.

RULE: a function R that associates with each claims problem $(c, \omega) \in \mathcal{C}$ a division $R(c, \omega) = (R_1(c, \omega), R_2(c, \omega), \ldots, R_n(c, \omega)) \in \mathbb{R}^n_+$.

- we impose: (a) efficiency; (b) no individual receives a negative amount; (c) no individual receives more than her claim.
- individual award (*premium subsidy*): $R_i(c, \omega)$
- individual loss (*own contribution or premium*): $c_i - R_i(c, \omega)$

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b. Solutions

PROPORTIONAL RULE, P.
For all $(c, \omega) \epsilon \mathcal{C}$ and all $i \epsilon N$, we have $P_i(c, \omega) = (\omega / TC) c_i$.

CONSTRAINED EQUAL AWARDS RULE, CEA.
For all $(c, \omega) \epsilon \mathcal{C}$ and all $i \epsilon N$, we have $CEA_i(c, \omega) = \min \{c_i, \lambda\}$ where $\lambda \epsilon \mathbb{R}_+$ is chosen so as to achieve efficiency.

A typical awards vector looks like $(c_1, c_2, ..., c_k, \lambda, \lambda, ..., \lambda)$.

CONSTRAINED EQUAL LOSSES RULE, CEL.
For all $(c, \omega) \epsilon \mathcal{C}$ and all $i \epsilon N$, we have $CEL_i(c, \omega) = \max \{0, c_i - \lambda\}$ where $\lambda \epsilon \mathbb{R}_+$ is chosen so as to achieve efficiency.

A typical awards vector looks like $(0, 0, ..., 0, c_k - \lambda, c_{k+1} - \lambda, ..., c_n - \lambda)$.

A curiosity?

TALMUD RULE, T.

For all $(c, \omega) \epsilon \mathcal{C}$ and all $i \epsilon N$, we have that

(i) if $\omega \leqslant TC/2$, then $T(c, \omega) = CEA(\frac{1}{2}c, \omega)$.

(ii) if $\omega \geqslant TC/2$, then $T(c, \omega) = \frac{1}{2}c + CEL(\frac{1}{2}c, \omega - \frac{1}{2}TC)$.

Popular solution in the Babylonian Talmud, analysed e.g. by Aumann and Maschler (JET, 1985):

A man has three wives whose marriage contracts specify that upon his death they should receive 100, 200 and 300 respectively. The man dies and his estate is found to be worth only 100. The Talmud recommends (33,33; 33,33; 33,33). If the estate is worth 300 it recommends (50, 100, 150). If it is worth 200, it recommends (50, 75, 75).

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c. Axioms and results

CONSISTENCY.
For each pair $\{N, N'\}$ $N' \subset N$, if $y \equiv R(c, \omega)$, then $y_{N'} = R(c_{N'}, \sum_{N'} y_i)$.

COMPOSITION DOWN.
If $\omega' < \omega$, we have $R(c, \omega') = R(R(c, \omega), \omega')$.

COMPOSITION UP.
If $\sum_i c_i \geqslant \omega' > \omega$, then $R(c, \omega') = R(c, \omega) + R(c - R(c, \omega), \omega' - \omega)$.

Result for CEL (Belgium)

- Constrained equal awards is the only rule to satisfy exemption, composition down and consistency.

EXEMPTION.
If $c_i \leqslant \omega/n$, then $R_i(c, \omega) = c_i$.

- Constrained equal losses is the only rule to satisfy exclusion, composition up and consistency (Herrero, Villar, 2001).

EXCLUSION.
$R_i(c, \omega) = 0$ whenever $c_i \leqslant L/n$, where L is the *per capita* loss.

- INTERPRETATION: SOLIDARITY! (incentives for risk selection and/or premium differentiation)

Some further axioms

NO ADVANTAGEOUS TRANSFER.

For each $M \subset N$, and each $(c'_i)_{i \epsilon M} \epsilon \mathbb{R}^M_+$, if $\sum_M c_i = \sum_M c'_i$, then $\sum_M R_i(c,\omega) = \sum_M R((c'_i)_{i\epsilon M}, c_{N \setminus M}, \omega)$.

NO ADVANTAGEOUS MERGING OR SPLITTING.

For each pair $\{N, N'\}$ $N' \subset N$, if $\omega' = \omega$ and there is $i \epsilon N'$ such that $c'_i = c_i + \sum_{N \setminus N'} c_j$,and for each $j \epsilon N' \setminus \{i\}$, $c'_j = c_j$, then $R_i(c', \omega') = R_i(c,\omega) + \sum_{N \setminus N'} R_j(c,\omega)$.

- INTERPRETATION: REMOVE STRATEGIC INCENTIVES.

Results for proportionality (the Netherlands)

- The proportional rule is the only rule satisfying no advantageous transfer.

- The proportional rule is the only rule satisfying no advantageous merging or splitting.

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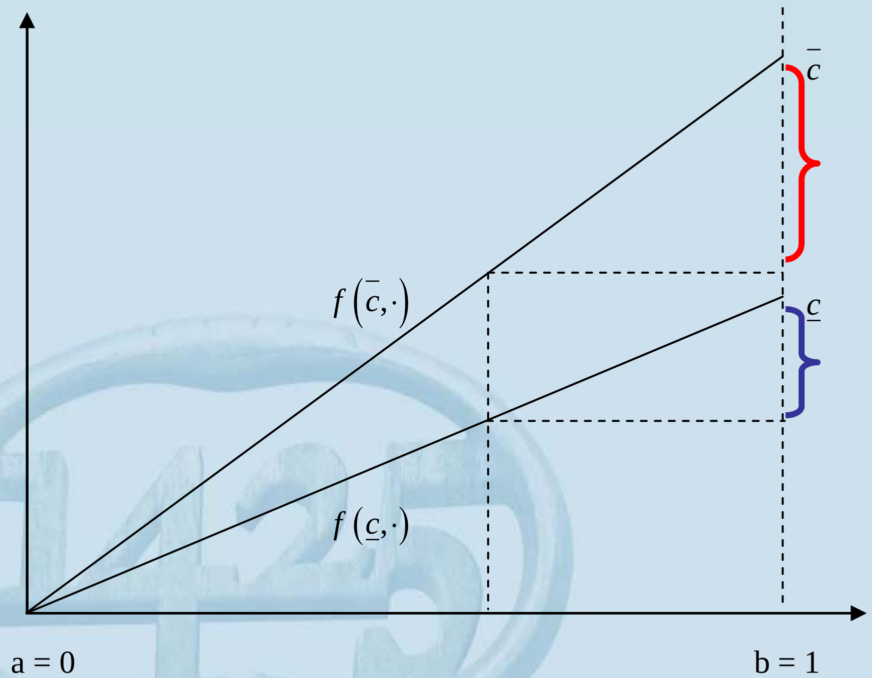
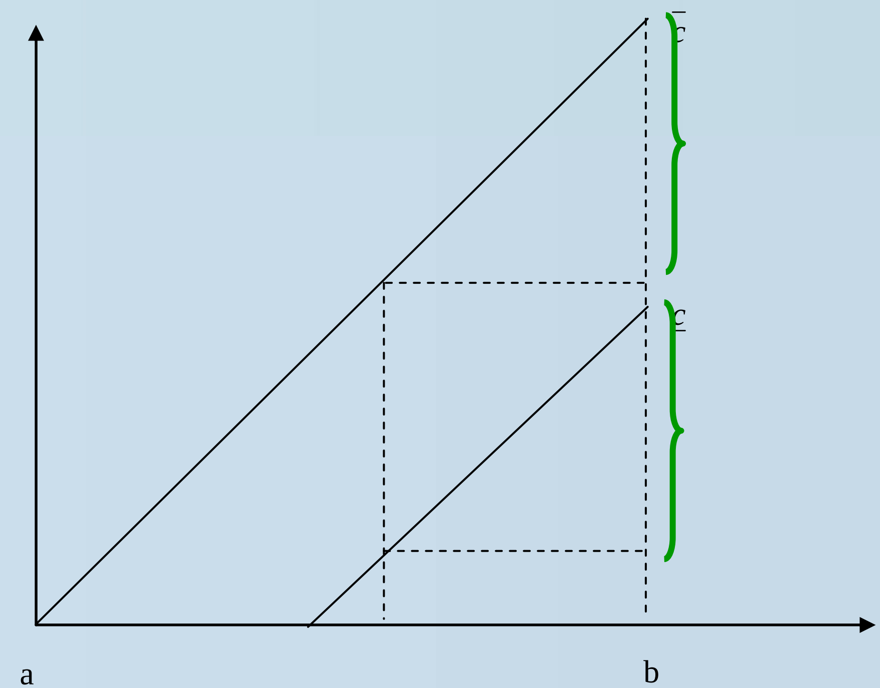
PARAMETRIC RULE (Young, 1987)

$R^f(c, \omega)$ is the awards vector y such that there exists $\lambda \epsilon [a, b]$ for which, for each $i \epsilon N$, $y_i = f(c_i, \lambda)$.





Interpretation

- Interpret $f(c_i, \lambda)$ in function of "incentives for risk selection", given the "distance" between the acceptable costs (the claim) and the actual premium subsidy.

- No need to stick to the proportional rule, or to CEL: other possibilities (e.g. progressive or regressive).

CONCLUSION

- Risk adjustment is NOT a merely technical problem, it unavoidably entails value judgments.
- Modern social choice theories make it possible to formalize these value judgments: trade-offs.
  - acceptable costs: neutrality versus solidarity.
  - imposing budget constraint: strategic incentives versus solidarity.

- MAIN CHALLENGE: confront these approaches with the theory on “optimal risk adjustment”:
  - think about objective functions in traditional theory.
  - introduce behavioural model in social choice approach.