Voluntary Pooling of Genetic Risk: A Health Insurance Experiment

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Motivation I: Increased Info on Individual Health Risks

Technological advances: Better detection, estimation and monitoring of health risks

⇒ technically allow health insurers to better tailor individual health insurance plans to an individual’s particular health risk profile
Motivation II: Health Risk Components

Overall health risk is a combination of factors that are

▶ outside of the individual’s control: e.g. genetic predisposition

▶ under the individual’s control: health behaviors, prevention

Should the pricing of health insurance plans, both in public and in private markets, be generally allowed to condition on tracked health behaviors?

And should and can the general prohibition of using genetic information in health insurance be upheld?
Motivation III: Fairness Views

Luck egalitarianism (Dworkin, 1981)

▶ Inequalities arising from brute luck, i.e. outside of control, should be eliminated

▶ Inequalities arising from option luck, i.e. under control, should be accepted

Taxation context (Weinzierl, 2016)

▶ Income inequalities stemming from (un)controllable factors are often deemed fair (unfair)
This Study

- Do people express social preferences for pooling uncontrollable health risk in an incentivized health insurance experiment?
- Does a group insurance with pooling of different genetic risk types emerge?

Experimental Design Overview

- Total health risk has a genetic risk and behavioral risk component
- Subjects differ in their assigned genetic risk and make choices on
  - Preventive effort (behavioral risk component)
  - Health insurance:
    - Group insurance/mutual: pooling of different health risk types
    - ‘Individual’: premium based only on individual’s health risk profile
Experimental Conditions: Differ in Degree of Pooling of Health Risk Components

<table>
<thead>
<tr>
<th></th>
<th>FP condition</th>
<th>GPO condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preventive effort</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Premium group insurance</strong></td>
<td>full community rating (pooling of genetic + behavioral risk)</td>
<td>community rating on genetic risk only, individually, fairly priced behavioral risk (premium discount)</td>
</tr>
<tr>
<td>Premium ‘individual’ insurance</td>
<td>actuarially fair pricing according to an <em>individual</em>’s total (genetic + behavioral) health risk</td>
<td>individual insurance, no insurance</td>
</tr>
</tbody>
</table>

▶ **Free-riding** incentive is eliminated in the GPO treatment
Results

1. We find social preferences for pooling.

2. However, we observe only a low level of actual genetic risk pooling across all experimental conditions.

3. Due to large heterogeneity in willingness to pool across subjects, and dynamics of willingness to pay

4. We observe a mismatch between voting from survey and incentivized decision
Related Literature

Preferences for redistribution

- Inequity aversion: Aversion towards unequal income distribution (e.g. Fehr & Schmidt 1999; Bolton & Ockenfels 2000)

- Source dependence: Income inequalities stemming from (un)controllable factors are deemed fair (unfair)
  - Risk context: brute vs. option luck: (e.g. Cappelen et al. 2013; Möllerström et al. 2015)

Health insurance experiments

- WTP for private health insurance under different allocation rules in public health insurance (Buckley et al. 2012)

- WTP for mutual insurance after informational boost (Gajdos et al. 2017)
The Experiment
General Set-Up

- Subjects form “societies” of 8 people
  - 4 subjects assigned low genetic risk
  - 4 subjects assigned high genetic risk
- Risk composition of society is common knowledge
- Members of a society engage in a game involving decisions on preventive effort and health insurance
- This game is repeated over 10 periods
- Composition of society and genetic risk constant over time
- At the end one period is randomly selected for payment
Situation in Each Period

- Subjects receive initial endowment
- Subjects face the risk to turn ill
- Probability of illness is additive in two components
  - Genetic risk: non-modifiable (20% or 40%)
  - Behavioral risk: modifiable with prevention (initially 20%)

\[
p_\theta(e) = \pi_\theta + z - h(e) .
\]

- Illness requires costly treatment
- Group and individual insurance fully cover the treatment cost in the case of illness
Decisions in Each Period

Decision 1: Choice of preventive effort level
- Choice between levels 0 to 10
- Preventive effort reduces the risk of illness linearly
  + increases the probability of winning a voucher for prevention offer at local sports facility
- Monetary effort costs are convex

Decisions 2 & 3: Health insurance choice
- WTP for group insurance ⇒ group insurance or not
- Individual insurance vs. no insurance, when not group insured
Entscheidung 1

Ihre Anfangsausstattung: 1000 ECU
Ihr genetisches Risiko zu erkranken: 20 %

1. Welches Level an Gesundheitsprävention zur Reduktion des Verhaltensrisikos möchten Sie wählen?

Ihre Entscheidung:

☐ 0  ☐ 1  ☐ 2  ☐ 3  ☐ 4  ☐ 5  ☐ 6  ☐ 7  ☐ 8  ☐ 9  ☐ 10

Durch Ihre Investition in Gesundheitsprävention erhalten Sie den Voucher für das Functional Movement Screen mit der Wahrcheinlichkeit, die in der Tabelle (Instruktionen) für die entsprechende Investition angegeben ist.

Der Besuch des Functional Movement Screenings hilft Ihnen, Ihre Bewegungsabläufe zu verbessern und Verletzungsrisiken vorzubeugen.

OK
Profit in Each Period

With group/individual insurance

\[ Profit = \text{endowment} - \text{prevention cost} - \text{insurance premium} \]

Without insurance

- If sick:
  \[ Profit = \text{endowment} - \text{prevention cost} - \text{treatment cost} \]
- If healthy:
  \[ Profit = \text{endowment} - \text{prevention cost} \]
Insurance Premiums and Experimental Condition Variation

Group insurance premium (FP):  
▶ Same premium for all group members  
▶ Premium equals the expected treatment costs of an average group member

Group insurance premium (GPO):  
▶ Pools only the genetic risk component for group insurance members  
▶ Gives individual premium discounts based on individual behavior/preventive effort, fairly priced

Individual insurance premium:  
▶ Actuarially fair pricing based on an individual's total (genetic + behavioral) health risk
# Learning Over Periods

<table>
<thead>
<tr>
<th>Period 1 of 1</th>
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</table>

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your genetic risk to become sick</td>
<td>20%</td>
</tr>
<tr>
<td>Your original behavior risk to become sick</td>
<td>+20%</td>
</tr>
<tr>
<td>Your risk reduction through investment in health prevention</td>
<td>-10%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your current total risk to become sick</td>
<td>30%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Event Description</th>
<th>Cost (ECU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your costs for health prevention</td>
<td>66 ECU</td>
</tr>
<tr>
<td>Your contribution for group insurance</td>
<td>348 ECU</td>
</tr>
</tbody>
</table>

**General Information about Group Insurance**

- **Total Members**: 7
  - **With high genetic risk to become sick**: 3
- **Insurance Premium**: 300.00 ECU

**Personal Information**

- **Insurance Status**: GRUPPENVERSICHERT
- **Insurance Premium**: 300.00 ECU
- **Health Status**: NICHTEKRANK
- **Gender**: 634.00 ECU

[OK]
Post-Experimental Tasks

Two incentivized tasks

- Holt-Laury task: risk aversion (Holt & Laury 2002)
- Dictator game: altruism
- One game (decision) selected at random for payment

Post-experimental questionnaire

- Risk aversion, altruism, reciprocity (Falk et al. 2016)
- Sociodemographic characteristics
- **Voting behavior** on four different health insurance systems
- **Use of health apps**
- **Willingness to share health information** with health insurance
Experimental Procedure

Main experiment
▶ 6 sessions conducted at ETH DeSciL (Oct./Nov. 2017)
▶ 96 subjects (students, 47% males, average age 22)
▶ 12 matching groups, i.e. 6 per treatment

Duration and payments
▶ Duration: 2 hours
▶ Average payment: 50.99 CHF
Predictions

No social preferences

- Low genetic risk types are not willing to pool genetic risk (cross-subsidize high genetic risk types)
  ⇒ no mixed group insurance
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  ⇒ no mixed group insurance

Inequity aversion wrt genetically caused income differences

- If advantageous inequity aversion of low genetic risk types is sufficiently strong, they are willing to pool
- threshold value of advantageous inequity aversion to support pooling is higher under FP than GPO (free-riding problem under FP)
Predictions

No social preferences

- Low genetic risk types are not willing to pool genetic risk (cross-subsidize high genetic risk types)
  \[ \Rightarrow \text{no mixed group insurance} \]

Inequity aversion wrt genetically caused income differences

- If advantageous inequity aversion of low genetic risk types is sufficiently strong, they are willing to pool
- threshold value of advantageous inequity aversion to support pooling is higher under FP than GPO (free-riding problem under FP)

1. No mixed group insurance with negligible social preferences.
2. With social preferences more mixed group insurance, on average, in GPO than in FP.
Results
Results: Overview

Table 3. Choices and Insurance Outcomes, Total and by Genetic Risk Type and Experimental Condition

<table>
<thead>
<tr>
<th></th>
<th>Low risk types</th>
<th></th>
<th>High risk types</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>FP condition</td>
<td>GPO condition</td>
<td>FP condition</td>
</tr>
<tr>
<td>WTP for group insurance (in ECU)</td>
<td>250</td>
<td>163.3</td>
<td>175.3</td>
<td>332.3</td>
</tr>
<tr>
<td>Existence of group insurance (in %)</td>
<td>69.2</td>
<td>53.3</td>
<td>85.0</td>
<td>53.3</td>
</tr>
<tr>
<td>Participation in group insurance (in %)</td>
<td>23.1</td>
<td>12.9</td>
<td>16.7</td>
<td>17.9</td>
</tr>
<tr>
<td>Preventive effort</td>
<td>4.9</td>
<td>4.9</td>
<td>4.6</td>
<td>4.9</td>
</tr>
<tr>
<td>Observations</td>
<td>960</td>
<td>240</td>
<td>240</td>
<td>240</td>
</tr>
</tbody>
</table>

Notes: Subject-period-observations (e.g., 960 = 96 subjects × 10 periods). 20 ECU = 1 CHF. Possible group insurance premiums range between 140 ECU (low risk subjects with effort of 10) and 420 ECU (high risk subjects with effort of 0).

- Group insurance 1.6 times more likely to exist in GPO condition compared to FP
- Share of subjects participating in group insurance also higher in GPO
Results: Insurance Shares

Low Risk Types

High Risk Types

Some mixed group insurance emerges
Results: Social Preferences wrt Genetic Risk Pooling
Share of Subjects with Positive Net WTP

- Individuals do express social preferences. Significantly higher share with positive net WTP under GPO than FP (MWU: $p=0.02$).
Results: Social Preferences wrt Genetic Risk Pooling
Share of Subjects with Positive Net WTP over Time

- In all but two periods, share of with positive net WTP larger under GPO than FP. Decrease in share of low types over time.
Willingness to Pool Genetic Risk: Individual Level

Strong heterogeneity in social preferences for pooling
Willingness to Pool Genetic Risk: Societal Level

### Low Risk Types

<table>
<thead>
<tr>
<th>Subject</th>
<th>WTP/Premium (in ECU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>74</td>
<td>[Graphic]</td>
</tr>
<tr>
<td>76</td>
<td>[Graphic]</td>
</tr>
<tr>
<td>77</td>
<td>[Graphic]</td>
</tr>
<tr>
<td>78</td>
<td>[Graphic]</td>
</tr>
</tbody>
</table>

### High Risk Types

<table>
<thead>
<tr>
<th>Subject</th>
<th>WTP/Premium (in ECU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>73</td>
<td>[Graphic]</td>
</tr>
<tr>
<td>83</td>
<td>[Graphic]</td>
</tr>
<tr>
<td>85</td>
<td>[Graphic]</td>
</tr>
<tr>
<td>87</td>
<td>[Graphic]</td>
</tr>
</tbody>
</table>

**Legend:**
- **Black line**: WTP for group insurance
- **Gray line**: Individual insurance premium

**Period:**
- 0 2 4 6 8 10
Results: Post-experimental Survey

<table>
<thead>
<tr>
<th>Variable</th>
<th>FP condition</th>
<th>GPO condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of health app</td>
<td>31.3</td>
<td>22.9</td>
</tr>
<tr>
<td>Willingness to share health information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>29.2</td>
<td>20.8</td>
</tr>
<tr>
<td>Yes, if premium discount</td>
<td>35.4</td>
<td>64.6</td>
</tr>
<tr>
<td>No</td>
<td>35.4</td>
<td>14.6</td>
</tr>
<tr>
<td>Vote on health insurance system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual insurance only</td>
<td>12.5</td>
<td>8.3</td>
</tr>
<tr>
<td>Individual + group insurance (GPO)</td>
<td>60.4</td>
<td>62.5</td>
</tr>
<tr>
<td>Individual + group insurance (FP)</td>
<td>18.8</td>
<td>1.6</td>
</tr>
<tr>
<td>Group insurance (FP) only</td>
<td>8.3</td>
<td>12.5</td>
</tr>
<tr>
<td>Observations</td>
<td>48</td>
<td>48</td>
</tr>
</tbody>
</table>

Subjects under GPO 20 percentage points more likely to share info with health provider (Test of proportions: p=0.02).
Additional Experiment: Simplified insurance decision

- Unconditional choice between group insurance, individual insurance, no insurance (no WTP)
- Timing of effort decision: Subsequent to insurance choice
- No voucher: Optimal effort should be the same across individuals (with the same insurance choice)
- Higher share of low risk types

Result

- Low share of mixed group insurance in both experimental conditions similar to current experiment
Conclusion

Summary

▶ We observe social preferences for pooling of genetic risk
▶ However overall only low level of actual pooling across all conditions
▶ Due to heterogeneity in social preferences and dynamics of WTP in markets

Discussion and Extensions

▶ Heterogeneity in risk reduction productivity across types
▶ Opt-out instead of opt-in for group insurance membership