Does random auditing reduce tax evasion in the lab?

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Does random auditing reduce tax evasion in the lab?

Mohammed Ali Bchir, Nicolas Daures, Marc Willinger
Motivations

- Empirical context
  - Water extraction from aquifers in coastal zones
  - High risk of saline intrusion
  - Under-reporting of water extraction

- Designing mechanisms to reduce misreporting
  - Random auditing + Fine
  - Collective penalties (e.g. ambient tax, …)
This study

• Authorities have limited information and limited budget
• Objective: minimizing the number of agents who cheat
• Mechanism with probabilistic audit
• Conditionnal audit probability (conditionned on past observed behavior)

Greenberg (1986)
Assumptions (1)

- In each period, each agent receives a random income $y$
- Players report income $z \leq y$
- Net income
  - If not audited: $y - T(z)$  \quad (N.B. $T(y) \leq y$)
  - If audited:
    - Truthful reporting: $y - T(y)$
    - Cheating: $y - T(z) - P(y,z)$ with $P(y,z) > T(y) - T(z)$
- Audit probability: $p > 0$
- Audit is perfect
Assumptions (2)

• Agents live an infinite number of periods
• Agents are risk-neutral
• Myopic behaviour
• \( p_i(y) \) is the smallest audit probability for which player \( i \) reports truthfully
• Myopic players cheat for \( p < p_i(y) \) whatever \( y \)
• (there exists \( \rho > 0 \), such that for all \( y \) and all \( i \) \( p_i(y) > \rho \))
Assumptions (3)

- $r =$ audit probability determined by the tax authority’s budget constraint (exogenous)
  - If $r = 1$ all players report truthfully
  - If $r < \rho$ all players will cheat
  - If $\rho < r < p_i(y)^{\max}$ some players will cheat

- $\Rightarrow$ they can increase their utility by cheating until they are audited, and then stop cheating

- The tax authorities try to minimize the number of tax evaders in the population $n_1$
Predictions (1)

No cheating detected

Group 1

Audit detected $\Rightarrow$ Fine

Audit proba $p_1 > 0$

Group 2

Audit and truthfull report

No audit

Group 3

Audit proba $p_3 = 1$

Cheating detected $\Rightarrow$ Fine

Cheating detected $\Rightarrow$ Fine

Audit proba $p_2 < p_1$
Predictions (2)

- All players cheat
- No player cheats
- No player cheats

Group 1
- n₁ players
- (αN)

Group 2
- n₂ players
- (1 − α)N

Group 3
- 0 player
Experimental design (1)

- Income stream: each subject receives a randomly selected income between 100 and 1000 yens at each period
- Infinite lifetime (cont. prob = 0.9)
- Many lives: each subject experiences several lives.
- Ending: end time announced at the beginning. After end time, no new sequence could start. Running sequence were allowed to be continued during a maximum extra-time of 15mn.
- Payment: One sequence randomly selected and paid out
Experimental design (2)

- Two-treatments:
  - T1 = low audit probability:
    Group 1 : $p_1 = \frac{1}{3}$
    Group 2 : $p_2 = \frac{1}{4}$
  - T2 = high audit probability:
    Group 1 : $p_1 = \frac{1}{2}$
    Group 2 : $p_2 = \frac{1}{3}$

- Penalty
  \[ P(y,z) = (y - z) \times a \]
Summary of the data

<table>
<thead>
<tr>
<th></th>
<th>Low audit</th>
<th>High audit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of subjects</td>
<td>36</td>
<td>38</td>
</tr>
<tr>
<td>Average number of sequences</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>(min/max)</td>
<td>(3/12)</td>
<td>(4/16)</td>
</tr>
<tr>
<td>Average number of periods</td>
<td>31</td>
<td>30</td>
</tr>
<tr>
<td>(min/max)</td>
<td>(21/82)</td>
<td>(21/82)</td>
</tr>
<tr>
<td>Number of observations</td>
<td>7630</td>
<td>10180</td>
</tr>
</tbody>
</table>
Proportions of subjects in groups

<table>
<thead>
<tr>
<th></th>
<th>Low audit</th>
<th>High audit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( (p_1 = 1/3 ), \ p_2 = 1/4)</td>
<td>( (p_1 = 1/2, \ p_2 = 1/3) )</td>
</tr>
<tr>
<td><strong>Predicted</strong></td>
<td><strong>Estimated</strong></td>
<td><strong>Predicted</strong></td>
</tr>
<tr>
<td>Group 1</td>
<td>43%</td>
<td>50%</td>
</tr>
<tr>
<td>Group 2</td>
<td>57%</td>
<td>28%</td>
</tr>
<tr>
<td>Group 3</td>
<td>0%</td>
<td>20%</td>
</tr>
</tbody>
</table>
Beginning and end behaviour

High audit probability

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average 2 first sequences</td>
<td>58.8%</td>
<td>29.1%</td>
</tr>
<tr>
<td>Average 2 last sequences</td>
<td>49.6%</td>
<td>17.8%</td>
</tr>
</tbody>
</table>
Evolution of the frequency of fraud with repetition

Low audit

<table>
<thead>
<tr>
<th>seq</th>
<th>group 1</th>
<th>group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>36</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>35</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>34</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>26</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>9 et +</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

Legend:  
- Blue: Group 1  
- Red: Group 2
High audit

seq 1  seq 2  seq 3  seq 4  seq 5  seq 6  seq 7  seq 8  seq 9  seq >=10
39 39 39 39 38 37 32 29 24 <= 14
group 1 group 2

[Bar chart showing data for seq 1 to seq >=10, with values ranging from 0 to 1 for each category. The chart includes two groups, indicated by blue and maroon bars.]

Legend:
- Blue bar: group 1
- Maroon bar: group 2
Frequency of fraud according to income (low audit)
Frequency of fraud per income level for each group (low audit)

<table>
<thead>
<tr>
<th>Income Level</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>7.41%</td>
<td>0.93%</td>
</tr>
<tr>
<td>200</td>
<td>21.27%</td>
<td>3.80%</td>
</tr>
<tr>
<td>300</td>
<td>41.84%</td>
<td>10.11%</td>
</tr>
<tr>
<td>400</td>
<td>0.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td>500</td>
<td>20.0%</td>
<td>30.0%</td>
</tr>
<tr>
<td>600</td>
<td>40.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>700</td>
<td>60.0%</td>
<td>70.0%</td>
</tr>
<tr>
<td>800</td>
<td>80.0%</td>
<td>90.0%</td>
</tr>
<tr>
<td>900</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

The bar chart shows the frequency of fraud for each income level for group 1 and group 2.
Frequency of fraud according to income (high audit)
Frequency of fraud per income level for each group (high audit)
Individual strategies

1. Predicted strategy (15%)
   Group 1: Fraud the whole income almost always
   Group 2: No fraud (almost always)

2. Predicted strategy for high income only (23%)
   Group 1: Fraud the whole income only for high income
   Group 2: No fraud (almost always)

3. Cheating more frequently as income increases (27%)
   Fraud if income is high in both groups
Predicted strategy
(low audit)

<table>
<thead>
<tr>
<th>ID</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>80,00</td>
<td>0,00</td>
</tr>
<tr>
<td>4</td>
<td>75,74</td>
<td>0,00</td>
</tr>
<tr>
<td>7</td>
<td>72,03</td>
<td>8,41</td>
</tr>
<tr>
<td>29</td>
<td>72,60</td>
<td>5,45</td>
</tr>
<tr>
<td>30</td>
<td>96,36</td>
<td>0,00</td>
</tr>
<tr>
<td>31</td>
<td>86,79</td>
<td>5,08</td>
</tr>
</tbody>
</table>
Predicted strategy for high income
(Low audit)

<table>
<thead>
<tr>
<th>ID</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>47,03</td>
<td>2,15</td>
</tr>
<tr>
<td>6</td>
<td>41,30</td>
<td>5,88</td>
</tr>
<tr>
<td>9</td>
<td>48,48</td>
<td>3,95</td>
</tr>
<tr>
<td>11</td>
<td>46,24</td>
<td>10,81*</td>
</tr>
<tr>
<td>24</td>
<td>48,61</td>
<td>16,67*</td>
</tr>
<tr>
<td>27</td>
<td>52,88</td>
<td>3,16</td>
</tr>
<tr>
<td>34</td>
<td>44,04</td>
<td>0,00</td>
</tr>
</tbody>
</table>

* Below 3,5% after sequence 1

- Low incomes : $y \leq 350$
- High incomes : $y \geq 750$
- Middle incomes : $350 < y < 750$
Summary

• Mechanism to minimize fraud based on random auditing and segregation
• Group 1: subjects fraud less frequently than predicted, and fraud only a part of their income
• Group 2: subjects fraud too frequently
• In both groups fraud is more frequent as income increases
Feasibility

\[ p_1 \alpha + p_2 (1 - \alpha) \leq r \]

\[ \rho \alpha < r \]

Group 1

\[ p_1 = \frac{\rho}{2} \]

\[ \frac{\rho}{2} \alpha \]

Group 2

\[ p_2 = \frac{\alpha}{1 - \alpha} \times \frac{\rho}{2} \]

\[ \frac{\alpha}{(1 - \alpha)} \frac{\rho}{2} (1 - \alpha) \]

Group 3

\[ p_3 = 1 \]