Inspectors or Google Earth?
Optimal fiscal policies under uncertain detection of evaders

Martin Besfamille (Universidad Torcuato Di Tella)
Pablo Olmos (Universidad Torcuato Di Tella)

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Important strand of literature has analyzed optimal tax-enforcement policies.
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Unrealistic assumption: detection rates vary between 30% (Erard and Feinstein, 2009) and 50% (Feinstein, 1991).
This failure to detect evaders clearly modifies the analysis of optimal tax-enforcement policies.
Introduction

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- Is the detection probability exogenous or endogenous?
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- Is the detection probability exogenous or endogenous?
  - Theoretical consideration.
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Is the detection probability exogenous or endogenous?

- Theoretical consideration.
- Empirical issue: governments invest resources to improve their tax administration’s capacity to detect evaders.
To our knowledge, investments made by governments to improve the tax administration’s capacity to detect evaders, considered as one of the components of the fiscal policy, have not been rigorously studied so far.
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We characterize these optimal investments and we show how they interact with other dimensions of an optimal fiscal policy.
Outline of the presentation

- The model
Outline of the presentation

- The model
- Optimal fiscal policy under asymmetric information
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- The model
- Optimal fiscal policy under asymmetric information
- Numerical simulations of the model
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- Optimal fiscal policy under asymmetric information
- Numerical simulations of the model
- Conclusion
The model

- Formalizes the design and the implementation of a fiscal policy in a simple three-stage game.
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- Presents two class of active agents: individuals, government.
The model: individuals

- Continuum of individuals of measure 1.
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  - $i = p$: poor, with taxable income $y_p$
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- Some taxpayers are dishonest
  - $\theta \in ]0, 1[$: fraction of dishonest (rich) taxpayers.
The model: individuals

- Taxpayer $i$’s ex-post welfare is given by

$$W_i = u(q_i) + g$$
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- $g$: public good.
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- Taxpayer $i$’s ex-post welfare is given by

$$W_i = u(q_i) + g$$

- $q_i$: consumption of the (numéraire) private good
- $g$: public good.

- The strictly increasing and concave utility function $u$ satisfies

$$u(0) = 0 \quad \lim_{q \to 0} u_q = \infty \quad \lim_{q \to \infty} u_q = 0.$$
The model: government

- The government acts according to the utilitarian criterion

\[ W = \mu W_r + (1 - \mu) W_p \]
The model: government

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- The government designs the fiscal policy...
The government acts according to the utilitarian criterion:

\[ W = \mu W_r + (1 - \mu) W_p \]

The government designs the fiscal policy... but delegates its implementation to a tax administration.
The model: timing

- First stage: the government invests capital $\kappa$ to improve the tax administration’s capacity to detect evaders.
The model: timing

- First stage: the government invests capital $\kappa$ to improve the tax administration’s capacity to detect evaders.
- Second stage: the government designs the tax law $(t, \pi, f)$

The tax law has to verify taxpayers’ ex-post limited liability, horizontal and vertical equity.
The model: timing

- First stage: the government invests capital $\kappa$ to improve the tax administration’s capacity to detect evaders.

- Second stage: the government designs the tax law $(t, \pi, f)$
  - $t$: tax schedule

Besfamille and Olmos (UTDT) (Fiscal policies under imperfect auditing) 06/2010 10 / 23
First stage: the government invests capital $\kappa$ to improve the tax administration’s capacity to detect evaders.

Second stage: the government designs the tax law $(t, \pi, f)$
- $t$: tax schedule
- $\pi, f$: enforcement policy
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- $t$: tax schedule
- $\pi, f$: enforcement policy
- The tax law has to verify taxpayers’ ex-post limited liability, horizontal and vertical equity.
The model: timing

- Third stage: the tax administration implements the tax law.

Incomes \( y_i \) are not observable, so individuals are requested to report them. The tax administration audits each income report according to the (previously designed) probability \( \pi \). If an individual is not audited, he pays the tax that corresponds to his report. If he is audited and if a misreport is detected, the evader has to pay the due tax, plus an additional penalty \( f \). With all revenues collected (taxes and penalties, net of investment and audit costs), the government finances the public good \( g \).
The model: timing

- Third stage: the tax administration implements the tax law.
  - As incomes $y_i$ are not observable, individuals are requested to report them.
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Besfamille and Olmos (UTDT) ()
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The model: detection technology

• Audits are imperfect: if an individual is audited, the tax administration discovers his income with probability \( \delta \in ]0, 1[ \).
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- The detection probability $\delta$ is a continuous and strictly increasing function $\delta(\kappa, \nu)$.
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The detection probability \( \delta \) is a continuous and strictly increasing function \( \delta(\kappa, \nu) \).

The function \( \delta(\kappa) \) satisfies

\[
\lim_{\kappa \to 0} \delta = \delta_i \quad \text{and} \quad \lim_{\kappa \to \infty} \delta \leq 1.
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The model: detection technology

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$$\lim_{\kappa \to 0} \delta = \delta_{\iota} \quad \text{and} \quad \lim_{\kappa \to \infty} \delta \leq 1.$$ 

- $\delta_{\iota}$: exogenous initial detection probability.
The model: detection technology

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$$\lim_{\kappa \to 0} \delta = \delta_l \quad \text{and} \quad \lim_{\kappa \to \infty} \delta \leq 1.$$ 

- $\delta_l$: exogenous initial detection probability.

- $\nu > 0$: investment productivity.
We solve the model backwards.
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Second stage: for a given detection probability $\delta$, we characterize the optimal tax law.
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Second stage: for a given detection probability \( \delta \), we characterize the optimal tax law.

First stage: we find the optimal level of investment \( \hat{\kappa} \).
Second stage: the audit regime

- When $\delta$ is relatively high, the tax law will be enforced: the Revelation Principle applies $\rightarrow$ mechanism design approach.
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- When $\delta$ is relatively high, the tax law will be enforced: the Revelation Principle applies $\rightarrow$ mechanism design approach.
- Mookherjee and Png (1989): no need to audit a taxpayer that reported to be rich $\rightarrow \pi_p$.
- The optimal tax law solves the following problem

$$\begin{align*}
\text{Max}_{t_p, t_r, f_{r,p}, \pi_p, g} & \quad \mu u(y_r - t_r) + (1 - \mu)u(y_p - t_p) + g \\
\text{subject to} & \\
0 \leq \pi_p \leq 1 & \\
t_p \leq y_p & (LL_p) \\
t_r + f_{r,p} \leq y_r & (LL_r) \\
u(y_r - t_r) \geq (1 - \delta\pi_p)u(y_r - t_p) + \delta\pi_p u(y_r - t_r - f_{r,p}) & (IC) \\
g = \mu t_r + (1 - \mu)t_p - (1 - \mu)\pi_p c - \kappa & (B)
\end{align*}$$
Second stage: the no audit regime

- When \( \delta \) is relatively low, the tax law will not be enforced.
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- When some rich taxpayers are honest, the government can collect higher taxes from them.
- In this case, there is no complete revelation of individual types.
- Dishonest rich taxpayers misreport and evasion occurs.

The government solves

$$\begin{align*}
\max_{t_p, t_r, g} & \quad \mu [(1 - \theta)u(y_r - t_r) + \theta u(y_r - t_p)] + (1 - \mu)u(y_p - t_p) + g \\
\text{subject to} & \\
& g = [1 - \mu(1 - \theta)] t_p + \mu(1 - \theta) t_r
\end{align*}$$
Second stage: the optimal tax law

Let $\delta \leq 1$ be the threshold that characterizes when each regime emerges.

Stage

Figure 1(a) - $t_p$

Figure 1(b) - $t_r$

Figure 1(c) - $\pi_p$

Figure 1(d) - $\pi_p$

Figure 1(e) - $g$

Figure 1(f) - $\text{EPS}$

Figure 1(g) - $\text{EW}$
The investment decision has two different impacts.
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- on the detection probability $\delta \Rightarrow$ indirectly, the government chooses the audit regime.
First stage: optimal level of investment

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- In order to address the choice of regime in terms of the variable $\kappa$, let $\kappa$ denote the solution of the implicit equation $\delta(\kappa, \nu) = \delta$. 

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First stage: optimal level of investment

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  - We find $\kappa^A$ : the level of investment that maximizes $\mathbb{E}W^A$. 
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- In order to address the choice of regime in terms of the variable $\kappa$, let $\kappa$ denote the solution of the implicit equation $\delta(\kappa, \nu) = \delta$.

- Characterization of the optimal investment $\hat{\kappa}$
  1. We find $\kappa^A$: the level of investment that maximizes $\mathbb{E}W^A$.
  2. Provided both regimes of audit emerge, we compare $\mathbb{E}W^A(\kappa^A)$ with $\mathbb{E}W^{NA}(0)$. 

Besfamille and Olmos (UTDT) (Fiscal policies under imperfect auditing 06/2010 17 / 23)
Under the audit regime, the optimal investment $\kappa^A$ solves the following problem

$$\begin{aligned}
\max_{\kappa} & \mu \left[ u(y_r - t_r^A) + t_r^A \right] + (1 - \mu) \left[ u(y_p - t_p^A) + t_p^A \right] - (1 - \mu) \pi_p^A c - \kappa \\
\text{subject to} & \\
& \delta = \delta(\kappa, \nu) \\
& \max\{0, \kappa\} \leq \kappa \\
& \kappa \leq \mu t_r^A + (1 - \mu) t_p^A - (1 - \mu) \pi_p^A c
\end{aligned}$$
Under the audit regime, the optimal investment $\kappa^A$ solves the following problem

$$\begin{aligned}
\text{Max } \mu \left[ u(y_r - t_r^A) + t_r^A \right] + (1 - \mu) \left[ u(y_p - t_p^A) + t_p^A \right] - (1 - \mu) \pi_p^A c - \kappa \\
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- Existence of a solution
Under the audit regime, the optimal investment \( \kappa^A \) solves the following problem

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\delta &= \delta(\kappa, \nu) \\
\max \{0, \kappa\} &\leq \kappa \\
\kappa &\leq \mu t_r^A + (1 - \mu) t_p^A - (1 - \mu) \pi_p^A c
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  - The constraint set may be empty.
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  - As the expected welfare $\mathbb{E}W^A$ is not generally concave, the first-order conditions are useless to completely characterize the maximum.
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\max_{\kappa} & \quad \mu [u(y_r - t_r^A) + t_r^A] + (1 - \mu)[u(y_p - t_p^A) + t_p^A] - (1 - \mu) \pi_p^A c - \kappa \\
\text{subject to} & \\
\delta & = \delta(\kappa, \nu) \\
\max\{0, \kappa\} & \leq \kappa \\
\kappa & \leq \mu t_r^A + (1 - \mu) t_p^A - (1 - \mu) \pi_p^A c
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- Existence of a solution

- Characterization of a solution
  - The constraint set may be empty.
  - As the expected welfare \( \mathbb{E}W^A \) is not generally concave, the first-order conditions are useless to completely characterize the maximum.
  - The comparison between \( \mathbb{E}W^{NA} \), \( \mathbb{E}W^A(\kappa^A) \) and \( \mathbb{E}W^{FA}(\kappa^{FA}) \) is not straightforward because it is a comparison of levels.
Numerical simulations of the model

- Parameter values representative of the US tax system and the IRS's operations in 2006.
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- Taxpayers are characterized by a CRRA utility function

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Numerical simulations of the model

- Parameter values representative of the US tax system and the IRS’s operations in 2006.
- Taxpayers are characterized by a CRRA utility function
  \[ u(q) = u(q) = \frac{q^{1-\sigma}}{1-\sigma}. \]
- The detection probability function \( \delta(\kappa, \nu) \) is formalized as a logistic
  \[ \delta(\kappa, \nu) = \delta_l + \nu \frac{1 - e^{-\kappa/a}}{1 - ne^{-\kappa/a}}, \]
  where \( a = 0.235 \) and \( n = 0.99 \).
Parameter values of the model

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>DEFINITION</th>
<th>BASELINE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma$</td>
<td>Coefficient of relative risk aversion</td>
<td>0.71</td>
</tr>
<tr>
<td>$\mu$</td>
<td>Percentage of rich taxpayers</td>
<td>67</td>
</tr>
<tr>
<td>$y_r$</td>
<td>Income of the rich</td>
<td>$52.304</td>
</tr>
<tr>
<td>$y_p$</td>
<td>Income of the poor</td>
<td>$6.747</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Percentage of dishonest taxpayers</td>
<td>36</td>
</tr>
<tr>
<td>$c$</td>
<td>Cost of a single audit</td>
<td>$14.833</td>
</tr>
<tr>
<td>$\delta_i$</td>
<td>Initial detection probability</td>
<td>0.4</td>
</tr>
<tr>
<td>$\nu$</td>
<td>Investment productivity</td>
<td>0.225</td>
</tr>
</tbody>
</table>

All money values are in thousands of dollars.
## Effects of investment

<table>
<thead>
<tr>
<th>SOLUTIONS</th>
<th>WITHOUT INVESTMENT</th>
<th>WITH INVESTMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\hat{\kappa}$</td>
<td>0</td>
<td>$0.059$</td>
</tr>
<tr>
<td>$\hat{\delta}$</td>
<td>0.4</td>
<td>0.62 ($+55%$)</td>
</tr>
<tr>
<td>$\hat{t}_p$</td>
<td>$6.03$</td>
<td>$5.83$ ($+2.9%$)</td>
</tr>
<tr>
<td>$\hat{t}_r$</td>
<td>$44.35$</td>
<td>$47.4$ ($+6.9%$)</td>
</tr>
<tr>
<td>$IP$</td>
<td>$-0.087$</td>
<td>0.176</td>
</tr>
<tr>
<td>$\hat{\pi}_p$</td>
<td>1</td>
<td>0.89 ($-11%$)</td>
</tr>
<tr>
<td>$\hat{g}$</td>
<td>$26.81$</td>
<td>$30.58$ ($+14.06%$)</td>
</tr>
<tr>
<td>$EPS$</td>
<td>85.3%</td>
<td>85.5% ($+2.4%$)</td>
</tr>
</tbody>
</table>
Summary of the comparative statics results

- **Investments in detection widen the range of parameters where the tax law is enforced.**

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Besfamille and Olmos (UTDT) (2010) [Fiscal Policies under Imperfect Auditing]
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- The option to invest modifies some comparative statics results.
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- Investments in detection widen the range of parameters where the tax law is enforced.
- Investment and audit expenditures can be complements or substitutes.
- The option to invest modifies some comparative statics results.
- The two different ways of making less equal the top of the income distribution (by increasing $\mu$ or $y_r$) have not the same impact upon $\hat{\kappa}$. 
Summary of the comparative statics results

- Investments in detection widen the range of parameters where the tax law is enforced.
- Investment and audit expenditures can be complements or substitutes.
- The option to invest modifies some comparative statics results.
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- Investing optimally may not be sufficient to eliminate the regressiveness that characterizes the tax structure when the government cannot improve the tax administration's detection technology.
Summary of the comparative statics results

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- The public good’s provision and the efficiency of the public sector increase with investment.
This paper is a first step towards the incorporation of investments that improve the tax administration’s capacity to detect evaders in the theory of optimal fiscal policies.
Conclusions

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- We simulate the model to identify the solutions but also to study how the optimal investment interacts with the other components of the optimal fiscal policy.
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- We simulate the model to identify the solutions but also to study how the optimal investment interacts with the other components of the optimal fiscal policy.
- Clearly this model suggests that one needs to incorporate such investments into the currently used definitions of ‘tax effort’ in empirical models.