TAX EVASION ON A SOCIAL NETWORK

Duccio Gamannossi degl'Innocenti [1] Matthew D. Rablen [2]

[1]University of Exeter

d.gamannossi@exeter.ac.uk

www.dgdi.me

[2]University of Sheffield

m.rablen@sheffield.ac.uk

www.sheffield.ac.uk/economics/people/rablen

CONTENT

INTRODUCTION

TAX EVASION - RELEVANCE AND RESEARCH

→ Tax evasion causes **significant losses of public revenues** (£4.4 bn. in UK)

→ Growing interest by tax agencies to exploit "big data" and network theory to **improve efficiency of deterrence measures**

→ Predictive tools find **patterns in data arising due to the determinants of subjects' decisions**

→ We investigate the **impact of social network on tax evasion decisions** and develop a framework to **asses the value of social network data**

TAX EVASION AND REFERENCE DEPENDENCE

→ We **relate tax evasion behaviour to** a substantial body of evidence that people seek to "**keep up with the Jones**"

→ Specifically, **one way to keep up with the Jones' is to evade** more tax than others do

→ An immediate consequence is that **individual evasion behaviour is related to how others are behaving**

→ A taxpayer takes into account the behaviour of others through his **reference income**, a "benchmark" of others' consumption

RELATED LITERATURE

→ Kahneman and Tversky 1979
Reference-dependence of utility

→ Rablen 2008
Self and social comparison effects in utility

→ Ballester, Calvo, Zenou 2006
Network games with local payoff complementarities

→ Quah 2007
Monotone comparative statics on network games

MODELLING FEATURES

Provide a model where:

→ Taxpayers may engage in **risky** tax evasion

→ Taxpayers differ in **income**, **probability of detection** and **reference group** (individuals in a taxpayer's social network)

→ **Self** and **social** comparison shape the **reference income**

→ **Social** comparison depends on taxpayer' **reference group**

RESEARCH QUESTIONS

→ Our analysis has focused on **three** questions:

1. Is it possible to characterize **optimal evasion** when people evaluate their consumption relative to others?
   → How do **different conditions** like tax-schedule, deterrence policies or individual traits, affect it? (comparative statics)

2. Is it possible to characterise the **revenue effects** of interventions?

3. How much does the **availability of more information** (related to social networks) improve the capacity of a tax authority to **infer audit revenue effects**?

MODEL

MODELLING OF EVASION

- → We define **evasion** as the **tax liability not paid** by the taxpayer
- → Evasion is a **risky** activity:
  - → The **tax agency** is actively seeking to detect and **shut-down** evasion
  - → There is a compound probability that:
    - → **The taxpayer is discovered** under declaring
    - → The **tax agency is successful** in shutting down evasion and imposes a fine on the evader

TAXPAYERS CHARACTERISTICS

- → Taxpayers are **distinguished** by:
  - → **Probability** of being audited
  - → Exogenous **Income**
  - → Who they compare to in the social network: their **reference group**
- → Taxpayers evaluate their **reference income** based on the individual characteristics and the tax-deterrence parameters.

REFERENCE INCOME

→ Taxpayers determine their reference income based on **Social**- and **Self**-comparisons

- → **Self**:

  Own past consumption (**Habit income**)

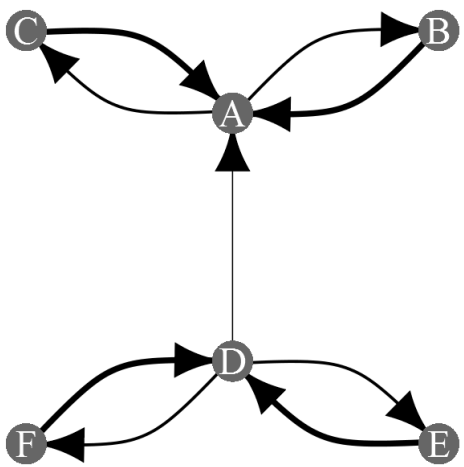
- → **Social**:

  The (weighted) **average consumption** of individuals in a taxpayer's social network

AN EXAMPLE OF A SOCIAL NETWORK

Graph and **matrix** form of a **weighted directed** network

Directed Network



$$\begin{array}{c} \\ A \\ B \\ C \\ D \\ E \\ F \end{array} \begin{array}{c} \begin{array}{cccccc} A & B & C & D & E & F \end{array} \\ \begin{pmatrix} 0 & .5 & .5 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 \\ .2 & 0 & 0 & 0 & .4 & .4 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \end{pmatrix} \end{array}$$

OPTIMAL EVASION

OPTIMAL EVASION

→ Key theoretical result is that **evasion is closely related to the concept of (Bonacich) network centrality**

→ More "**central**" **taxpayers evade more**

A taxpayer is more "**central**" the more numerous the people comparing to him

→ Network centrality is a concept developed in sociology

→ Measures the amount of influence/power players have within a network

MONOTONE COMPARATIVE STATICS RESULTS

Habit consumption	$+$	Other's Income	$+/0$
Own comparison	$+$	Social comparison	$+/0$
Own audit prob.	$-$	Others audit prob.	$-/0$
Risk Aversion	$-$	Fine	$-$
Tax rate	$+$		

Effect on **optimal evasion** of a change in parameters (taxpayer characteristics, tax-deterrence schedule)

REVENUE EFFECTS OF INTERVENTIONS

REVENUE EFFECTS OF INTERVENTIONS

How does an audit to a taxpayer affects revenues collected?

1. **Direct effect**

   Evaded liabilities recovered from the targeted taxpayer

2. **Indirect effects**

   Expected additional revenue that arises **from future changes in evasion behaviour** (**negative externality**)

   → from the audited tapayer

   → from non-audited taxpayers

→ Indirect effects are of primary importance since estimates are **2-6 X** direct ones

TAX AGENCY'S INFERENCE PROBLEM

→ Tax authorities engage in inferring both **direct effects** $\mathbf{E}^{SS}$ and **aggregate gross indirect effects** $\boldsymbol{\Sigma}$

→ Taxpayers usually ranked by discriminant function and audited sequentially until budget is exhausted

→ Crucial information for tax authorities is correct rank of $\mathbf{E}^{SS}$ and $\boldsymbol{\Sigma}$

→ Optimal audit targeting if tax authorities were able to exactly infer **rankings** of direct and indirect effects.

Key finding:

A new measure of **Bonacich centrality** correctly ranks **own** and **cross indirect** effects

INFERENCE OF REVENUE EFFECTS

→ What might be the value of " big data" tools that seek to construct social networks?

We estimate by simulation the **additional audit revenues** $\Delta\mathfrak{R}(\mathbf{G})$ from exploiting **network information** in targeting

→ Two settings considered:

1. **Full observability** ($\mathcal{F}$): The tax agency observes all comparison intensities
2. **No observability** ($\emptyset$): The tax agency observed no comparison intensities

→ Audit revenues increase by $\Delta\mathfrak{R}(\mathbf{G}) \approx \mathbf{6}\%$ when **social network information** is available

CONCLUSIONS

CONCLUDING REMARKS

→ Social interaction may affect evasion behaviour

→ Different **Bonacich** measures of centrality characterise optimal **evasion** and **revenues effects** of audits

→ **Social network information** improves significantly the **prediction** of revenue effects from audits

FURTHER RESEARCH

→ Extend the analysis to **crime** as a whole

→ Analyse how adding or **removing taxpayers (detention)** may affect compliance

Thank You!

Questions?