ARTICLE IN PRESS

Journal of Economic Psychology xxx (2013) xxx–xxx

Contents lists available at SciVerse ScienceDirect

Journal of Economic Psychology

journal homepage: www.elsevier.com/locate/joep

# Dynamics of tax evasion with back auditing, social norm updating, and public goods provision – An agent-based simulation

Sascha Hokamp *

*Brandenburg University of Technology Cottbus, Faculty 3, Institute of Economics, P.O. Box 101344, 03013 Cottbus, Germany*

ARTICLE INFO

*Article history:*
Available online xxxx

*JEL classification:*
C90
H26
H41
O17

*PsycINFO classification:*
2910
3000

*Keywords:*
Income tax evasion
Back auditing
Public goods provision
Pareto-optimality
Heterogeneous population
Social norms
Agent-based modeling

ABSTRACT

Income tax evasion dynamics and social interactions are analyzed with an agent-based model in heterogeneous populations. One novelty is the combined analysis of back auditing and ageing, which allows for incorporating psychological findings with respect to social norm updating over a taxpayer's life cycle. Another novelty concerns individual's social behavior regarding a Pareto-optimal provision of public goods. Simulation results support the counterintuitive conclusion drawn elsewhere in the literature that income tax compliance may decrease with raising marginal per capita returns (MPCRs). Yet, back auditing seems to have by far the strongest impact on the dynamics of fiscal fraud and also can help to curb the extent of tax evasion (ETE).



## 1. Introduction

Following the lead of Mittone and Patelli (2000), agent-based tax evasion models are gaining more and more popularity. Bloomquist (2006) and Pickhardt and Seibold (2011) provide an overview of recent developments, while Garson (2009) and Heath, Hill, and Ciarallo (2009) offer more general surveys of agent-based models. One reason for the ongoing attractiveness of agent-based tax evasion frameworks may be the fact that these settings give researchers a higher degree of control than available with human subjects in lab experiments. Another distinguishing feature of agent-based modeling is the opportunity to include rather complex real world situations, for instance, various social interaction procedures in a society of behaviorally heterogeneous agents; aspects which the standard neoclassical approach to tax evasion cannot handle.

In this paper heterogeneous taxpayer agents have to file a tax return in an environment which consists of a government, a tax authority and individual social networks of acquaintances. Income tax evasion dynamics are then investigated according to five aspects, that are, (i) lapse of time effects (or back auditing), (ii) age heterogeneity of agents, (iii) social norm evolution

* Tel.: +49 355 693087.
*E-mail address:* sascha.hokamp@tu-cottbus.de

0167-4870/$ - see front matter 
http://dx.doi.org/10.1016/j.joep.2013.01.006

Please cite this article in press as: Hokamp, S. Dynamics of tax evasion with back auditing, social norm updating, and public goods provision – An agent-based simulation. *Journal of Economic Psychology* (2013), http://dx.doi.org/10.1016/j.joep.2013.01.006

due to age effects, (iv) provision of pure public goods, and (v) behavioral updating with respect to Pareto-optimal provision of pure public goods. Among other things, the agent-based framework permits to examine various aspects of conditional cooperation and social behavior patterns that may be linked to contributions of many other scholars, e.g. Traxler (2010), Kube and Traxler (2011), Traxler and Spichtig (2011), and Traxler and Winter (2012). Findings include support for the counterintuitive result of Falkinger (1988, 1995) and Cowell (1992) that increasing the marginal per capita return (MPCR) may lead to more tax evasion.

Moreover, it is worth emphasizing that even though agent-based tax compliance models allow for a large variety of simulation scenarios, one may observe at least two open issues. First, the relevance of Pareto-optimal allocations has not yet been analyzed with an agent-based computational setting taking into account tax evasion and public goods provision.[1] Second, there is a persistent lack of docking and replication studies that verify and validate simulation results in this field of research.[2] Therefore, the purpose of this paper is to analyze income tax evasion dynamics within an agent-based model, which addresses both issues by extending and replicating an existing agent-based tax compliance framework.

The paper is organized as follows. The next section presents a mathematical background to augment the neoclassical model of Allingham and Sandmo (1972) by pure public goods provision. The third section describes the agent-based computational model. The fourth section provides results of various simulation scenarios. The final section concludes.

## 2. Neoclassical foundation

During the last four decades tax evasion models have been developed that add pecuniary as well as non-pecuniary parameters to well-known tax evasion parameters (audit probability, income, tax and penalty rate), and use a wide range of alternative utility functions. Alm, Cronshaw, and McKee (1993), Engel and Hines (1999), Balsa et al. (2006), Antunes, Balsa, Respício, et al. (2007), Hokamp and Pickhardt (2010), and, recently, Seibold and Pickhardt (2013) have contributed to the comparatively little literature about tax evasion and lapse of time effects (related to audits of more than one tax relevant period). For instance, exponential utility functions do allow for back auditing and, therefore, this section focuses on how to incorporate public goods provision into this class of functions.

Beck, Davis, and Jung (1991) was the first study to connect the neoclassical expected utility approach of Allingham and Sandmo (1972) with an exponential utility function in a concept of tax declaration under income uncertainty. Marchese and Privileggi (1999) and Hokamp and Pickhardt (2010) make use of exponential utility functions in an expected utility income tax amnesty setting and an agent-based income tax evasion model, respectively. Therefore, the latter framework is chosen in this paper to create not only a tax compliance docking study using another programming language, but to develop also a computational platform that permits to investigate additional features, *ceteris paribus* and jointly; for instance, social norm updating, public goods provision and lapse of time effects.

The next subsection introduces the provision of pure public goods as an extension of the chosen basic framework. Thereafter, comparative statics and lapse of time effects are considered.

### 2.1. Exponential utility and public goods provision

Following Hokamp and Pickhardt (2010, Eq. (1), p. 544) an artificial simulation world is populated with a society of $N$ heterogeneous agents with an exponential utility function defined as,

$$U_i[ATPNI_i] = 1 - e^{-\lambda_i \cdot ATPNI_i}. \tag{1}$$

In Eq. (1) $\lambda_i$ denotes a constant absolute risk parameter and $ATPNI_i$ is the received after tax and penalty net income.[3] The latter variable reflects the outcome of the tax regime and depends on individual taxes, $T_i$, individual penalties, $P_i$, and, a public good, $X$, that is provided according to,

$$X = T + P - A. \tag{2}$$

With respect to (2) the public goods provision, $X$, is funded by overall tax revenues, $T$, and penalties, $P$ (which include fines and reimbursement of evaded tax), minus tax administration costs, $A$. Functional relations concerning the latter three variables due to an individual's tax, $T_i$, and penalty, $P_i$, are given by,

$$T = \sum_{i=1}^{N} T_i, \tag{3}$$

[1] Five agent-based tax evasion frameworks consider public goods provision, that are, (i) Mittone and Patelli (2000), (ii) Antunes, Balsa, Urbano, Moniz, and Roseta-Palma (2006), Antunes, Balsa, and Coelho (2007), Antunes, Balsa, Respício, and Coelho (2007), Balsa, Antunes, Respício, and Coelho (2006), (iii) Szabó, Gulyás, and Tóth (2008), Szabó, Gulyás, and Tóth (2009), Szabó, Gulyás, and Tóth (2010), (iv) Pellizzari and Rizzi (2011), and (v) Méder, Simonovits, and Vincze (2012).

[2] Lima (2010), Lima (2012), Andrei, Comer, and Koehler (2011), and Pickhardt and Seibold (2011) are early contributions to agent-based tax evasion docking and replication studies.

[3] The right-hand-side of (1) may take any real value up to 1. For instance, negative utility may occur due to lapse of time effects when accumulated penalties and taxes are greater than actual income and public goods provision. However, how subjects finance a negative outcome ($ATPNI_i$) is not the purpose of this paper. Finally, note that in (1) throughout an agent's life cycle the risk preference (i.e. $\lambda_i$) may change, e.g. due to (social) norm evolution (e.g. see Nordblom & Žamac, 2012, and Traxler & Winter, 2012). For further details see Sections 3 and 4.