Chapter II
Taxpayer Compliance Simulation: A Multi-Agent Based Approach

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ABSTRACT

This chapter describes the development of a prototype multi-agent based model—the tax compliance simulator (TCS)—designed to help tax administrators think about ways to reduce tax evasion. TCS allows the user to define unique behavioral, income, and tax enforcement characteristics for one or two distinctive taxpayer populations. The capabilities of the model are demonstrated in a simulation of the deterrent effects of taxpayer audits. The simulation finds that a significant portion of audit-based deterrence may depend on the influence of taxpayers’ social networks rather than the probability of detection or penalty for underreporting as indicated by economic theory (Allingham & Sandmo, 1972).

INTRODUCTION

Tax evasion is the deliberate failure to pay taxes lawfully owed to the government. In recent years, many governments have become concerned about an apparent rise in the level of evasion. Some have linked this presumed increase to a growing tax burden that provides firms and individuals with an incentive to conduct business in the underground or nonobserved economy where detection is harder (Schneider & Enste, 2002). An alternative explanation offered by Bloomquist (2003a) sees higher evasion resulting from the trend of widening economic inequality that has taken place in many developed and developing countries in the last 30 years. One characteristic of this trend is a shift in the composition of income away from wages and salaries, which are more easily detected by tax authorities, to less visible sources, such as commercial transactions and...
investments. Unfortunately, the lack of reliable time-series evasion measures hampers efforts to resolve the debate one way or the other.

Regardless of evasion trends, many countries are facing serious fiscal challenges in the years ahead. Perhaps the best-known and most urgent of these challenges is the graying of the post-World War II “Baby Boom” generation. In many countries, a growing retirement-age population is expected to demand a greater share of government outlays in the form of pensions and health care. One measure that has been proposed to expand the tax base in order to meet this need is to permit more immigration. However, new immigrants also require substantial public investment in affordable housing and schools as well as training in language and workforce skills to help them assimilate into the national economy. Therefore, faced with the prospect of significant growth in public expenditures on aging and immigrant populations, many governments are looking for ways to increase revenues, preferably without raising the tax burden. Reducing tax evasion is seen by many politicians as an acceptable solution.

This chapter describes the development of a prototype multi-agent based model—the tax compliance simulator (TCS)—designed to help tax administrators think about how best to reduce the level of tax evasion. According to Taber and Timpone (1996, p. 11), computational models are most useful in social science applications when “some lower threshold of process theory exists but mathematical and statistical methods are intrac-tetable, where measurement seems less direct, and where one wishes to gather theoretical pieces into an integrative whole.” All of these conditions aptly describe our present state of knowledge about tax evasion which, I believe, makes this topic ideally suited for agent-based modelling.

The next section reviews earlier efforts to develop agent-based models of income tax evasion. This is followed by an overview of major design features of TCS. In the fourth section, TCS is used to analyze the deterrent effects of taxpayer audits. Finally, the last section summarizes main points and outlines topics for future research.

**PRIOR AGENT-BASED MODELS OF INCOME TAX EVASION**

Constructing computational models for tax compliance research is a relatively new development. Mittone and Patelli (2000) were the first to develop a multi-agent based simulation (MABS) model of income tax evasion. Building on the theoretical work of Myles and Naylor (1996), Mittone and Patelli assume the existence of three classes of taxpayers: honest, imitative, and free riders. Each taxpayer category has a unique utility function that describes its behavior. Honest taxpayers derive additional utility from paying as little in taxes as possible. Imitative taxpayers maximize their utility by paying what other taxpayers pay (population mean). All three groups also derive utility from public sector goods and services supported by voluntary and enforced tax contributions. Individual behavior is influenced indirectly by the group via the level of utility derived from public goods and services.

In each time period during the simulation, taxpayer agents must decide whether to evade more, less, or the same as in the preceding period. The decision is stochastic, but the choice probabilities depend on whether calculated utility decreased, increased, or was unchanged from last time. Decision probabilities are updated each time period based on the change in total utility associated with the previous round’s compliance decision.

Mittone and Patelli use their model to examine how aggregate evasion behavior varies with different starting mixes of taxpayers. They find that even when all taxpayers are initially honest, the absence of taxpayer audits causes revenues eventually to fall to zero (except for the occasional

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