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Optimal dynamic tax evasion

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ABSTRACT

We study optimal dynamic tax evasion in the framework proposed by Lin and Yang (2001) and Dzhumashev and Gahramanov (2011) with some modifications: a more flexible utility function, a more realistic audit process, and a penalty function which can be defined both on evaded income and evaded taxes. In the former case the elasticity between tax rate and tax evasion is positive, unless the subsistence consumption level is higher than a given threshold. In the latter case the relationship is usually negative , but the value of elasticity depends on the form of absolute risk aversion. In particular we show that for increasing relative risk aversion, for a tax rate higher than 50%, the elasticity may even become positive. US data are consistent with IRRA preferences.

1. Introduction

Since the seminal papers by Allingham and Sandmo (1972) and Yitzhaki (1974) (hereafter AS and YZ), literature on tax evasion has been producing controversial and sometimes counter-intuitive results on the effects of tax rates on tax evasion. In AS the effect is ambiguous and depends on the risk aversion of consumers/investors while YZ shows that an increase in the tax rate produces a reduction in tax evasion. On the other hand, the empirical literature (for a review see Feige and Cebula, 2011) shows a positive relationship between tax rate and tax evasion. The most recent literature, which studies tax evasion in a dynamic framework, does not seem to reconcile theory with empirical evidence. In a context *a` la* YZ Lin and Yang (2001) (LY) show that the relationship between tax rate and tax evasion is positive. However, Dzhumashev and Gahramanov (2011) (DG) point out some important flaws in LY's model and show that the correlation between tax rate and tax evasion is negative, as in YZ.

In this paper we modify the basic model proposed by LY as amended by DG in three main directions:

1. We use a penalty function that allows fines to be modelled both on evaded income and on evaded taxes.
2. We use hyperbolic absolute risk aversion preferences (HARA) which allow modelling of constant, increasing and decreasing relative risk aversion (CRRA, IRRA, and DRRA respectively), and a nonzero subsistence consumption level.
3. We model auditing as a Poisson process (with constant intensity); in fact, while evasion is a continuous decision, audit is a discrete process which happens only at given dates in time (and a finite number of times in any finite period).

We show that if the fine is levied on evaded income, the sign of the relationship between tax rate and tax evasion is always positive for DRRA and CRRA preferences. For IRRA preferences the sign of the elasticity can be negative if the level of

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subsistence consumption is sufficiently high. This result seems to solve, in a dynamic context, the ambiguity of the sign in the AS model.

If the fine is levied on the evaded tax we show that the elasticity between tax evasion and tax rate is: (i) lower then −1 for DRRA preferences, (ii) equal to −1 for CRRA preferences, and (iii) higher than −1 for IRRA preferences. In this latter case, the elasticity may even become positive for a sufficiently high tax level and given values of the preference parameters.

We show that US data are consistent with IRRA preferences; in our framework this means that when income increases the optimal tax evasion decreases.

The relationship between tax rate and optimal evasion is, however, highly sensitive to the form of the penalty function. When the latter is defined as a combination of the AS and YZ approaches we show that the sign of the relationship between tax rate and tax evasion may be positive or negative according to the investor's preferences and the parameters of the tax system. This might explain why empirical and theoretical models do not agree on the sign of the relationship. Actual tax systems use several parameters to determine the fine in the case of audit and the latter is hardly ever exactly proportional to either the evaded income or the evaded tax bill.

The paper will be organized as follows: in Section 2 we present the basic assumption of the LY model and our extensions; in Section 3 we present the main results of our analysis; in Section 4 we estimate the parameters of the theoretical framework, and, finally, Section 5 concludes.

2. The model

We assume that the behaviour of a representative consumer/investor is described by the following utility function:

$$U(c(t),G) = \frac{(c(t)-c_0)^{1-\delta}-1}{1-\delta} + V(G), \tag{1}$$

where $V(G)$ is an increasing and concave function, G is a public good (which is set outside the model as in LY), and $c(t)$ is consumption at time t. Eq. (1) is increasing and concave in consumption $c(t)$ if $\delta > 0$. The Arrow–Pratt relative risk aversion index with respect to $c(t)$ is

$$AP \equiv -\frac{\frac{\partial^2 U(c(t),G)}{\partial c(t)^2}c(t)}{\frac{\partial U(c(t),G)}{\partial c(t)}} = \frac{\delta c(t)}{c(t)-c_0}. \tag{2}$$

The relative risk aversion index and its absolute counterpart are both hyperbolic functions; this means that consumer's preferences belong to the so-called hyperbolic absolute risk aversion (HARA) family (see, for instance, Gollier, 2001), like most of the commonly used utility functions (log, quadratic, power, exponential).

By computing the derivative of the Arrow–Pratt relative risk aversion index with respect to $c(t)$

$$\frac{\partial AP}{\partial c(t)} = \frac{-\delta c_0}{(c(t)-c_0)^2}, \tag{3}$$

we can show that our utility function is able to capture three different behaviour with respect to risk, according to the sign of parameter c_0.

- $c_0 > 0$: the utility function (1) belongs to the DRRA (decreasing relative risk aversion) family and c_0 can be interpreted as a subsistence consumption level. In this case, the marginal utility tends to infinity when $c(t) \to c_0$ and, accordingly, $c(t) = c_0$ will never be optimal (optimal consumption will always lie above c_0). The existence of a strictly positive subsistence consumption level allows us to solve some puzzles and to reconcile theoretical findings with empirical evidence (see, for instance, Sethi et al., 1992; Weinbaum, 2005; Achury et al., 2012 for the role of subsistence consumption in portfolio choice and Strulik, 2010 for its role in modelling economic growth).
- $c_0 < 0$: the utility function (1) belongs to the IRRA (increasing relative risk aversion) family.[1] In this case c_0 loses its interpretation as a subsistence consumption level, but it allows us to capture the behaviour of an economic agent who becomes more and more conservative as his consumption increases. Holt and Laury (2002) and Eisenhauer and Ventura (2003) show evidence for increasing relative risk aversion. In Section 4 we show that the IRRA hypothesis seems to be consistent with US data on GDP and consumption.
- $c_0 = 0$: the utility function (1) belongs to the CRRA (constant relative risk aversion) family, one of the most commonly used. With $c_0 = 0$ and $\delta \to 1$ the utility (1) coincides with the log-utility function used by LY. However, this form may not be suitable to capture the consumer's risk aversion and may also lead to an incorrect interpretation of the role of risk aversion in the decision to evade. It is well known (see, for instance, Gamaletsos, 1974) that the HARA preferences allow

[1] The same attitude towards risk is captured by an exponential utility function of the form $u(c) = -e^{-\delta c}$, which can be viewed as the limit case of a HARA utility function as follows: $\lim_{\omega \to +\infty}(\omega\delta((c/\omega)+1)^{1-\omega\delta}/(1-\omega\delta)) = -e^{-\delta c}$, where δ is the (constant) absolute risk aversion index (which leads to an increasing relative risk aversion). The quadratic utility function, commonly used in some financial applications, belongs to the IRRA family too.