Income distribution and equilibrium multiplicity in a stigma-based model of tax evasion

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Abstract

This paper incorporates continuous income distribution into the stigma-based model of tax compliance. The paper investigates the effect of income distribution on the existence of multiple equilibria, and characterizes the conditions under which multiple equilibria emerge. Precisely, multiple equilibria exist if taxpayer incomes are sufficiently homogeneous, because the 'social coordination effect' dominates the 'individual characteristics effect'. Numerical simulations show that the main proposition is robust to allowing two-step audit policies on the part of the tax agency, under the presumption that the best (or good) equilibrium is selected whenever there are multiple equilibria. As a byproduct, the effect of various forms of tax reforms on the optimal two-step audit policy, the equilibrium compliance, and fiscal revenue is analyzed.
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1. Introduction

Tax evasion is as old as taxes themselves. In economic models of tax evasion, taxpayers decide how much income to report by solving a standard expected
utility maximization problem that trades off the tax savings from fraud against the risks of penalties for detected cheating. This view, the so-called portfolio approach, was the main idea of the seminal work by Allingham and Sandmo (1972). The portfolio approach has been extended in various directions (see Cowell, 1990; Andreoni et al., 1998, for comprehensive surveys). Nevertheless, close empirical scrutiny has revealed important inconsistencies between theory and evidence.

A couple of facts and findings motivate this paper. First, the rate of tax compliance is paradoxically high, relative to the expected punishment. Empirical studies, such as Graetz and Wilde (1985) and Skinner and Slemrod (1985), have documented the high rate of tax compliance in most countries. It seems puzzling that so many households behave honestly and that cheaters do not cheat more, considering that most taxpayers face a low probability of detection and expect a small penalty when caught. The experimental evidence (Baldry, 1986; Alm et al., 1992a) also suggests that some people never evade, even when the tax evasion gamble is clearly better than fair. To explain the apparent paradox, researchers have appealed to ethical norms (Bordignon, 1993), moral sentiments and misperceived audit probabilities (Erard and Feinstein, 1994a), and the orders of risk aversion (Benasconi, 1998). This study incorporates social stigma directly into the specification of taxpayer utility, hypothesizing that people may fear social stigma or damage to their reputation if they are to be disclosed as cheaters. An important feature of the model is the interdependence of individual behavior. That is, the larger the population share of taxpayers who evade tax, the smaller is the social stigma felt by an individual who attempts to cheat.

Second, it is known from experience that there are close relationships among income, tax policy, and evasion. Clotfelter (1983) and Poterba (1987) report that evasion increases with the tax rate. Experimental studies (e.g. Alm et al., 1992b) typically find that higher tax rates are associated with greater evasion. Most empirical findings suggest that the affluent are much more responsive to structural changes in the tax scheme and thus are suspected of more evasion. In statistical analyses of the historical impact of U.S. tax reforms, Feenberg and Poterba (1993) and Auerbach and Slemrod (1997) suggest that higher marginal tax rates lead the

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1 Based on the U.S. Internal Revenue Service estimates, only 1.7 percent of all U.S. tax returns were audited during the 1995 fiscal year and only 4.1 percent of all taxpayers whose federal returns were reassessed following an audit received some penalty. Refer to Andreoni et al. (1998) for more concrete figures.

2 The assumption that behavior is influenced by social stigma or the desire for status has a long tradition in economics. Examples include Akerlof (1980), Moffitt (1983), Gordon (1989), Besley and Coate (1992), Cole et al. (1992), Bernheim (1994) and Lindbeck et al. (1999).
rich to underreport enough income to cause a decline in the taxes paid by this class.\(^3\)

This study explicitly introduces a continuous income distribution. It is a departure from the existing literature, in which evasion is an independent decision-making problem with an equal income. Whether individuals choose to evade tax or not, and how much tax to evade, if any, depend on the before-tax income, the tax policy, and the population share of honest citizens. A social equilibrium is defined to be an endogenously determined population share of honest taxpayers together with the distribution of concealed incomes based on individual optimizations. This paper characterizes the social equilibrium and investigates the effects of pretax income distribution on the multiplicity of equilibrium. This paper also explores the effects of income, the marginal tax rate, and various forms of tax reform on individual evasion behavior and social corruption.

This paper elucidates the main points as follows. Equilibrium exists in multiplicity, if taxpayers become sufficiently homogeneous. Since taxpayers care about social stigma, the proportion of individuals who are expected to evade tax plays an important role in individual evasion decisions. If a majority (minority) of people are going to evade, then individual taxpayers will have a greater (smaller) incentive to evade taxes. This force is known as the ‘social coordination effect’. On the other hand, individuals are endowed with different levels of income. Hence, even if all taxpayers have the same preference and face the same tax policy, the marginal utilities of income concealed and the optimal evasion may be different. This second force is called the ‘individual characteristics effect.’ Note that the homogeneity of taxpayers increases as income inequality decreases, since taxpayers may differ only in pretax income. If taxpayers are sufficiently homogeneous, the social coordination effect dominates the individual characteristics effect. This leads to the emergence of multiple equilibria. In the limit as all taxpayers become endowed with an exactly equal income, the individual characteristics effect disappears while only the social coordination effect comes into play. In such a society, equilibrium population shares always exist in multiplicity, including two extreme states of complete corruption and complete honesty.

One might ask whether this result is an artifact of the assumption that the audit rate is constant over all reported incomes. In particular, how robust is the result to allowing possibilities that the government adopts an optimal two-step audit policy? I shall show that the answer to this question is conditionally positive. What I mean

\(^3\)Incomes declared and taxes paid by the rich increased dramatically after the Economic Recovery Tax Act of 1981 (ERTA) and the Tax Reform Act of 1986 (TRA86), which were characterized by a fall in the top marginal tax rate. On the other hand, the rise in the top marginal tax rate in the Omnibus Budget Reconciliation Act of 1993 (OBRA93) was followed by a decline in the fraction of taxes paid by the rich. However, Goolsbee (2000) argues that this decline is almost entirely a short-run shift in the timing of compensation rather than a permanent reduction in taxable income.
by ‘conditionally’ depends on the nature of the selected equilibrium in the presence of multiple equilibria. Given a particular audit rule, multiple equilibria may exist. But when there are multiple equilibria, which one is realized determines the optimality of the original audit policy. This paper shows by numerical methods that sufficient homogeneity gives rise to equilibrium multiplicity, provided that the best equilibrium is selected in the presence of multiple equilibria.

As a byproduct, this paper also analyzes the effect of tax reforms on compliance and tax revenue. In the first type of tax reform examined, marginal tax rates are reduced for all income groups. This study will show that such a tax reform reduces corruption, regardless of the nature of the underlying tax policies. In the second type of reform, a decline in tax rates for high-income groups accompanies a simultaneous increase in tax rates for lower groups to keep the target revenue unchanged. This paper shows by simulations that the effect of such a reform is largely ambiguous. However, the forms of the optimal audit rule look intuitive. If the tax burden is relatively heavier for poor people, it is optimal to concentrate audit resources on the lower and middle class while giving up the investigation of large reports. On the contrary, if tax is very progressive so as for the rich to have more incentive to cheat, the tax agency should audit the rich as well as the poor with less discriminatory probabilities.

The paper is most closely related to previous work by Gordon (1989), Besley and Coate (1992), and Lindbeck et al. (1999). Gordon was the first to modify the standard tax evasion model by introducing taxpayers’ social stigma, in order to explain some empirical inconsistencies. Our analysis differs from Gordon in two respects. First, the present treatment generalizes Gordon by allowing broader classes of tax policies and stigma functions. Second, while Gordon focuses on the case of fixed income, we consider the continuous income distribution and its effect on evasion. From the viewpoint of the modeling technique, the paper resembles Lindbeck et al. and its predecessor, Besley and Coate. However, they focus on the welfare stigma while taxation is simply a means of financing welfare payments, so the problem of tax compliance does not arise. In Gordon and Besley–Coate, the source of individual heterogeneity is preferences, such as the private psychic cost of evasion and a personal degree of sympathy for the needy poor, given that the income level is fixed. On the contrary, individuals in this paper have completely identical preferences and may only differ in their endowed income levels. Moreover, individuals not only decide whether to evade or not, but also how much income to conceal, unlike Lindbeck et al.’s binary choice problem.

In this paper, tax policy is assumed to be exogenously given as the product of a political process which is not modeled here. On the other hand, some research is focused on the determination of progressive taxation. The normative theory of optimal taxation, which originated with Mirrless (1971), attempts to explain why certain tax schemes may or may not be socially desirable. Some literature on political economy analyzes why a progressive tax policy wins the election as an outcome of the political process. Roemer (1999) deserves special mention. In
Roemer, a non-degenerate income distribution plays an important role in explaining why both leftist and rightist political parties typically propose progressive income taxation. Roemer characterizes a Nash equilibrium in a political voting game between a leftist party and a rightist party. He utilizes a crucial assumption on income distribution, which states that more than half the voters have incomes that are less than the mean.

Another line of research on tax evasion and corruption deterrence is based on repeated game reasoning or on other dynamics. Examples are Greenberg (1984), Lui (1986), and Tirole (1996). In Lui’s overlapping-generations framework, a multiplicity of steady state equilibria stems from the crucial assumption that when corruption becomes more prevalent in the economy, it is harder to audit a corrupt official effectively. Tirole provides a dynamic model of collective reputations, in which a member’s incentives are affected by his past behavior, and because of partial observability of his track record, by the group’s past behavior as well. Tirole shows that multiple steady states exist when parameters satisfy several conditions for a strong enough dynamic complementarity between past and future reputations. My paper derives the conditions for the emergence of multiple equilibria, which stems only from distributional characteristics of taxpayer income.

The remainder of this paper is organized as follows. Section 2 presents the environment, the individual taxpayer’s optimization problem, and the notion of social equilibrium. Section 3 contains an analysis of the relationship between income distribution and equilibrium characterization, especially for the multiplicity of equilibrium. Section 4 studies the robustness of the main result to more general audit policies. Section 5 provides formal definitions of tax reform and analyzes the effect of various forms of tax reform on evasion and actual revenue. Section 6 presents the concluding remarks.

2. The model

2.1. The economy

There is a continuum of individuals. An individual is characterized by his income, $y$, or his type. Individuals supply labor inelastically, as they derive no utility from leisure. The distribution of income is given by a probability measure $\mu$ on $[y, y']$, where $0 \leq y < y' < \infty$. It is assumed that the cumulative probability distribution function $F$ is strictly increasing and differentiable, with the probability density $f(y) = F'(y)$ being positive.

The government collects income tax according to a given tax schedule. The notation $T(x)$ signifies the amount of net tax to be paid, where $x$ is the reported income. The income tax schedule is assumed to be the product of a political process, which is not modeled here. For the purposes of this study, therefore, the
tax function $T(x)$ is exogenously determined and is common knowledge among all taxpayers. In addition, we make the following assumptions.

**Assumption 1.** (i) $T : [y, \bar{y}] \to \mathbb{R}$ is twice continuously differentiable; (ii) $0 \leq T'(x) \leq 1$ for all $x$; (iii) $x - T(x) \geq 0$ for all $x$.

Differentiability is assumed primarily to simplify the subsequent analysis. Assumption 1(ii) says that the amount of tax as well as the post-tax income must be non-decreasing in the pretax income. In other words, fiscal policy should not reverse the original income status. Assumption 1(iii) is an individual rationality condition. The tax schedule $T(x)$ departs from reality in two respects. First, income tax is actually levied according to marginal tax brackets. This implies that $T(x)$ is not differentiable at some bracket points. Second, deductions and personal exemption, although independent of income, may depend on other characteristics, such as family size, hospitalization, and education costs. The first difference is minor. The second discrepancy is ignored by implicitly assuming that such factors are averaged out across a large number of taxpayers, although this assumption is not innocuous.

Tax policy $T(x) = x - b$ is purely socialistic, under which the government confiscates all income and redistributes it to $b$. Policy $T(x) = 0$ is laissez-faire. Define a policy $T(x)$ to be progressive (regressive) if it generates an after-tax income function which is concave (convex) in pretax income. This is equivalent to having $T'' < 0$ ($T'' > 0$). A proportional or flat-rate tax policy implies $T'' = 0$. In the following, we rule out tax policies that are progressive in some range of incomes and regressive in other ranges.

### 2.2. Individual optimization

Each taxpayer endowed with a taxable income of $y$ must decide how much income to report to the tax authorities. He knows that his declaration will be audited with some probability $p$. If audited, all his unreported income will be discovered and he will have to pay a penalty at rate $s$ on each dollar that he should have paid in tax. Thus, the taxpayer can expect, on the average, a return of $(1 - p - ps)$ dollars for every dollar of tax evaded. The tax evasion gamble is assumed to be better than fair. That is, $(1 - p - ps) > 0$.\(^4\) Let $z$ denote the undeclared income, so $z = y - x$. Consumption $C$ is a random variable:

\(^4\)The other case, in which $(1 - p - ps)$ is negative, is of little interest, since tax evasion would never take place. Empirical evidence also supports this assumption. For example, Skinner and Slemrod (1985) show that the fiscal systems of most countries imply values of this parameter in the range of 0.75 and 0.99.
\[ C = y - T(y) + \tilde{\theta}[T(y) - T(y - z)], \]  
where \( \tilde{\theta} = 1 \) with probability \((1 - p)\), and \( \tilde{\theta} = -s \) with probability \( p \).

The utility from consumption is a strictly increasing and concave function. The disutility of evading tax is a non-decreasing function in the fraction of honest taxpayers as well as in the amount of undeclared but detected income. An individual feels stigma only if he is audited and exposed as a cheater. Formally, individuals wish to maximize the following expected utility:

\[ U(z) = E[u(C)] - p\Phi(h, z), \]  
where \( E[\cdot] \) is the expectation operator and \( h \in [0, 1] \) denotes the fraction of honest taxpayers in society. The function \( \Phi(h, z) \) measures the size of the stigma cost that an individual incurs when the proportion of honest taxpayers is \( h \), and when he underreported income by \( z \). We make the following assumptions on the functions \( u \) and \( \Phi \).

**Assumption 2.** (i) The utility function, \( u : \mathbb{R}_+ \rightarrow \mathbb{R} \), is real-valued and twice continuously differentiable on \( \mathbb{R}_+ \), with \( u' > 0 > u'' \); (ii) \( \Phi : [0, 1] \times \mathbb{R} \rightarrow \mathbb{R} \) is twice continuously differentiable, with \( \Phi_h, \Phi_z, \Phi_{hh}, \Phi_{zz} > 0 \).

Assumption 2(i) implies that taxpayers are risk-averse. Assumption 2(ii) implies that the social stigma cost rises as more people are honest in paying taxes or as larger amounts of concealed income are discovered. The function \( \Phi(0, z) \) is the marginal disutility from concealing income by \( z \) in a completely corrupt society, so it measures an individual’s inherent morality cost. On the other hand, the function \( \Phi(1, z) \) is the marginal disutility from concealing income by \( z \) in the completely honest society.

The first-order condition for expected utility maximization is that

\[ E[u'(C) \tilde{\theta}/p]T'(y - z) - \Phi_z(h, z) \leq 0, \]  
with the equality holding if and only if \( z > 0 \). The second-order condition is

\[ E[u'(C) \tilde{\theta}^2/p][T'(y - z)]^2 - E[u'(C) \tilde{\theta}/p]T''(y - z) - \Phi_{zz}(h, z) < 0, \]  
which holds if Assumptions 2(i) and (ii) are satisfied and the tax system is non-regressive.

The necessary condition for an interior solution to exist is that \( E[u'(C)T'(y - z)\tilde{\theta}/p] \) evaluated at \( z = 0 \) is strictly positive. But this always holds by the

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\(^*\)Following Yitzhaki’s (1974) modification of the Allingham–Sandmo model, the fine is levied on tax evaded rather than on income concealed. In this specification, it is known that tax changes have only an income effect.

\(^\dagger\)The standard portfolio-type models, such as Allingham and Sandmo (1972) and Yitzhaki (1974) can be reduced to a special case of \( \Phi = 0 \) in our framework.
maintained assumption that \((1 - p - ps) > 0\). Formally, evasion is optimal for taxpayers with income \(y\) that satisfies the following inequality:

\[
G(y) = \frac{1 - p - ps}{p} T'(y)u'(y - T(y)) > \Phi(h, 0).
\]

Those with income \(y\) satisfying the reverse inequality do not evade at all. That is, honesty is the best policy.

Since \(G(y)\) is continuous in \(y\) and the domain \([\underline{y}, \overline{y}]\) is compact, a global maximum and a global minimum of \(G(y)\) always exist. For future reference, let \(G_{\max}\) and \(G_{\min}\) denote the maximum and the minimum of \(G(y)\), respectively.

### 2.3. Social equilibrium and stability

The situation that taxpayers face is an anonymous game. A continuum of population of players chooses whether or not to evade tax and how much tax to evade, if any. A player’s preferences depend only on his own actions (the undeclared income) and on aggregate statistics over the population (the population fraction of honest taxpayers). An equilibrium arises if the perceived number of evaders is consistent with the actual number of evaders. Now we introduce the notion of social equilibrium suitable to the present context.

Let \(Y_{\mu}(h)\) denote the set of income levels for which individuals optimally do not evade tax when the fraction of honest taxpayers is exactly \(h\). Formally,

\[
Y_{\mu}(h) = \{ y \in [\underline{y}, \overline{y}] | G(y) \leq \Phi(h, 0) \},
\]

for each \(h \in [0, 1]\). Since the functions \(G\) and \(\Phi\) are continuous, for any \(h \in [0, 1]\) the set \(Y_{\mu}(h)\) belongs to the Borel sigma algebra of \([\underline{y}, \overline{y}]\).

If all taxpayers expect \(h\) to be the population share of honest taxpayers and this expectation is self-fulfilling, then \(h\) must be identical to the population share of taxpayers with incomes belonging to the set \(Y_{\mu}(h)\). Hence,

\[
h = \mu(Y_{\mu}(h)),
\]

where \(\mu\) is the probability measure associated with the income distribution \(F\). Mathematically, this is a fixed-point equation in \(h\), with the exogenous function \(T(\cdot)\). The right-hand side of Eq. (7) is a continuous function of \(h\), mapping the unit interval \([0, 1]\) into itself. By Brouwer’s fixed point theorem, we can conclude that there exists at least one population fraction \(h^*\) satisfying Eq. (7) for any given tax schedule \(T(\cdot)\). A solution \(h^*\) to Eq. (7) will be called an *equilibrium* population share of honest taxpayers.

A natural class of dynamics in the expectation formation that underlies Eq. (7) can be imagined. Assume that individuals repeatedly decide whether and/or how much tax to evade at each period \(t\). Time runs from \(t = 1\) to infinity. Suppose that all individuals predict a population share \(h_t\) of honest taxpayers at period \(t\). If
\( \mu(Y_t(h_t)) \) equals \( h_t \), then the aggregate of taxpayers has succeeded in making a correct, or self-fulfilling, prediction. However, if \( \mu(Y_t(h_t)) > h_t \), it is plausible that some individuals who evaded tax will now become honest, since the social stigma was greater than expected. Likewise, if \( \mu(Y_t(h_t)) < h_t \), some individuals who were honest in paying tax will now shift to evasion. In such an adaptive process, \( h_t \) will strictly increase (decrease) if \( \mu(Y_t(h_t)) \) exceeds (falls short of) \( h_t \). The definition of stability is standard and does not need to be formally justified. Moreover, if the process converges, the limit coincides with a social equilibrium.\(^7\)

2.4. Geometric exposition

It will be helpful to explain individual optimization and social equilibrium in graphs. Fig. 1a illustrates the individual optimization problem. Under the assumption that the second-order condition is satisfied, \( E[u'(C)T'(y - z)\bar{\theta}/p] \) is strictly decreasing in \( z \), as is shown in the northeast quadrant of Fig. 1a. The function \( G(y) \), which is \( E[u'(C)T'(y - z)\bar{\theta}/p] \) evaluated at \( z = 0 \), is depicted in the northwest quadrant. Suppose that the population fraction of honest taxpayers is \( \hat{h} \). In this state, taxpayers with income below \( \hat{y} \) do not evade, whereas the remaining taxpayers optimally evade. As an example, an individual whose true income is \( \hat{y} \) conceals his income by \( \hat{z} \) and reports to the tax authorities as if he earned \( \hat{\hat{x}} \); (\( \hat{y} - \hat{z} \)). From the fixed-point map depicted in Fig. 1b, it is also obvious that the state \( \hat{h} \) is not self-fulfilling because \( \hat{h} \neq F(\hat{y}) \).

3. Equilibrium multiplicity

3.1. The main result

Whether equilibrium exists in multiplicity, and what happens at equilibrium, depend on the underlying functions (such as \( u, \Phi, F \) and \( T \)) as well as various parameters (such as \( p \) and \( s \)). This section analyzes how the sub-utility functions \( \Phi \) and \( u \), and, in particular, the income distribution \( F \) affect the multiplicity of equilibria and their characterizations.

The first proposition considers the extreme situations in which the stigma cost is either very small or very large with respect to other parameters. Recall that \( G_{\min} = \min_{y \in [\bar{y}, \bar{x}]} G(y) \) and \( G_{\max} = \max_{y \in [\bar{y}, \bar{x}]} G(y) \). To avoid notational clutter, we rule out the non-generic cases of \( \Phi(0, 0) = G_{\min} \) and \( \Phi(1, 0) = G_{\max} \).

\(^7\)Particularly relevant is Pommerehne et al. (1994), in which taxpayers choose how much to cheat each period and there is a dynamic feedback process leading to various social equilibria and institutions.
Proposition 1. (i) State \( h = 0 \) is an equilibrium if and only if \( \Phi_z(0, 0) < G_{\min} \); (ii) state \( h = 1 \) is an equilibrium if and only if \( \Phi_z(1, 0) > G_{\max} \). Furthermore, the corresponding equilibrium is locally stable.
**Proof.** Assume that \( \Phi_i(0, 0) < G_{\min} \), then Eq. (5) holds for all \( y \in [y, \tilde{y}] \) at the state \( h = 0 \). This implies that all individuals optimally evade more or less tax. Hence, the state \( h = 0 \) is self-fulfilling. To prove the ‘only if’ part of (i), suppose to the contrary that \( \Phi_i(0, 0) > G_{\min} \) holds, but that \( h = 0 \) is an equilibrium. Let \( y_{\min} \) be a value of \( y \) at which \( G(y) \) attains its global minimum, \( G_{\min} \). Since the function \( G \) is continuous, there exists an open neighborhood \( U \) of \( y_{\min} \) such that the reverse strict inequality to Eq. (5) holds for all \( y \in U \). (Remember that the non-generic case of \( \Phi_i(0, 0) = G_{\min} \) is ruled out.) Since \( f = F' \) is strictly positive on the whole support, \( F(U) \) is strictly positive and thus is \( h \). This contradicts the supposition that \( h = 0 \) is an equilibrium.

Let us demonstrate the local stability of \( h = 0 \) when \( \Phi_i(0, 0) < G_{\min} \). Since \( \Phi_i \) is continuous by Assumption 2(ii), there exists a neighborhood \( V \) of 0 such that if \( \bar{h} \in V \), then Eq. (5) still holds for all \( y \in [y, \tilde{y}] \). This is equivalent, however, to the local stability of \( h = 0 \).

Part (ii) can be proved by an analogous argument.  

Proposition 1 is quite intuitive. If and only if the inherent morality cost is sufficiently small, complete corruption can be observed as an equilibrium phenomenon. On the other hand, a completely honest society can be realized, if and only if corrupt individuals feel very high stigma in such an environment. Moreover, a society that is close enough to the corresponding state converges to it. If the conditions in Proposition 1(i) and (ii) are both satisfied, then there exist at least three equilibria, including two stable ones, \( h = 0 \) and \( h = 1 \).

Now consider the situation in which the conditions of Proposition 1 are all violated, i.e. both \( \Phi_i(0, 0) > G_{\min} \) and \( \Phi_i(1, 0) < G_{\max} \) hold. Assumption 2(ii) makes it clear that \( \Phi_i(h, z) \) is monotonically increasing in \( h \), so \( \Phi_i(0, 0) < \Phi_i(1, 0) \). Combining the existence of equilibrium and Proposition 1 leads to the conclusion that equilibrium always exists, and, furthermore, all equilibria lie strictly between 0 and 1. In other words, evaders and non-evaders always coexist on the equilibrium. The next Proposition will show the effect of income distribution on the multiplicity of equilibria and their characterizations in this intermediate case.

**Proposition 2.** Assume that \( G_{\min} < \Phi_i(0, 0) < \Phi_i(1, 0) < G_{\max} \). Let \( \{\mu_k\}_{k=1}^{\infty} \) be a sequence of probability measures that converges weakly to the point mass at \( a \), where \( a \) is a constant. Then the following holds: (i) If \( G(a) \in (\Phi_i(0, 0), \Phi_i(1, 0)) \), then there exists a finite \( K \) such that at least two stable equilibria exist for any \( k > K \). (ii) If \( G(a) \in (G_{\min}, \Phi_i(0, 0)) \), then for any \( \eta > 0 \) there exists a finite \( K \) such that \( h^* \in (1 - \eta, 1) \) on any equilibrium for \( k > K \). (iii) If \( G(a) \in (\Phi_i(1, 0), G_{\max}) \), then for any \( \eta > 0 \) there exists a finite \( K \) such that \( h^* \in (0, \eta) \) on any equilibrium for \( k > K \).

**Proof.** (i) We want to show that if most incomes are distributed around the mean \( a \) (that is, sufficiently large \( k \)) then there exists a stable equilibrium near \( h = 0 \).
Formally, we claim that for some positive $d$ and a sufficiently large $k$, the mapping of $\mu_k(Y_{\rho}(h))$ from $[0, \delta]$ to itself has at least one fixed point, and, moreover, at least one of the fixed points is stable. It suffices to argue that as $k$ becomes larger, the value $\mu_k(Y_{\rho}(0))$ approaches zero and the graph of $\mu_k(Y_{\rho}(h))$ becomes very flat for $h$ near 0. Let $\delta$ be a strictly positive number smaller than $G(a) - G(0, 0)$. Since $\Phi_{\rho}(0, 0) > G_{\max}$ and the support of $\mu_k$ is $[y, \tilde{y}]$, $\mu_k(Y_{\rho}(0))$ is strictly positive for any $k$. By the assumption of weak convergence, we can choose $K_1$ large enough such that $k > K_1$ implies $\mu_k(Y_{\rho}(0)) < \delta$. For any $\delta' > 0$, we can also choose $K_2$ large enough so that $k > K_2$ implies $\mu_k(Y_{\rho}(\delta)) < \delta'$. Since $\delta'$ is independent of $\delta$, we may choose $\delta' < \delta$ so that $k > K_5$ implies $\mu_k(Y_{\rho}(\delta)) < \delta$. Clearly, $\mu_k(Y_{\rho}(h))$ is continuous and strictly increasing in $h$ for any $k$. By Brouwer’s fixed point theorem, there exists a fixed point $h^* \in [0, \delta]$ such that $\mu_k(Y_{\rho}(h^*)) = h^*$ for $k > \max\{K_1, K_2\}$. Since $\mu_k(Y_{\rho}(0)) > 0$ and $\mu_k(Y_{\rho}(\delta)) < \delta$, at least one of the fixed points must be stable.

We also want to show that for $k$ sufficiently large, a stable equilibrium exists near $h = 1$. By the symmetric argument as above, it can be shown that for $\epsilon \in (0, G_{\max} - \Phi(1, 0))$ fixed, the mapping of $\mu_k(Y_{\rho}(h))$ from $[1 - \epsilon, 1]$ to itself has at least one fixed point for $k$ large enough. Furthermore, at least one of the fixed points is stable.

It is done if $k$ is chosen large enough for all of the above claims to hold.

(i) Fix $\eta > 0$. Since $\{\mu_k\}_k$ converges weakly to the point mass at $a$, we can choose $K$ large enough so that $\mu_k(Y_{\rho}(0)) > 1 - \eta$ for $k > K$. Since $G_{\max} > \Phi(1, 0)$, it is true that $\mu_k(Y_{\rho}(1)) < 1$ for any $k$. Hence, for $k > K$, all the fixed points lie within $(1 - \eta, 1)$.

(ii) This can be proven by an analogous argument to (i) above.

In the present model, all taxpayers have identical preferences and face the same situation. They may differ only in endowed incomes, and, thus, the amount of taxes to be paid. Each taxpayer has to decide whether or not to evade tax and how much tax to evade, if any. Since individual taxpayers care about social stigma, the proportion of individuals who are expected to cheat plays an important role in each individual’s decision-making. If a majority (minority) of people are going to evade, then the incentive for an individual taxpayer to evade would become greater (smaller). This force is called the ‘social coordination effect’. On the other hand, individuals are endowed with different levels of income. Hence, even if all taxpayers have the same preference and face the same tax policy, the marginal utilities of undeclared income and, consequently, the optimal evasion may differ. This second force is known as the ‘individual characteristics effect.’

Proposition 2(i) states that multiple equilibria exist if taxpayers are sufficiently homogeneous. This is because the social coordination effect dominates the individual characteristics effect. If all people are born with an equal endowment, the individual characteristics effect disappears and only the social coordination effect comes into play. In such a society, the equilibrium population shares always
exist in multiplicity, including two extreme states \( h = 0 \) and \( h = 1 \). Proposition 2(ii) deals with the case in which taxpayers’ homogeneity increases and stigma cost is relatively high. Roughly speaking, only a negligible fraction of taxpayers will evade in this case, although the number of equilibria is indeterminate. Proposition 2(iii), which is the counterpart to 2(ii), states that most taxpayers evade if their income levels are sufficiently homogeneous and the disutility of stigma is relatively low.

The specification of \( F \) is general enough to encompass a broad range of stigma functions. The simplest form may be either \( F(h, z) = \varphi(h)z \), or \( F(h, z) = \varphi(h)[T(y) - T(y - z)] \), where \( \varphi' > 0 \). If one believes that the utility cost from stigma depends not on the amount evaded but on the fraction of income unreported, one may set \( F(h, z) = \varphi(h)z/y \). Casual observations and empirical evidence make it clear that the degree of stigma would vary across occupations and income levels. For example, CEOs, government officials, and professors might perceive a relatively large degree of stigma from cheating, as might relatively wealthy individuals. Such a situation can be modeled as, for instance,

\[
F(h, z) = y\varphi(h)[T(y) - T(y - z)].
\]

Although different specifications may yield different implications on the identities of evaders and the amounts evaded, the main results of this section still go through. That is to say, regardless of the forms of the utility function and the tax scheme, multiple equilibria emerge if taxpayers become sufficiently homogenous.

This section is concluded with a remark on why a multiplicity of equilibria matters. The reason is that whether equilibrium exists in multiplicity or in uniqueness gives drastically different policy implications for corruption deterrence and fiscal revenue. Consider a situation in which there are two equilibria and the economy is currently stuck in the bad, corrupt equilibrium. Let us take the proposition that a tax reform that reduces the marginal tax rates for all income groups decreases corruption, which will be shown later. Suppose that at some date the government carries out a sufficiently strong tax reform that lasts some periods and makes the corrupt state disappear. After the reform, the economy would shift to the good, honest equilibrium. Once the economy approaches the good equilibrium close enough, it will still remain there, even if a retroactive government returns to the ancien regime. Although the effectiveness of the tax reform is surely attenuated, the economy will stay at an equilibrium that is qualitatively different from the pre-reform equilibrium. That is, corruption ratchets down. Tax revenue will also increase, since evasion decreases while the final tax policy is the same as the pre-reform policy. By contrast, corruption does not ratchet down when the equilibrium is uniquely determined. A tax reform, no

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8In this extreme case, the source of equilibrium multiplicity is logically similar to that observed in Lui (1986), Becker (1991), Blomquist (1993), Tirole (1996) and Lindbeck et al. (1999).
matter how drastic it might be, only implies a temporary decrease in corruption and will be nullified as soon as a new government in power revives the old tax system.

### 3.2. Numerical illustrations

For the sake of the reader, it will be helpful to consider a heuristic example at various points in this paper. The following case will be used for illustrative purposes throughout. Taxpayers’ preferences are characterized by the log utility function, \( u(x) = \ln x \), and the stigma cost function,

\[
\Phi(h, z) = [A + (B - A)h][T(y) - T(y - z)],
\]

where \( B > A \geq 0 \). For all the simulations we set the tax agency budget at a level that limits the total number of audits to 10 percent of the returns filed. In addition, we set the penalty rate \( s \) to 2. Consider the lognormal distribution with the pdf

\[
l(y \mid m, \sigma^2) = \frac{1}{y \sqrt{2\pi\sigma^2}} \exp\left[ -\frac{1}{2\sigma^2}(\ln y - m)^2 \right].
\]

We truncate the lognormal distribution so that it takes on nonzero values only over the range from 6 to 15 measured in ten thousands of dollars. For this distribution we choose the parameters \((m, \sigma^2)\) so that the mean income is kept constant at 10. Since truncation does not preserve the first and second moments, the parameters \(m\) and \(\sigma^2\) depend on each other in order to keep the mean of the truncated distribution constant. Specifically, we report our simulation results under the following pairs of parameters, \((m, \sigma^2) = (2.48788, 0.8), (2.31442, 0.15), (2.302585, 0.01)\).

Fig. 2 displays the fixed-point maps for a proportional tax scheme: \( T(x) = 0.3x \). Plugging parameter values into Eq. (5) gives rise to \( G(y) = 3/y \). In view of Proposition 1, it can be shown that \( h = 0 \) is an equilibrium if \( A < 10/15 = 0.667 \), and that \( h = 1 \) is an equilibrium if \( B > 10/6 = 1.667 \). Now let \( A = 0.9 \) and \( B = 1.2 \), then the population fraction of honest taxpayers \( h \) lies strictly between 0 and 1. Numerical analysis confirms that a unique equilibrium exists if \( \sigma^2 = 0.8 \) or \( \sigma^2 = 0.15 \). Specifically, with \( \sigma^2 = 0.15 \), there exists a unique equilibrium in which approximately 85.05 percent of taxpayers report income honestly. With a higher dispersion \( \sigma^2 = 0.8 \) of incomes, the proportion of honest taxpayers falls to 55.46 percent. In the case of \( \sigma^2 = 0.01 \), there exist three equilibria, of which two are stable, \( h = 0 \) and \( h = 1 \).

The above example may help the reader understand how multiple equilibria emerge as income becomes increasingly homogenous. As was proven in Proposition 2, this is robust to the tax scheme. Fig. 3 depicts the social equilibria for a quadratic taxation: \( T(x) = \frac{1}{35}x^2 \). The family of quadratic tax policies has been studied extensively in the existing literature. (Refer to Roemer, 1999, and...
references therein.) It is easy to check that this tax scheme satisfies Assumption 1. Plugging parameter values into Eq. (5) gives rise to

\[ G(y) = \frac{7}{y - (1/35)y^2}. \]

In view of Proposition 1, complete corruption is an equilibrium if and only if \( A < 0.817 \), and complete honesty is an equilibrium if and only if \( B > 1.408 \). As before, let \( A = 0.9 \) and \( B = 1.2 \). Numerical analysis reveals that with \( \sigma^2 = 0.8 \), approximately 69.36 percent of taxpayers behave honestly. This proportion rises to 97.96 percent as taxpayer characteristics become more homogeneous, i.e. \( \sigma^2 = 0.15 \). If \( \sigma^2 = 0.01 \), so that taxpayers are quite homogenous, multiple equilibria exist, of which two are stable, \( h \approx 0 \) and \( h \approx 1 \).

4. Optimal two-step audit rule

4.1. Framework

We have thus far maintained the assumption that all tax reports face the same likelihood of being investigated. While this was common in the early literature,
more recent studies have permitted the audit function to vary with the amount of income reported. These studies have shown that, generally, it is not optimal from an enforcement standpoint to hold the audit probability constant.

The models in this literature fall into two categories. The first assumes that the tax agency can announce and commit to its audit rule before taxpayers file returns. These models share common elements with a principal-agent framework. In contrast, models in the second category postulate that the tax authority cannot commit to its audit rule but instead decides which taxpayers to audit after all returns have been filed. These models make use of game-theoretic concepts of equilibrium, especially sequential equilibrium.9

For the commitment case, it has been shown that the strategy that maximizes tax revenue typically involves a cutoff rule. One interesting feature of the cutoff rule is that it is non-decreasing in reported income. The simplest cutoff rule consists of a threshold value, and a policy to audit any report below the threshold with some

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probability, but to leave all reports above the threshold un-audited. The simple cutoff rule has been shown to be optimal only under restrictive assumptions, including risk-neutrality. Moreover, it is required that the hazard function of income distribution be decreasing in income. Border and Sobel (1987) provide a thorough analysis of the case in which taxpayers are risk-neutral and there are a discrete number of possible true incomes. Mookherjee and P’ng (1989) characterize the optimal audit strategy when taxpayers are risk averse. The optimal audit strategies identified by Border and Sobel and Mookherjee and P’ng possess properties qualitatively similar to the cutoff rule.

Inspired by the above observations and also motivated by numerical tractability, we postulate that the tax department applies a two-step cutoff audit rule as follows. The audit rule consists of a threshold value \( \hat{x} \), and a policy to audit any report below the threshold with probability \( p_a \), but to audit any report above the threshold with a lower probability \( p_b \). The objective of the tax authority is to choose the optimal two-step audit policy \((\hat{x}; p_a, p_b)\) that maximizes expected tax revenue, subject to the rational behavior of the taxpayers and an exogenously fixed budget. We continue to set the penalty rate to 2.

Given the audit policy \((\hat{x}; p_a, p_b)\), each individual taxpayer optimally chooses reported income \( x^* \) that maximizes his expected utility. Let \( R(\hat{x}) \) denote the induced distribution function of reported incomes over the whole population. The threshold is chosen so that the audit budget is just exhausted in equilibrium. For the simulations we set the tax agency budget at a level that limits the total number of audits to 10 percent of the returns filed. Formally, \( \hat{x} \) must satisfy the budget constraint \( p_a R(\hat{x}) + p_b [1 - R(\hat{x})] = 0.1 \). Since the induced distribution depends on the threshold \( \hat{x} \) in turn, there is no guarantee for this budget constraint to hold a priori. Hence, we should find by numerical methods the optimal audit policy satisfying the budget constraint and the resulting distribution of reported incomes. Last, the social equilibrium is analogously defined as in the previous case of fixed audit rate.

Since obtaining the closed-form solutions seems improbable, we rely on numerical analysis using the same model as in the previous section. Taxpayers’ preferences are characterized by the log utility function, \( u(x) = \ln x \), and the stigma cost function,

\[
\Phi(h, z) = [A + (B - A)h][T(y) - T(y - z)],
\]

where \( B > A \geq 0 \). Consider the lognormal distribution with the pdf

\[
l(y \mid m, \sigma^2) = \frac{1}{y \sqrt{2 \pi \sigma^2}} \exp \left[ -\frac{1}{2 \sigma^2} (\ln y - m)^2 \right].
\]

\( ^{10} \)In this paper, the proportion of honest taxpayers is endogenously determined, unlike Erard and Feinstein (1994b). However, I do not claim that my paper generalizes Erard and Feinstein, since my paper adopts a principal-agent model while theirs is based on the game-theoretic approach.
We truncate the lognormal distribution so that it takes on nonzero values only over the range from 6 to 15 measured in ten thousands of dollars. For this distribution we choose the parameters \((m, \sigma^2)\) so that the mean income is kept constant at 10.

4.2. Numerical results

In the previous section, I verified that as taxpayers become sufficiently homogeneous, multiple equilibria necessarily emerge. Is that an artifact of the assumption that the audit rate is constant over reported incomes? More specifically, would enough homogeneity give rise to multiple equilibria even if the government adopts the optimal two-step audit policy?

In this section, I will show that the answer to this question is conditionally positive. What I mean by ‘conditionally’ hinges on the nature of the selected equilibrium in the presence of multiple equilibria. Given a particular audit rule, multiple equilibria may exist. But when there are multiple equilibria, the equilibrium realized determines the optimality of the original audit policy. Put differently, it may well be the case that a particular audit policy indeed maximizes fiscal revenue if a good (or the best) equilibrium is realized, but it is no longer optimal if a bad (or the worst) equilibrium is realized. Based on the numerical analysis, I can claim that sufficient homogeneity gives rise to equilibrium multiplicity under the presumption that the best equilibrium is selected whenever there is more than one equilibrium.

Consider proportional taxation: \(T(x) = 0.3x\). Fig. 4 displays the fixed-point maps for the case in which a good equilibrium is selected among multiple equilibria. With \(\sigma^2 = 0.03\), the equilibrium is unique. With \(\sigma^2 = 0.005\) or \(\sigma^2 = 0.0005\), there are multiple equilibria. For example, when \(\sigma^2 = 0.0005\), there are three equilibria, of which two are stable, \(h^* = 0.5134\) and \(h^* = 1\). The upper part of Table 1 reports the optimal two-step audit rates, the cutoff point, the equilibrium fraction of honest taxpayers, and the maximized fiscal revenue, under the assumption that a good equilibrium is always selected in the presence of multiple equilibria. Let us look at the case of \(\sigma^2 = 0.005\). It is optimal from the government’s viewpoint to audit taxpayers whose reported incomes fall short of 9.68 with probability 0.12 and the remaining taxpayers with probability 0.09. Three equilibria exist, namely \(h^* = 0.36, 0.94\) and \(h^* = 1\). Since we assume that the best equilibrium is realized, we take \(h^* = 1\), meaning everyone reports income honestly. Hence, the revenue would be 3.

Fig. 5 depicts the fixed-point maps for the case in which the worst equilibrium is selected whenever there are multiple equilibria. As is clear from the graph, no matter how small \(\sigma^2\) might be, the equilibrium is unique. The underlying logic is as follows. For very small \(\sigma^2\) and less discriminatory two-step audit rates, one can show by the same logic as in the previous section that there would be multiple equilibria. Let \(E\) denote the worst equilibrium among them. Generally, \(E\) is bad enough, so that one can always find an alternative, more discriminatory audit rule.
Fig. 4. The effect of increased homogeneity on equilibrium multiplicity under the assumption that the best equilibrium is realized.

Table 1
The optimal audit policy, the social equilibrium, and maximized revenue

<table>
<thead>
<tr>
<th>$\sigma^2$</th>
<th>$p_a$</th>
<th>$p_b$</th>
<th>Cutoff</th>
<th>$h^*$</th>
<th>Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>The case in which the best equilibrium is selected</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.03</td>
<td>0.11</td>
<td>0.09</td>
<td>9.88</td>
<td>0.96</td>
<td>2.9963</td>
</tr>
<tr>
<td>0.005</td>
<td>0.12</td>
<td>0.09</td>
<td>9.68</td>
<td>1</td>
<td>3.0000</td>
</tr>
<tr>
<td>0.0005</td>
<td>0.11</td>
<td>0.09</td>
<td>10</td>
<td>1</td>
<td>3.0000</td>
</tr>
<tr>
<td>The case in which the worst equilibrium is selected</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.03</td>
<td>0.11</td>
<td>0.09</td>
<td>9.88</td>
<td>0.96</td>
<td>2.9963</td>
</tr>
<tr>
<td>0.005</td>
<td>0.11</td>
<td>0.04</td>
<td>10.76</td>
<td>0.86</td>
<td>2.9842</td>
</tr>
<tr>
<td>0.0005</td>
<td>0.11</td>
<td>0.05</td>
<td>10.21</td>
<td>0.84</td>
<td>2.9946</td>
</tr>
</tbody>
</table>
Fig. 5. The effect of increased homogeneity on equilibrium multiplicity under the assumption that the worst equilibrium is realized.

under which the equilibrium is unique and fares better than $E$. The tax authority should optimally adopt such an alternative audit rule instead of a less discriminatory audit rule that would give rise to multiple equilibria.

Refer to the lower part of Table 1 for concrete results. Take the case of $\sigma^2 = 0.005$ again. It is optimal for the tax authority to audit reported incomes below 10.76 with probability 0.11 and the remaining reports with probability 0.4. Compared to the former case in which a good equilibrium is selected, this means that more intermediate files are investigated while reasonably large reports are audited with a much lower probability of 0.04. This is intuitively appealing, since if the worst equilibrium is always to be realized, the tax agency had better give up auditing the high-income class, which are relatively immaterial in population, and
concentrate resources on auditing the heavy populated middle-income class. Under the optimal audit policy, approximately 86 percent of taxpayers report income honestly and the resulting revenue amounts to 2.9842 only.

Our results are robust to the tax scheme. I worked with the quadratic taxation

\[ T(x) = \frac{1}{35} \left[ x^2 - \int_{6}^{15} x^2 \, dF(x) \right] + 3, \]

which is revenue-equivalent to the linear taxation \( T(x) = 0.3x \). Additional simulations confirm that the optimal two-step audit rule, the cutoff, the social equilibrium and the maximized fiscal revenue exhibit qualitatively the same patterns and properties.

5. Tax reform and corruption

This section analyzes the effect of tax reform on the magnitude of evasion and the fiscal revenue. Two kinds of tax reform are considered. First, the government may tax some income groups more heavily without lowering the tax rates for other groups. After this type of reform, all individuals would face equal or higher tax rates than before. Second, an increase in tax rates on the income of the rich may accompany a simultaneous decrease in tax rates on the income of the poor. To study this type of reform, this paper confines its focus to the tax reforms that are expected to generate the same tax revenue.

In the case of a fixed audit rate, no definite results can be obtained with respect to the effect of tax reform on equilibrium and actual revenue. It depends on the functional forms of utility, stigma and taxation. Hereafter, we focus our attention on situations in which the tax agency adopts an optimal two-step audit rule. Taxpayers’ preferences are characterized by the log utility function, \( u(x) = \ln x \), and the linear stigma cost function,

\[ \Phi(h, z) = [A + (B - A)h][T(y) - T(y - z)]. \]

The pretax incomes follow the truncated lognormal distribution over the interval \([6, 15]\). Assume that \( \sigma^2 = 0.15 \). In this case, the social equilibrium is always unique, so no trouble arises in comparisons between different tax regimes.\(^{11}\)

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\(^{11}\) How can we evaluate the effect of tax reform in the presence of multiple stable equilibria? This study adopts a traditional approach such as Goodwin (1951) and Cooper (1994), in which agents coordinate on the one which is closest to the equilibrium in the previous period, while the structure of the taxation evolves smoothly. When an equilibrium of this type disappears, the economy jumps to an equilibrium of a different type. For example, the underlying adjustment process can be the monotone dynamics described in Section 2.3. This rule of thumb is obviously ad hoc, but it is acceptable since our concern is policy evaluation rather than equilibrium selection.
Imagine a situation in which the government lowers (raises) the marginal tax rates for all income classes. For simulation purposes, two specific types of taxation are considered: linear taxation \( T(x) = tx \), where \( t \) changes from 0.1 to 0.5, and quadratic taxation \( T(x) = \alpha x^2 \), where \( \alpha \) varies from 1/65 to 1/25. Notice that the larger \( t \) or \( \alpha \) implies heavier taxation for all income classes.

Table 2 summarizes the simulation results. The second and third rows of each table report the fraction of complying taxpayers and the maximized fiscal revenue, respectively. The last row shows the ratio of revenue loss to the target revenue. The target revenue is defined as the amount that the government would collect if all taxpayers honestly report their incomes and pay tax according to the statutory schedule. Note that the actual tax revenues may be different because of the presence of tax evasion. It is clear from the table that compliance increases (conversely decreases) and the gap between actual revenue and target revenue widens if the government lowers (conversely raises) marginal tax rates for all income levels. Nevertheless, the gross fiscal revenue increases (conversely decreases). I do not include the optimal two-step audit rules in the table, since there are generally many combinations of \( p_a \) and \( p_b \) that maximize revenue.

Next, I analyze the effect of tax reforms in which the tax burden becomes heavier for some classes while the tax burden is reduced for others. For that purpose, a formal definition of tax progressivity and revenue neutrality is introduced. A tax policy \( T^1 \) is called more progressive than \( T_0 \) if there exists a unique \( \hat{y} \in (y, \tilde{y}) \) such that \( T^1(y) < T_0(y) \) for \( y \in [y, \hat{y}) \), \( T^1(y) = T_0(y) \) for \( y = \hat{y} \) and \( T^1(y) > T_0(y) \) for \( y \in (\hat{y}, \tilde{y}] \). It is called revenue neutral if

\[
\int_{\hat{y}}^{\tilde{y}} [T^1(y) - T_0(y)] \, dF(y) = 0.
\]

Under more progressive taxation, all taxpayers with an income above (below) the threshold type are supposed to pay more (less) tax. Any pairs of revenue-neutral tax policies are expected to generate the same level of target revenues.

<table>
<thead>
<tr>
<th>Table 2</th>
<th>The effect of tax reform on compliance, maximized revenue, and the proportion of revenue loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Linear taxation ( T(x) = tx )</td>
<td>( t )</td>
</tr>
<tr>
<td>Equilibrium ( h ) (%)</td>
<td>100</td>
</tr>
<tr>
<td>Revenue</td>
<td>1</td>
</tr>
<tr>
<td>Revenue loss (%)</td>
<td>0</td>
</tr>
<tr>
<td>(b) Quadratic taxation ( T(x) = \alpha x^2 )</td>
<td>( \alpha )</td>
</tr>
<tr>
<td>Equilibrium ( h ) (%)</td>
<td>100</td>
</tr>
<tr>
<td>Revenue</td>
<td>1.6246</td>
</tr>
<tr>
<td>Revenue loss (%)</td>
<td>0</td>
</tr>
</tbody>
</table>
Now let us consider the affine tax system: $T(x) = t(x - 10) + 3$, where $t$ varies from 0.1 to 0.5. This tax scheme is revenue neutral regardless of the parameter $t$, and the higher $t$ implies more progressive taxation. Table 3 reports the optimal two-step audit rule, the equilibrium fraction of honest taxpayers, fiscal revenue, and the ratio of revenue loss to the target revenue (which is 3 here). The effect of revenue-neutral tax reforms is largely ambiguous. There are some ranges in which an increase in $t$ results in more corruption or less revenue. For instance, as $t$ rises from 0.1 to 0.2, revenue diminishes while compliance increases a little. To the contrary, as $t$ rises from 0.2 to 0.3, compliance decreases while revenue increases. For $t$ higher than 0.3, both tax compliance and revenue increase as taxation becomes more progressive. In this range, the Laffer relationship exists between tax progressivity and corruption, while the inverted-Laffer relationship exists between progressivity and actual revenue.

The optimal audit rules look intuitive. For small enough $t$, reported incomes that exceed a reasonably large threshold should be audit free. For example, for the case of $t = 0.1$, it is optimal for the government to audit reported income less than 12 with probability 0.13 and not to audit any report above 12. This means that if the tax burden is relatively heavier for poor people, it is optimal to concentrate audit resources on the lower and middle class while giving up the investigation of large reports. On the contrary, if tax is very progressive (large enough $t$) so as for the rich to have more incentive to cheat, the tax agency should audit the rich as well as the poor with less discriminatory probabilities.

6. Concluding remarks

I conclude the paper with some suggestions for future research. Perhaps the assumption one would most like to weaken is the inelasticity of labor supply. However, this assumption is partly motivated by existing empirical findings (Auerbach and Slemrod, 1997) that much of the movement in the reported income
of high-income households represents the shifting of income and not income creation, such as additional labor supply. Another suggestion for future research may be a fusion of two types of stigma-based models, including both tax evasion and welfare transfer. The current paper focuses on taxpayers’ evading decision, while the literature on welfare stigma, such as Moffitt (1983), Besley and Coate (1992), and Lindbeck et al. (1999), assumes away the possibility of evasion.

A more concrete suggestion for future research is related to equilibrium selection among multiple equilibria. In order to evaluate the tax reform in the presence of multiple equilibria, it is assumed that, as the structure of the economy changes, the equilibrium moves smoothly by an ad hoc adjustment dynamic process. If one is concerned more about the equilibrium selection problem, an incomplete information approach such as Morris and Shin (2001) can be the proper path to follow. In a possible modification, taxpayers observe their own cost of stigma and the history of the levels of aggregate corruption. The distribution of individual characteristics evolves through a random process. Applying the iterative elimination of strictly dominated strategies, one can characterize the Bayesian Nash equilibrium with a unique cutoff property. Kim (2001) pursues this line of research to explain the ambiguity and uncertainty often observed in tax auditing policies.

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References


