

Is tax amnesty good for the tax evader?

Abstract

Whether or not tax evaders join tax amnesty programs after evading taxes, an important index is the influence of tax amnesty programs on compliance. To study this question, this paper sheds light on a rather neglected but important area of the tax amnesty literature in the economic analysis of tax evaders' secondary evasion. Considering that people who participate in tax amnesty program after the government approved a tax amnesty may not honestly report the whole amounts of evaded tax, thus committing a secondary tax evasion. It is shown that even considering the risk of abstaining from tax amnesty program and incurring possible uncertainty of tax evasion penalties, participating in a tax amnesty program provides a higher level of utility for a tax evader. This result reflects the observation that many tax evaders are willing to pay taxes even when expected penalty rate and the probability of being caught evading taxes are extremely low. Also, because secondary tax evasion is accompanied by tax amnesty, we suggest that during the initial assessment period of the tax amnesty plan, tax revenue drastically increased, when the assessment period ends, tax revenue stably declined and ultimately converged on a fixed value.

Keywords: Tax evasion; Tax amnesty; Concealment cost; Secondary tax evasion; Puzzle of compliance

1. Introduction

Tax amnesty program is not a new tax but an administrative scheme to collect past taxes and may be a relatively low-priced means by which these tax liabilities can be collected, and governments of all kinds have increasingly turned to tax amnesties as part of their fiscal revenues in recent years. During the past thirty-four years, it can be observed that tax amnesty programs have been used in many countries in both developed and developing world. For instance, almost all U. S. states have offered tax amnesty programs since 1980, and Spanish Government in 2012 announced a tax amnesty for undeclared assets or those hidden in tax havens, and repatriation would be allowed by paying a 10 percent tax with no criminal penalty to prevent money from flowing out of that state. Shortly afterwards, the Liechtenstein Government in 2014 advocated the idea of a one-off, non-punitive voluntary declaration of

non-compliance tax amnesty programs, a program currently enforced in Switzerland to avoid an “accumulation” of amnesties. However, it is worthy of note that many amnesty programs which developing countries have been employed, often repeatedly incessantly, including Chile, Colombia, India, and the Mexico.

In an important early study, Arindam et al. (1995) provide empirical estimates of the revenue impact of Indian income tax amnesties between 1965 and 1993. This study examines the role of amnesties to allow tax evaders to join these programs and honestly pay the taxes that were evaded by past tax evasion. Their empirical results indicate that only the 1975 amnesty appears to have had a positive impact on tax revenue while other amnesties having negligible or even negative effects. Luite and Sobel (2007) suggest that, in general, if at first one country declares an amnesty program, it brings the government temporary revenue augments during the amnesty period but then brings about a reduction in tax revenue in the long run. Laborda and Rodrigo (2003) find that amnesties had no effect on tax revenue in either the short or the long term. Yet, Luitel and Mahar (2013) suggest that tax amnesties raise higher tax revenues for the US state treasury in the short term. Also, Fisher et al. (1989) suggest that amnesty seems to generate immediate revenue efficiently.

In the interest of tax evaders, how then can existing literature explain why tax evaders may find it worthwhile to take advantage of tax amnesty programs ? Leonard and Zeckhauser (1987) discuss that the argument in favor of tax amnesty programs is some people gain and no one sacrifices if a tax amnesty is provided. Yet, Olivella (1996) suggest that although governments offer tax amnesty programs, tax evaders may not participate in such programs. As Olivella (1996) noted, tax evaders join tax amnesty programs and honestly pay the taxes that were evaded, they risk incurring stringent inspections by tax authorities on their previous annual incomes because of the increase in reported income; this can hamper future intentions to evade paying taxes. Also, Almet al.(1990) argue that the expectation of an amnesty significantly reduced compliance, however, these negative impacts on compliance can be offset by greater post-amnesty enforcement efforts.

Other work, Cyert and DeGroot (1987) argue that tax evaders are not well aware of the disutility from tax evasion when they file their tax returns but learn about it well through experience. If they later learn that they would like to be more honest than they have been, an amnesty gives them an opportunity to repay the evaded tax amounts. Besides, Luitel and Tosun's paper (2013) regard joining tax amnesty programs as a Pareto improvement, because it benefits tax evaders without damaging other parties; however, implementing these programs may decrease tax compliance rates among honest taxpayers, violating horizontal equity.

In practice, if tax evaders fail to honestly repay the taxes they evaded after joining tax amnesty programs, when the unreported proportion is subsequently discovered by tax authorities, they must pay penalties equivalent to those paid by the tax evaders who did not join the program when found guilty of tax evasion. Unfortunately, existing theories of tax

amnesties have neglected the influence of this condition on expected utility and the income and risk behavior of tax evaders. To fill this gap in the economics literature, this paper considers the influence of tax averters' partial or complete participation in tax amnesty programs (where secondary tax evasion potentially occurs) on their income, expected utility, risk appetite, and choice behaviors. Furthermore, the impact of perceived tax revenue with tax amnesty was also analyzed.

The structure of this study is as follows: Section 1 presents the introduction; Section 2 discusses the conditions that must be fulfilled for government tax amnesty plans to succeed; Section 3 investigates tax evaders' partial or full participation in tax amnesty plans, tax evaders who participate in the tax amnesty plan but repeat tax evasion, the effect of participating or not participating in the tax amnesty plan on expected utility and risk-related decisions; and under the prevalence of tax amnesty, investigating the implications for tax amnesty compliance of increased taxpayer income; Section 4 explores the influence of the government's implementation of the tax amnesty plan on tax revenue during the initial and final assessment periods; and Section 5 offers the conclusion.

2. The analytical framework

Based on the general settings used in traditional studies, assume that tax evaders and tax authorities exist in societies. Consider the following simple economy. All the individuals in the economy earn the same income, and are risk neutral, and have the same utility function. In utility models, non-expected utility theories such as the subjectively weighted utility, the Allais paradox, the prospect theory, and the rank-dependent expected utility theory have been used to explain that people's decision-making behavior is irrational, contrary to the expected utility hypothesis. In addition, using subjective weights or subjectively weighted utilities to analyze the decision-making behavior of people typically causes the sum of the subjective weights of tax evaders to be greater than 1, which contradicts the economic and rational behavior proposed in the expected utility hypothesis.¹ Therefore, this study used the von Neumann-Morgenstern axioms to analyze the occurrence probability of each type of situation to satisfy the hypothesis that economic activities performed collectively by a society are equalized.

Suppose a tax evader makes decisions by envisioning the consequences of his actions and then choosing an action that maximizes his/her expected utility. Regardless of whether tax evasion activities are caught, let a tax evader whose fixed real income, y , is given. Reported income is taxed at the marginal tax rate m . $F(s)$ be the function of the hidden cost of each dollar evaded, and s be the ratio of the hidden cost of each dollar evaded to the evaded one

¹ Take, for example, prospect theory replaces the probability of the risky occurrence with a "weighting function" that underweights high probabilities and overweights low ones. Therefore, prospect theory has failed so far to attract the attention of economists as a valuable tool of analyzing tax amnesties, an exception being Alm and Beck (1990).

dollar. The hidden cost of each dollar evaded is expressed as $C(s) = s \times \int dF(s)$, where

$F'_s(s) = f_s(s)$, $s \in [0,1]$, $C(0) = C'(0) = 0$, $C'(s) > 0$, $C''(s) > 0$, and $y^\sigma > 0$ denotes the fixed real income of a tax evader while σ is coefficient governing the relationship between changes in income and changes in tax payments. A tax evader faces two conditions: p , the probability of being caught evading taxes; and $(1-p)$,² the probability of successful escape, assume p is independent of reported income. Let v be the proportion of unreported income to fixed real income. In this case, suppose that τ is the penalty rate that must be paid to the government for each dollar evaded by a tax evader who does not join a tax amnesty program and is found guilty of tax evasion,³ where $\tau(m) > m$. Also, in line with Torgler and Schaltegger (2005), a second or third tax amnesty does not improve tax compliance. Hence, assume that tax amnesty can only be used once. It is also assumed that, if audited, all of the unreported income of a tax evader will be discovered. If a tax evader joins a tax amnesty program after evading taxes, the amnesty penalty rate of each dollar evaded is χ , $\forall \chi < \tau$.

For a tax evader, the disutility of evading tax is increasing in the fraction of honest taxpayers, where $h \in [0,1]$ denotes the fraction of honest taxpayers in society. The coefficient A measures the degree of disutility that a cheater feels when $100h$ percent of taxpayers report income honestly, where $A \in [0,1]$. In case of evasion, now let the expected rate of return on a dollar of evaded tax $E(r) = (1-p-\tau \times p) \times m$ be strictly positive (or, $(1-p)/p > \tau$). Under this assumption, the government may eliminate evading tax simply by choosing p and τ so that $E(r) \leq 0$. However, Should the government employ p and τ , if it can influence this parameter? This paper accords with the world of experience and adopts Andreoni's (1991) suggestions that it may be rather costly for government to do so. The cost benefit principle reveals that eq. (1) represents the premise that a tax amnesty program is not joined following tax evasion:

$$(1-p) \times (1-m \times (1-v) + m \times v \times r - A \times h) + p \times (1-m+v \times m - \tau \times m \times v) > 1 + m \times v \times s \times \int dF(s), \forall s, \forall 0 \leq v \leq 1 \quad (1)$$

Further, this paper denotes that, when risks are unidentified, tax evaders encounter two choices after evading taxes: (i) participating in tax amnesty programs and paying penalties, or (ii) not joining such program, but risking the probability of being caught versus successful escape.

Let χ be the penalty rate of each dollar evaded by the representative tax evader who joins a tax amnesty program before being caught evading taxes in previous years, and $m < 1 < \chi < \tau$. Let κ be the proportion of back duty payments to actual unreported taxes of a tax evader

² $\tau \times p < 1$, denoting that corner solutions are eliminated, and only interior solutions are considered in this model.

³ Because part of the unreported incomes may be legally exempt incomes, the method of Yitzhaki (1974) was adopted, basing penalties on evaded taxes, rather than basing penalties on evaded incomes as suggested by Allingham-Sandmo (A-S) model (1972).

after joining that tax amnesty program, and $\kappa \in [0,1]$. The value of this proportion is only known to the tax evader who voluntarily repays his/her delinquent taxes. Hence, if a tax evader joins a tax amnesty program, the total amount of evaded taxes due can be expressed as $\kappa \times y \times m \times v \times \chi$. This paper stands in contrast with some existing literature. Assume that a tax evader in an amnesty program does not honestly repay the evaded taxes. When the unreported proportion $1 - \kappa$ is subsequently discovered by tax authorities, the additional amount of penalties due can be expressed as $(1 - \kappa) \times y \times m \times v \times \tau$.

Given the definition, an effective tax amnesty strategy provided by the government is given by :

Proposition 1. The premise for establishing an effective tax amnesty program is

$$\frac{\varpi^\circ}{q_t} < \theta^* \dots$$

Proof: See Appendix 1 for details. □

3. Analysis of the secondary tax evasion under tax amnesty

Let ε be the ex ante probability of a tax evader who joins a tax amnesty program after evading taxes, and $1 - \varepsilon$ be the probability of not joining such program, where

$$\varepsilon(y^\sigma \times v) = \int_{\Omega(y^\sigma \times v)} f(\lambda) d\lambda, \quad \varepsilon \in [0,1].$$

Assume that real income is subject to some

stochastic shock, λ , the shock is supposed to be a stochastic variable with probability distribution function $f(\lambda)$, $\lambda \in (-\infty, \infty)$. To see this, this paper quotes the definition made by Andreoni (1991) to resolve this exogenous variable, ε . Consider a tax evader initially underreports $y^\sigma \times v$, assume that he/she knows $f(\lambda)$ but not realize λ . After experiencing λ a tax evader is given an opportunity for the amnesty program. Let

$$\Phi(y^\sigma \times v; \lambda; s) = U(y^e) - U(y^c) - y^\sigma \times m \times v \times s \times \int dF(s)$$

be the ex post net utility gain

from participating a tax amnesty. Then a tax evader will take the tax amnesty if and only if $\Phi \geq 0$. In spite of λ is exogenous, a tax evader has some control over Φ through his/her picking of $y^\sigma \times v$. Therefore, define the set function $\Omega(y^\sigma \times v) = \{\lambda : \Phi(y^\sigma \times v; \lambda; s) \geq 0\}$. Given $U(\bullet)$ is a von Neumann-Morgenstern cardinal utility function (1944), then if

$\lambda \in \Omega(y^\sigma \times v)$, a tax evader will take the amnesty. In this scenario, According to Proposition

1, when $\frac{\varpi^\circ}{q_t} < \theta^*$, that is, $\theta^A \leq \theta_{t-1} = \theta^*$, $\kappa \notin [-\infty, \theta^A]$, $\forall \varepsilon$, $0 < \varepsilon \leq 1$, then a tax averter

joins a tax amnesty program.

Thus, as defined by this paper, a tax evader with a differentiable von Neumann-Morgenstern cardinal utility function will make a choice after evading taxes: (1) participating in tax amnesty programs and paying penalties, or (2) not joining such program, but risking the probability of being caught versus successful escape, then, the expected utility

177 of a tax evader can be expressed as :

$$178 \quad \hat{E}u(y^\sigma) \equiv (1-\varepsilon) \times U(y^c) + \varepsilon \times U(y^e) - y^\sigma \times m \times v \times s \times \int dF(s), \quad \forall \varepsilon. \quad (2)$$

179 Assume that in Eq. (2),

$$180 \quad y^c = (1-p) \times (1-m \times (1-v) + v \times m \times r - A \times h) \times y^\sigma + p \times (1-m + v \times m - \tau \times m \times v) \times y^\sigma, \quad \text{and}$$

$$181 \quad y^e = y^\sigma \times [1 - \chi \times m \times v \times \kappa - m \times v \times \tau \times (1-\kappa)], \quad \text{where } y^c \text{ is the expected revenue for a tax}$$

182 evader not joining tax amnesty programs, and y^e the expected revenue for a tax evader

183 joining such programs. Therefore, the joint probability density function can be expressed as

$$184 \quad f_{y^e}(y^e) = \frac{d}{dy^e} \int_0^\infty \left\{ \int_0^1 f_{y^e, \varepsilon}(y^e, \varepsilon') d\varepsilon' \right\} dy^e = \int_0^1 f_{y^e, \varepsilon}(y^e, \varepsilon') d\varepsilon', \quad \text{and as a taxpayer decides to}$$

185 evade taxes. As mentioned earlier, let v be the proportion of hidden incomes to actual

186 incomes (i.e., the rate of tax erosion). Then, the Hamiltonian first-order optimal control

187 condition of v for the expected utility of tax evasion implies:

$$188 \quad H = \left[(1-\varepsilon) \times p \times y^\sigma \times m \times (\tau-1) - (1-\varepsilon) \times (1-p) \times m \times (1+r) \times y^\sigma \right] \times U'(y^c) + \quad (3)$$

$$\left[\varepsilon \times y^\sigma \times \chi \times m \times \kappa + \varepsilon \times y^\sigma \times m \times \tau \times (1-\kappa) \right] \times U'(y^e) + y^\sigma \times m \times s \times \int dF(s) = 0,$$

$$189 \quad \text{The requirement for internal solution is } \tau < \frac{(1-p) \times (1+r) + p}{p}, \quad \forall \varepsilon.$$

190 Eq. (4) indicates that the second order condition of v for the expected utility is $H_v < 0$, or,

191 $\partial^2 H / \partial v^2 < 0$. This reveals that the function of the utility of tax evasion is strictly concave,

192 $U''(\cdot) < 0$, and therefore, the **representative** tax evader is a risk averter.⁴

$$193 \quad H_v = (1-\varepsilon) \times \left[p \times y^\sigma \times m \times (\tau-1) - (1-p) \times m \times (1+r) \times y^\sigma \right]^2 \times U''(y^c) + \varepsilon \times \quad (4)$$

$$\left[y^\sigma \times \chi \times m \times \kappa + y^\sigma \times m \times \tau \times (1-\kappa) \right]^2 \times U''(y^e),$$

194 As mentioned earlier, κ be the proportion of back duty payments to actual unreported

195 taxes of a tax evader after joining that tax amnesty program. Using Eq. (3), it is simple to show

196 that the influence of κ on the second **order** condition H_κ for the expected utility of tax

197 evasion is :

$$198 \quad H_\kappa = \varepsilon \times y^\sigma \times m \times (\chi - \tau) \times U'(y^e) + \left[\varepsilon \times y^\sigma \times \chi \times m \times \kappa + \varepsilon \times y^\sigma \times m \times \tau \times (1-\kappa) \right] \times m \times v \times y^\sigma \times (\tau - \chi) \times U''(y^e) \quad (5)$$

199 Eq.(5) clearly demonstrates that the function of κ (i.e., the proportion of back duty

200 payments) to the second order condition for the expected utility of tax evasion is strictly

201 concave (i.e., $H_\kappa < 0$). A similar result is available for κ from Eq.(5), that even the

⁴ The second order condition for the expected utility of tax aversion, $H_v < 0$ and $H_\kappa < 0$, indicates that for either the initial or secondary tax evasion after joining a tax amnesty program, large amounts of hidden income increase the risk aversion of a tax evader.

representative tax evader who participates in a tax amnesty program, may not honestly report the whole amounts of evaded tax, thus committing a secondary tax evasion; nevertheless, the tax evader is strictly risk averse.

Proposition 2. In the circumstances of partial or complete participation in an tax amnesty program, when the penalty rate is based on the evaded taxes, the second order condition of the hidden-to-actual income proportion, ν , for the expected utility of tax evasion is $H_\nu < 0$, or, $\frac{\partial^2 H}{\partial \nu \times \partial \nu} < 0$, and the second order condition of the proportion tax duty payments to actual reported taxes for the expected utility of tax evasion is $H_\kappa < 0$, or, $\frac{\partial^2 H}{\partial \nu \times \partial \kappa} < 0$, confirming the assumption that Hamiltonian is a strictly concave function for both ν and κ , and that tax evaders are risk averters.

Moreover, this paper turns to a central question thus presented concerns the choice to be made between participating in tax amnesty programs after evading taxes or abstaining from tax amnesty program and incurring possible uncertainty of tax evasion penalties. To analyze this question, this section derives the preference implications of the sign of U'' and U''' by providing a practical theorem for experimental investigations about the influence of tax amnesty on the risk of decision-making for tax evaders.

Let the original properties of a tax averter be B , where $B \geq 0$, and the definitions of y^c and y^e be identical to those in Eq. (2). Consider people who participated in tax amnesty programs after the government proposed an amnesty may not honestly report the whole amounts of evaded tax, thus committing a secondary tax evasion, the expected utility function is

$$(1 - \varepsilon) \times U(B + y^c) + \varepsilon \times U(B + y^e) - y^\sigma \times m \times \nu \times s \times \int dF(s), \quad (6)$$

Clearly, the indifference curve of tax evasion in the bidimensional space of the probability of $y^c - y^e$; thus, it can be expressed as:

$$(1 - \varepsilon) \times U(B + y^c) + \varepsilon \times U(B + y^e) - y^\sigma \times m \times \nu \times s \times \int dF(s) \equiv U(W), \quad (7)$$

Based on the implicit function theorem, define the relationship of y^c and y^e as $y^e(y^c)$, in which Eq. (7) passes through (0, 0). A total differentiation of both sides of Eq. (7) generates the following:

$$(1 - \varepsilon) \times U'(B + y^c) + \varepsilon \times U'(B + y^e) \times y^{e'}(y^c) = 0, \quad (8)$$

Differentiating Eq. (8) generates the following:

$$(1 - \varepsilon) \times U''(B + y^c) + \varepsilon \times \left[U''(B + y^e) \times \{y^{e'}(y^c)\}^2 + U'(B + y^e) \times y^{e''}(y^c) \right] = 0, \quad (9)$$

234 Substituting $y^c = y^e = 0$ into Eq. (8) generates $y^{e'}(0) = -(1-\varepsilon)/\varepsilon$. Substituting $y^c = y^e = 0$
 235 into Eq. (9) generates

$$236 \quad (1-\varepsilon) \times U''(B) + \varepsilon \times \left\{ U''(B) \times \frac{(1-\varepsilon)^2}{\varepsilon^2} + U'(B) \times y^{e''}(0) \right\} = 0,$$

237

which can be rearranged to form the following proposition:

$$238 \quad y^{e''}(0) = \frac{(1-\varepsilon)}{\varepsilon^2} \times \left[\frac{-d \ln U'(B)}{dB} \right], \quad (10)$$

239 **Proposition 3.** If a tax evader's cardinal utility function is $U''(B) < 0$, then $y^{e''}(0) > 0$,
 240 The definition of Eq. (10) indicates that a greater Arrow-Pratt index of absolute risk
 241 aversion generates a greater curvature of the indifference curve near (0, 0) in the
 242 bidimensional space of y^c / y^e . Therefore, let π_w be the risk premium. If "tax amnesty"
 243 is normal good, and $\pi_w(y^e) \geq \pi_w(y^c)$, then the corresponding gamble set size of
 244 joining tax amnesty programs, $\pi_w(y^e)$, is smaller than that of not joining such programs.

245 Under such conditions, joining tax amnesty programs is more profitable than not joining
 246 such tax amnesty programs. Fig.1 illustrates the representative tax evader's response to the
 247 tax amnesty program, after considering the representative tax evader who participates in a tax
 248 amnesty program, may not honestly report the whole amounts of evaded tax, thus committing
 249 a secondary tax evasion. Moreover, this is a theoretical result which appears to be relatively
 250 robust; participating in tax amnesty programs yields relatively high levels of utility, and is
 251 advantageous to tax averters.

252 In addition, based on Eqs. (7) and (10), define $U'''(B)$ is continuous on $[B, W]$ with
 253 $0 \leq B < W$, and π_w , as defined above, denotes the risk premium. Intuitively, it implies that :

$$254 \quad U'''(W) > U'''(B) \quad \forall W, \quad \forall B \quad (11)$$

255 As mentioned previously, letting y^e and y^c be two risk prospects on tax amnesty
 256 programs, which satisfies the method of moment(MOM), expresses expected utility and also
 257 satisfies $E(y^e)^k = E(y^c)^k$ for all k except $k = 3$. The condition here is

$$258 \quad \begin{aligned} & EU(B + \pi_w(y^e)) - EU(B + \pi_w(y^c)) \\ &= \frac{1}{6} \times \left\{ E[\pi_w(y^e) - \pi_w((1-\varepsilon) \times y^c - \varepsilon \times y^e)]^3 - E[\pi_w(y^c) - \pi_w((1-\varepsilon) \times y^c - \varepsilon \times y^e)]^3 \right\} \times \\ & \quad U'''(B + \pi_w((1-\varepsilon) \times y^c + \varepsilon \times y^e)) \end{aligned} \quad (12)$$

259 As is clear from Eq. (12), an important implication of Eq. (12) implies that the sign of U'''

determines preference between y^e and y^c .⁵

Thus, if an amnesty is offered, the relationship between W and π is given by :

$$\frac{d\pi_w}{dW} = \frac{U'(y^e) - U'(y^c)}{U'(y^e)} < 0 \quad \forall y^e, \quad \forall y^c \quad (13)$$

An insight into the likely effect on the sign of Eq. (13). It is known from Eq. (13) which implies that, under the prevalence of tax amnesty, the greater the income, the lower the tax compliance.

In this case, the representative tax evader reveals decreasing absolute risk aversion (DARA). Thus, an increase in income leads to an decrease in tax compliance. This expression, is seeking to supplement, but not supplant, the Arrow (1970) theory of risk aversion.

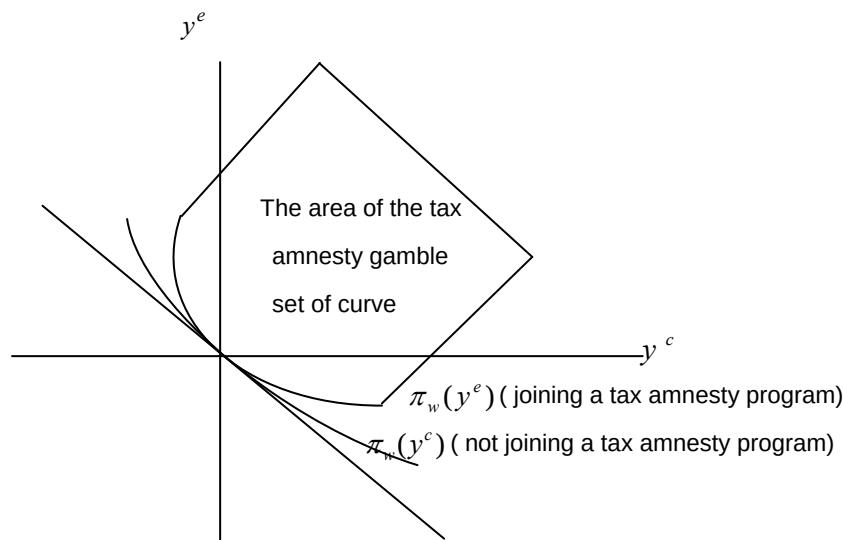


Figure 1. The gamble set of joining or not joining tax amnesty programs

4. Effect of government implementation of tax amnesty on tax revenue

Finally, the analysis could be extended to examine the effect of tax amnesty on tax revenue. Stella (1991) indicated that receipt of additional tax revenue is typically unlikely to occur in the short-run. But tax amnesty plans may reduce the willingness of taxpayers to voluntarily file taxes; such plans may result in the long-term erosion of a country's tax base. However, contrary to Stella's assertion, this study determined that this statement may not be true in practice. According to actual analyses of the various state-level tax amnesty plans recently implemented in the United States, almost all of the states experienced a short-term increase in fiscal revenue because tax evaders paid overdue taxes or negotiated fines. For example, the state government of Connecticut experienced an increase in tax revenue of approximately US\$175–180 million after the tax amnesty plan was implemented in 2013. Other examples of increases in tax revenue after the implementation of tax amnesty plans are listed as follows by

⁵ Suppose the government plans to offer an amnesty, it can be shown from Eq. (12) that $U''' > 0$ denotes "tax amnesty" is a normal good.

state, year, and amount of tax revenue: New Jersey, 2009, US\$661 million; Louisiana, 2009, US\$439 million; Nebraska, 2013, US\$8.98 million; Florida, 2010, US\$160 million (this tax amnesty plan lasted 90 d); and California, 2005, US\$683 million.⁶ These results differed from the argument proposed by Stella (1991). In other words, based on the tax amnesty plan situations experienced by the various U.S. states, tax amnesty should exhibit a positive effect on tax revenue for governments.

4.1. The expected tax revenue without implementing the tax amnesty

To examine the effect of tax amnesty on tax revenue, Andreoni (1991) argued that tax revenue increase as a result of tax amnesty plans is influenced by the amount of taxes evaded by tax evaders before their participation in the tax amnesty plans. However, Andreoni ignored the effect of assessment period on tax amnesty and tax revenue. Therefore, in this section, the general settings employed by previous literature were used and to examine the influence of tax amnesty plans and assessment period on tax revenue. Suppose that the assessment period in which the government implemented a tax amnesty plan was defined as J ; R^e , which was an exogenous variable, signified the estimated total tax revenue during the assessment period after implementation of a tax amnesty plan; the estimated total tax revenue without implementing the tax amnesty plan was defined as S^e ; $0 < t < T$ marked the period in which the tax amnesty plan was implemented; T was the last day of the assessment period; and λ and μ were the indicator variables of the indicator function that displayed the relationship between time and tax revenue. The expected tax revenue without implementing the tax amnesty plan S^e changed as time t changed. The exponential function to define this relationship is as follows:

$$S^e(t) = e^{-\lambda t + \mu} \quad (14)$$

Eq. (14) shows the changes in the relationship between time and tax revenue for the various assessment periods when no tax amnesty plan was implemented by the government.

Eq. (15) was the differential equation for the tax revenue collected.

$$\frac{dS^e}{dt} = -\lambda \times S^e \quad (15)$$

Eq. (15) shows that tax revenue received by the government gradually declines as the assessment period reaches the final period in the absence of any tax amnesty scheme.

4.2. Short-term Effect of Government Implementation of Tax Amnesty on Tax Revenue

Assuming that a certain percentage of tax evaders, γ , would participate in the tax amnesty plan during the assessment period, the changes in tax revenue over time would be directly proportional to Eq. (16)

⁶Information obtained from the following website:
<http://www.governing.com/columns/assessments/gov-tax-now-pay-later.html>

$$327 \quad \gamma \times J \times \frac{R^e - S^e}{R^e} \quad (16)$$

328 This study demonstrated that during the initial assessment period of the tax amnesty plan,
 329 tax revenue drastically increased. However, as the assessment period gradually approached
 330 the final day of the assessment period, tax revenue stably declined and ultimately converged
 331 on a fixed value. Proposition 4 was thus formulated:

332

333 **Proposition 4: During the initial period in which the government implements a tax**
 334 **amnesty plan, tax revenue drastically increases; however, as the assessment period**
 335 **ends, the probability that tax payers are exempt from fines and successfully evade**
 336 **taxes increases. Therefore, tax revenue received by the government gradually declines**
 337 **as the assessment period reaches the final period, and tax revenue converges on a**
 338 **fixed value.**

339 **Proof: See Appendix 2 for details. □**

340 As mentioned above, with the number of vacancies on current empirical literatures
 341 discussing a tax evader who participates in a tax amnesty program, a tax evader may not
 342 honestly report the whole amounts of evaded tax, thus committing a secondary tax evasion.
 343 This paper takes a different approach to set up theoretical models and capture these effects.
 344 Our finding is in line with some tax amnesty plans recently implemented in the United States,
 345 which reveals that all the states' first amnesty plan brings an immediate revenue boost.
 346 Furthermore, as it can be seen from the empirical finding in Luitel et al. (2007), tax amnesty
 347 has a declining marginal benefit to the state, which is also in line with the models we employ.
 348 Hence, we see these empirical evidences reinforce the results obtained in our mathematical
 349 solutions.

350 In this section, we summarize that a tax amnesty program brings immediate and short-run
 351 impact, but we also have doubts about the long-run revenue impact of a tax amnesty. As
 352 mentioned above, we show that by breaking horizontal equity, tax amnesties might be
 353 perceived as unfair, but governors perceive tax amnesties as another short-run revenue
 354 source rather than a tax increase alternative.

355

356 5. Conclusions

357 Theories proposed in previous literature may not have been based on practical economic
 358 and social situations. In this study, the possibility that tax evaders engaged in repeated tax
 359 evasion after participating in the tax amnesty plan was included as part of the model to avoid
 360 over simplification of the model assumption. This article contributes to the literature on tax
 361 amnesties in the following six aspects. First, the influence of erosion rate of tax base due to tax
 362 evader's option to tax amnesty plan on the second order condition of the subjective expected
 363 utility of tax evaders is characterized by a strictly concave function. Second, the influence of
 364 the proportion of back duty payments (recovered from tax evaders who voluntarily paid the
 365 negotiated fines and overdue taxes not discovered during previous periods) on the

second-order condition of the subjectively expected utility of tax evaders exhibited strictly concave function. Third, by incorporating the amount of money originally possessed by tax evaders, this study demonstrated that compared with tax evaders who did not participate in the tax amnesty plan, those who participated exhibited higher differentiable von Neumann-Morgenstern cardinal utility function. In other words, it shows that, provided there are no changes in penalty rate, and thus the probability of being caught evading taxes, even if tax evaders who participated in tax amnesty programs may not honestly report the whole amounts of evaded tax, thus committing a secondary tax evasion. Nonetheless, this result unambiguously reveals the tax evaders participated in tax amnesty programs yield relatively high levels of von Neumann-Morgenstern cardinal utility, and it is always beneficial to tax evaders. Fourth, the results of this study support the puzzle of compliance philosophy proposed by Diego and Luca (2011), demonstrating the reason that tax evaders are willing to participate in tax amnesty plans despite the probability of the exogenous variables “penalty rate” and “probability of tax evasion activities being discovered” being low. Fifth, tax evaders’ willingness to actively participate in tax amnesty plans after tax evasion decreases as their income or wealth increases, indicating that the tax evaders’ utility function features decreased absolute risk aversion (a robust assumption) and that risk assets subject to tax amnesty were normal goods (i.e., the elasticity obtained from the absolute risk aversion function was greater than the robust assumption of zero). Sixth, during the initial assessment period of the tax amnesty plan, tax revenue drastically increased. However, because tax payers are exempt from fines and not required to pay overdue taxes when the assessment period ends, tax revenue stably declined and ultimately converged on a fixed value. This result may stand in contrast with some existing literature as mentioned previously, but accords well with the world of experience which reflects the observation that many tax evaders are willing to pay taxes even when expected penalties and the probability of being caught evading taxes are extremely low. Note that, this paper, seeks to supplement, but not supplant, the traditional considerations of tax amnesty theories.

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Appendix 1.

In Proposition 1, consider risk-neutral agent and the objective of a tax evader who has not been found guilty of tax evasion prior to the current period is to pursue the minimal individual cost of joining a tax amnesty program. Let q_t be the probability of being caught evading taxes in period t ; the cost of a tax evader can be expressed as

$$\Delta C = \min_{\kappa \in [0,1]} [m \times \chi \times \kappa + q_t \times \theta \times (1 - \kappa) \times m \times \tau] \times y \times v \quad (\text{A.1.1})$$

where θ denotes the probability of being caught hiding incomes through any type of government inspection. Adopt κ , the proportion of back duty payments of a tax evader who joins a tax amnesty program, to determine the first-order optimal control condition of the aforementioned equation: $\theta^A = \frac{\chi}{\tau \times q_t}$; the optimal strategy for a tax evader regarding joining a tax amnesty program can be expressed as ⁷

$$\kappa^* = \begin{cases} 0 & \text{if } \theta < \theta^A \\ [0, 1] & \text{if } \theta = \theta^A \\ 1 & \text{if } \theta > \theta^A \end{cases} \quad (\text{A.1.2})$$

This deduction proves that only evader who meet the condition of $\theta^A < \theta$ choose to join a tax amnesty program. A tax evader in the condition of $\theta^A > \theta_{t-1} = \theta^*$, $\theta \in [0, \theta^A]$ does not join such program. The number of tax evaders who have not been caught committing tax evasion before the current period (t) can be expressed using the probability density function

$$(1 - q^*) \times \hat{\theta}. \text{ Thus, } (1 - q^*) \times \hat{\theta} = \min \left\{ \theta^*; \frac{\varpi^\circ}{q_t} \right\}, \text{ where } \varpi^\circ = \frac{\chi}{\tau} \text{ and } \varpi^\circ \text{ denotes the}$$

ratio of χ (the amnesty penalty rate of each dollar evaded) to τ (the penalty rate, which is greater than the marginal tax rate m) that must be paid by a tax evader who did not join a tax amnesty program and is subsequently discovered by tax authorities. Therefore, the premise for an amnesty program to be effective is $\frac{\varpi^\circ}{q_t} < \theta^*$.

⁷ If tax penalties are based on the evaded incomes of a tax averter, then

$$\Delta C = \min_{\kappa \in [0,1]} [\beta \times \sigma + q_t \times \theta \times (1 - \sigma) \times \tau] \times y \times v, \quad \theta^A = \frac{\chi}{\tau \times q_t}$$

466 **Appendix 2.**

467 Based on (15) and (16), the differential equation was expressed as (A.2.1):

$$468 \quad \frac{dS^e}{dt} = -\lambda \times S^e + \gamma \times J \times \frac{R^e - S^e}{R^e} \quad (\text{A.2.1})$$

469 Further computations produced a nonhomogeneous equation:

$$470 \quad \frac{dS^e}{dt} = -\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times S^e + J \times \gamma \quad (\text{A.2.2})$$

471 The homogeneous equation corresponding to the nonhomogeneous equation, (A.2.2), is as
472 follows:

$$473 \quad \frac{dS^e}{dt} = -\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times S^e \quad (\text{A.2.3})$$

474 Using the separation of variables method, the following equation was obtained:

$$475 \quad \int \frac{dS^e}{S^e} = -\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times \int dt \quad (\text{A.2.4})$$

476 By using the integrals from both sides of the equation, the following equation was formulated:

$$477 \quad \ln |S^e| = -\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times t + C$$

478 Solving this equation produced the result $S^e = \pm e^{-\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times t + C}$

479 By setting the constant $C = \pm e^C$ and substituting this constant into the aforementioned
480 equation, the general solution for the homogeneous equation (A.2.3) was obtained:

$$481 \quad S^e = c \times e^{-\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times t} \quad (\text{A.2.5})$$

482 The general solution (A.2.5.) of the homogeneous equation was modified and the constant C
483 was changed to the constant for time $c(t)$ to satisfy the nonhomogeneous equation (A.2.2.)
484 and obtain the hypothetical solution for the nonhomogeneous equation:

$$485 \quad S^e(t) = c(t) \times e^{-\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times t} \quad (\text{A.2.6})$$

486 Because the solution of (A.2.6) must satisfy the differential equation (A.2.2), the
487 aforementioned equation was substituted into the equation and the derivative was calculated
488 to produce the following equation:

$$\begin{aligned}
& \frac{dc(t)}{dt} \times e^{-\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times t} + c(t) \times \left[-\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times e^{-\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times t} \right] \\
& = -\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times c(t) \times e^{-\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times t} + \gamma \times J
\end{aligned} \tag{A.2.7}$$

The following equation was derived by rearranging the equations:

$$\frac{dc(t)}{dt} = \gamma \times J \times e^{-\left(\lambda + \gamma \times \frac{J}{R^e}\right) \times t}$$

By setting $\beta = \lambda + \gamma \times \frac{J}{R^e}$ and calculating the integral, the following equation was obtained:

$$c(t) = \gamma \times J \times \int e^{\beta t} dt = \gamma \times J \times \frac{e^{\beta t}}{\beta} + c' \tag{A.2.8}$$

Therefore, the general solution for the nonhomogeneous equation was expressed as follows:

$$S^e(t) = \left(\gamma \times J \times \frac{e^{\beta t}}{\beta} + c' \right) \times e^{-\beta t} = \frac{\gamma \times J}{\beta} + c' \times e^{-\beta t} \tag{A.2.9}$$

The initial value of the actual tax revenue was set as $S(0) = S_0$ and substituted into (A.2.9)

to produce the following result:

$$S(0) = S_0 = \frac{\gamma \times J}{\beta} + c' \times e^{-\beta \times 0}$$

$$\therefore c' = S_0 - \frac{\gamma \times J}{\beta}$$

Therefore, the expected cumulative tax revenue for assessment period $0 < t < T$ was as

follows:

$$S^e(t) = \frac{\gamma \times J}{\beta} + \left(S_0 - \frac{\gamma \times J}{\beta} \right) \times e^{-\beta t} \tag{A.2.10}$$

(A.2.10) indicates that during the initial assessment period of the tax amnesty plan, tax

revenue drastically increases. However, as the final day of the assessment period approaches,

tax revenue will stably decline and ultimately converge on a fixed value.