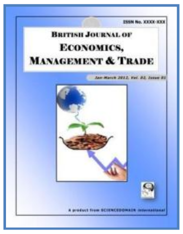

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Is Tax Amnesty Good for the Tax Evader?

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Authors' contributions

This work was carried out in collaboration between both authors. Author YKW initiated the study, wrote the preliminary draft and modeling specification of the manuscript. Author WJH helped in analyzing the model, technical writing and editing of the manuscript, and clarifying the responses to the reviewers' comments. Both authors read and approved the final manuscript.

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ABSTRACT

Whether or not tax evaders join tax amnesty programs, an important indicator is the influence of tax amnesty programs on compliance. To study this question, the paper sheds light on a relatively neglected but important area of prevailing tax amnesty literature in the economic analysis of tax evaders' secondary tax evasion. Considering that people who participate in tax amnesty programs may not honestly report the whole amounts of evaded taxes, it leads to 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 the secondary tax evasion is accompanied by tax amnesty, thereby it suggests that during the initial assessment period of the tax amnesty plan, tax revenue drastically increases, and then when the assessment period ends, tax revenue stably declines and ultimately converges on a fixed magnitude.

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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 [1]. 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. Also, in 2012, 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 the state [2]. 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 [3]. However, it is worthy of note that many amnesty programs which developing countries have been employed often repeat incessantly, including Chile, Colombia, India, and Mexico [1,5].

In an important early study, [4] 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 [4]. [5] suggest that, in general, if one country declares an amnesty program at first, it brings the government temporary revenue augments during the amnesty period but then brings about a reduction in tax revenue in the long run. [6] find that amnesties had no effect on tax revenue in either the short or the long term. Yet, [7] suggest that tax amnesties raise higher tax revenues for the US state treasury in the short term. Also, [8] suggest that amnesty seems to generate immediate revenue efficiently.

In the interest of tax evaders, how can existing literature explain why tax evaders may find it worthwhile to take advantage of tax amnesty programs？[9] discuss that the argument for tax amnesty programs is some people obtain and no one sacrifices if a tax amnesty is provided. Yet, [10] suggests that although governments offer tax amnesty programs, tax evaders may not participate in such programs. As [10] notes, 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 tax evasion. Also, [11] 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, [12] 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, [13] 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 is 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 the implications for tax amnesty compliance of increased taxpayer income under the prevalence of tax amnesty; 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 uses the von Neumann-Morgenstern axioms [14] 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, a tax evader whose fixed real income, y , is given. Reported income is taxed at the marginal tax rate *m*. Let $\mathrm{F}(s)$ be the function of the concealment (hidden) cost of each dollar evaded, and s be the ratio of the hidden cost of each dollar evaded to the evaded one dollar. The concealment or hidden cost of each dollar evaded is expressed as $C(s)=s\times\int \mathrm{d}F(s)$, 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, assuming p is independent of reported income. Let υ 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 [15], a second or third tax amnesty does not improve tax compliance. Hence, assume that tax amnesty can be used only once. It is also assumed that, if audited, all of a tax evader's the unreported income 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 100*h* 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 $E(r)\le 0$.

[1] *For example, prospect theory replaces the probability of the risky occurrence with a "weighting function" that under weights high probabilities and over weights 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 [11].*

[2] $\tau\times p<1$ *indicates 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 [16] was adopted, basing penalties on evaded taxes, rather than basing penalties on evaded incomes as suggested by Allingham-Sandmo (A–S) model [17].*

However, Should the government employ p and τ, if it can influence this parameter ? This paper accords with the world of experience and adopts [18] 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:

$$(1-p)\times(1-m\times(1-\upsilon)+m\times\upsilon\times r-A\times h)+p\times(1-m+\upsilon\times m-\tau\times m\times\upsilon)>1+m\times\upsilon\times s\times\int dF(s)\ ,\ \forall s,\ \forall 0\leq\upsilon\leq 1 \tag{1}$$

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 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 repay 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 $\kappa\times y\times m\times\upsilon\times\chi$. 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 $(1-\kappa)\times y\times m\times\upsilon\times\tau$.

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

Proof: See Appendix 1 for details. □

An interesting corollary of Proposition 1 corresponds to the conditions that must be fulfilled for government tax amnesty plans to succeed.

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 $\varepsilon(y^{\sigma}\times\upsilon)=\int_{\Omega(y^{\sigma}\times\upsilon)}f(\lambda)\,d\lambda$, $\varepsilon\in$ [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 [18] to resolve this exogenous variable, ε. Consider a tax evader initially underreports $y^{\sigma}\times\upsilon$, assuming that he/she knows $f(\lambda)$ but does not realize λ. After experiencing λ, a tax evader is given an opportunity for the amnesty program. Let $\Phi(y^{\sigma}\times\upsilon;\lambda;s)=U(y^{e})-U(y^{c})-y^{\sigma}\times m\times\upsilon\times s\times\int dF(s)$ 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 $y^{\sigma}\times\upsilon$. Therefore, define the set function $\Omega\,(y^{\sigma}\times\upsilon)=\{\lambda:\Phi(y^{\sigma}\times\upsilon;\lambda;s)\geq 0\}$. Given U(•) is a von Neumann-Morgenstern cardinal utility function [14], then if $\lambda\in\Omega\,(y^{\sigma}\times\upsilon)$, 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 [14] 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 of a tax evader can be expressed as:

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

Assume that in Eq. (2),

$y^{c} = (1-p)\times(1-m\times(1-\upsilon)+\upsilon\times m\times r - A\times h)\times y^{\sigma} + p\times(1-m+\upsilon\times m-\tau\times m\times\upsilon)\times y^{\sigma}$, and $y^{e} = y^{\sigma}\times[1-\chi\times m\times\upsilon\times\kappa - m\times\upsilon\times\tau\times(1-\kappa)]$, where y^{c} is the expected revenue for a tax evader not joining tax amnesty programs, and y^{e} the expected revenue for a tax evader joining such programs. Therefore, the joint probability density function can be expressed as $f_{y^e}(y^e) = \frac{d}{dy^e}\int_0^{\infty}\left\{\int_0^1 f_{y^e,\varepsilon}(y^{e'},\varepsilon')d\varepsilon'\right\}dy^{e'} = \int_0^1 f_{y^e,\varepsilon}(y^e,\varepsilon')d\varepsilon'$, as a taxpayer decides to evade taxes. As mentioned earlier, let υ be the proportion of hidden incomes to actual incomes (i.e., the rate of tax erosion). Then, the Hamiltonian first-order optimal control condition of υ for the expected utility of tax evasion implies:

$$\begin{aligned} H = &\left[(1-\varepsilon)\times p\times y^{\sigma}\times m\times(\tau-1) - (1-\varepsilon)\times(1-p)\times m\times(1+r)\times y^{\sigma}\right]\times U'(y^{c}) + \\ &\left[\varepsilon\times y^{\sigma}\times\chi\times m\times\kappa + \varepsilon\times y^{\sigma}\times m\times\tau\times(1-\kappa)\right]\times U'(y^{e}) + y^{\sigma}\times m\times s\times\int dF(s) = 0, \end{aligned} \tag{3}$$

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

We can offer the following interpretation of Eq. (3), the penalty of each dollar evaded by a tax evader, if he/she is audited, must be lesser than the expected rate of return on a dollar of evaded tax. It is consistent, however, with a view that a tax evader takes advantage of tax amnesty programs because he/she had found that, for a given probability of detection, the cost of cheating was less than the benefit.

Eq. (4) indicates that the second order condition of υ for the expected utility is $H_{\upsilon} < 0$, or, $\partial^2 H/\partial\upsilon^2 < 0$. This reveals that the function of the utility of tax evasion is strictly concave, $U''(\cdot) < 0$, and therefore, the representative tax evader is a risk averter.[4]

$$\begin{aligned} H_{\upsilon} = &(1-\varepsilon)\times\left[p\times y^{\sigma}\times m\times(\tau-1) - (1-p)\times m\times(1+r)\times y^{\sigma}\right]^2\times U''(y^{c}) + \varepsilon\times \\ &\left[y^{\sigma}\times\chi\times m\times\kappa + y^{\sigma}\times m\times\tau\times(1-\kappa)\right]^2\times U''(y^{e}), \end{aligned} \tag{4}$$

As mentioned earlier, κ be the proportion of back duty payments to actual unreported taxes of a tax evader after joining that tax amnesty program. Using Eq. (3), it is simple to show that the influence of κ on the second order condition H_{κ} for the expected utility of tax evasion is:

$$H_{\kappa} = \varepsilon\times y^{\sigma}\times m\times(\chi-\tau)\times U'(y^{e}) + \left[\varepsilon\times y^{\sigma}\times\chi\times m\times\kappa + \varepsilon\times y^{\sigma}\times m\times\tau\times(1-\kappa)\right]\times m\times\upsilon\times y^{\sigma}\times(\tau-\chi)\times U''(y^{e}) \tag{5}$$

[4] *The second order condition for the expected utility of tax aversion, $H_{\upsilon} < 0$ 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.*

Eq. (5) clearly demonstrates that the function of κ (i.e., the proportion of back duty payments) to the second order condition for the expected utility of tax evasion is strictly concave (i.e., $H_{\kappa} < 0$). A similar result is available for κ from Eq. (5), that even the representative tax evader who participates in a tax amnesty program, may not honestly report the whole amounts of evaded tax, and 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,* υ *, for the expected utility of tax evasion is* $H_{\upsilon} < 0$*,or,* $\frac{\partial^2 H}{\partial \upsilon \times \partial \upsilon} < 0$*,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,* $\frac{\partial^2 H}{\partial \upsilon \times \partial \kappa} < 0$*,confirming the assumption that Hamiltonian is a strictly concave function for both* υ *and* κ*, and that tax evaders are risk averters.*

Moreover, this paper turns to a central question concerning the choice to be made between participating in tax amnesty program 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 participate in tax amnesty programs after the government has proposed an amnesty may not honestly report the whole amounts of evaded tax, thus committing a secondary tax evasion, the expected utility function is

$$(1-\varepsilon)\times U(B+y^c)+\varepsilon\times U(B+y^e)-y^{\sigma}\times m\times\upsilon\times s\times\int dF(s), \tag{6}$$

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:

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

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), we can obtain the following Eq. (8):

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

Differentiating Eq. (8) generates the following:

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

Substituting $y^c = y^e = 0$ into Eq. (8) and Eq. (9), respectively, to obtain $y^{e^{'}}(0) = -(1-\varepsilon)/\varepsilon$ and

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

Then, we can rearrange the results to form the following proposition:

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

Proposition 3. *If a tax evader' cardinal utility function is* $U^{''}(B)<0$ *, then* $y^{e^{''}}(0)>0$, *The definition of Eq. (10) indicates that a greater Arrow-Pratt index of absolute risk aversion [19,20] generates a greater curvature of the indifference curve near (0, 0) in the bidimensional space of* y^c/y^e *, Therefore, let* π_w *be the risk premium. If "tax amnesty " is a normal good, and* $\pi_w(y^e)\geq\pi_w(y^c)$ *, then the corresponding gamble set size of joining tax amnesty programs,* $\pi_w(y^e)$ *, is smaller than that of not joining such programs.*

Under such conditions, joining tax amnesty programs is more profitable than not joining such tax amnesty programs. Fig. 1 illustrates the representative tax evader's response to the tax amnesty program, after considering the 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. Moreover, this is a theoretical result which appears to be relatively robust; participating in tax amnesty programs yields relatively high levels of utility, and is advantageous to tax averters.

We see that governments perceive tax amnesties as another short-run revenue source rather than a tax increase alternative, but it does not mean that tax amnesty programs encourage honest taxpayers to convert their income into nontaxable forms.

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

$$U^{'''}(W)>U^{'''}(B)\ \forall W\ ,\ \forall B \tag{11}$$

As mentioned previously, letting y^e and y^c be two risk prospects on tax amnesty programs which satisfy the method of moment (MOM) [21], express expected utility and also satisfy $E(y^e)^k=E(y^c)^k$ for all *k*, except *k* = 3. The condition here is

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

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]

[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.*

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

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

Having an insight into the likely effect on the sign of Eq. (13), it is known that under the prevalence of tax amnesty, the greater the income is, the lower the tax compliance is.

In this case, the representative tax evader reveals decreasing absolute risk aversion (DARA). Thus, an increase in income leads to a decrease in tax compliance. This expression, is seeking to supplement, but not supplant, the Arrow theory of risk aversion [19,20,21].

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. [22] indicates 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 [22] assertion, this study determines 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 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 days); and California, 2005, US$683 million. [6] These results differed from the argument proposed by [22]. 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, [18] 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, [18] ignored the effect of assessment period on tax amnesty and tax revenue. Therefore, in this section, the general settings employed by previous literature are 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:

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

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.

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

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

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)

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

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

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

Proof: See Appendix 2 for details. □

As mentioned above. With the number of vacancies on current empirical literatures discussing a 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. This paper takes a different approach to set up theoretical models and capture these effects. Our finding is in line with some tax amnesty plans recently implemented in the United States which reveal that all the states' first amnesty plan brings an immediate revenue boost. Furthermore, as can be seen in [5], empirical finding, tax amnesty has a declining marginal benefit to the state which is also in line with the models we employ. Hence, we see these empirical evidences reinforce the results obtained in our mathematical solutions.

In this section, we summarize that tax amnesty program brings immediate and short-run impact, but with rather scarce current empirical literatures on the long –term revenue effects of tax amnesty plans implemented in the United States or some countries. We also have doubts about the long-run revenue impact of a tax amnesty. As mentioned above, we show that by breaking horizontal equity, tax amnesties might be perceived as unfair [23], but governors perceive tax amnesties as another short-run revenue source rather than a tax increase alternative.

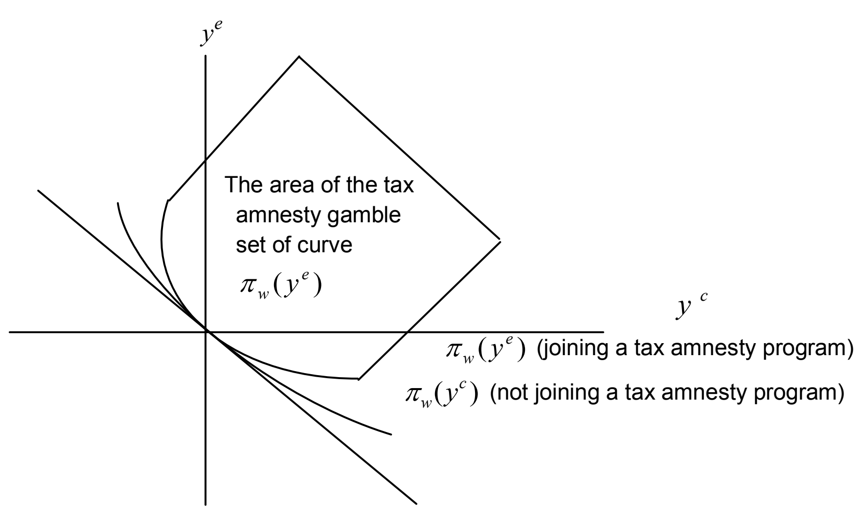

Fig. 1. The gamble set of joining or not joining tax amnesty programs

5. SUMMARY AND CONCLUDING REMARKS

The purpose of our article is to bridge the current literature to what have happened in many economies – such as tax evasion happens twice while the government implements the states' tax amnesty programs. However, most literature had neglected these critical issues, while it is in line with common sense and intuition. This paper develops a model of individual behavior under uncertainty to analyze the representative tax evader's secondary tax evasion under tax amnesty plan, avoiding over simplification of the general model assumption. We then turned to suggest that the success of a tax amnesty is related to a change in tax evader's risk appetite toward tax amnesty and the attitude of decision behavior. In addition, we analyze the short- and long-run effects of tax amnesty on tax revenues. As we have seen in previous sections, it is difficult to evaluate the [4] argument, because the results do not provide an explanation of the states that have held tax amnesties in most states.

Simply speaking, our findings follow from the above Propositions and there is no conflict between these findings. This article contributes to the literature on tax amnesties in the following six aspects. First, the corollary of Proposition 1 corresponds to the conditions that must be fulfilled for government tax amnesty plans to succeed are demonstrated in the Appendix 1. Second, the corollary of Proposition 2 reveals that the influence of erosion rate of tax base due to tax evader's option to tax amnesty plan on the second order condition of the subjective expected utility of tax evaders is characterized by a strictly concave function, in addition, the influence of the proportion of back duty payments (recovered from tax evaders who voluntarily paid the 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. Intuition for these results can be developed by noting that, under tax amnesty, the presence of secondary tax evasion reveals the representative tax evader's expected utility exhibits decreasing absolute risk aversion (DARA), and that tax evaders are risk averters.

Third, by incorporating the amount of money originally possessed by tax evaders, the corollary of Proposition 3 demonstrated that tax evaders who participated in the tax amnesty plan exhibited higher differentiable von Neumann-Morgenstern cardinal utility function [14] compared with those who did not. In other words, it shows that, provided there are no changes in penalty rate , and 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 [14], and it is always beneficial to tax evaders (for some of this similar discussion see [24,19]).

Fourth, our findings are in line with [25], a guilty conscience is often the critical factor in the decision to take advantage of an amnesty, notice that Proposition 3 also support the puzzle of compliance philosophy proposed by [26], 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, we have seen in Eq. (13), it is known that under the prevalence of tax amnesty, the greater the income is, the lower the tax compliance is. We adapt techniques from [24,19,20] by considering the 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, the corollary of Proposition 4 demonstrates, 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 of the tax burden imposed upon a taxpayer ends, tax revenue stably declined and ultimately converged on a fixed value. Our findings are thus consistent with [5], empirical finding, tax amnesty has a declining marginal benefit to the state. These findings also provide us with an important implication that governments enacted tax amnesties primarily to generate an immediate, short-run increase in compliance; as is the case in the United States, nobody is disputing that tax amnesties bring an immediate revenue boost for governments to fill budget gaps [27]. Interestingly, we find that tax amnesties have no long run impact on the tax collections, which is line with [28]. [28] use several times series methods to examine the long run effects of a tax amnesty, and apply these methods to the 1985 Colorado amnesty, the empirical results show that the Colorado tax amnesty has no long run influence on either the level or the trend of tax collections. Finally, and obviously, this paper, seeks to supplement, but not supplant, the traditional considerations of tax amnesty theories.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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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

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

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]

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

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 $\theta^{A} > \theta_{t-1} = \theta^{*}$, $\theta \in \left[\,0\,,\theta^{A}\,\right]$ 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 $(1-q^{*})\times\hat{\theta}$. Thus, $(1-q^{*})\times\hat{\theta} = \min\left\{ \theta^{*}; \frac{\varpi^{\circ}}{q_t} \right\}$, where $\varpi^{\circ} = \frac{\chi}{\tau}$ and ϖ° 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* $\Delta C = \underset{\kappa \in [0,1]}{\text{Min}} \left[\beta \times \sigma + q_t \times \theta \times (1-\sigma) \times \tau \right] \times y \times \upsilon$,

$\theta^{A} = \frac{\chi}{\tau \times q_t}$

Appendix 2

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

$$\frac{dS^e}{dt} = -\lambda \times S^e + \gamma \times J \times \frac{R^e - S^e}{R^e} \tag{A.2.1}$$

Further computations produced a nonhomogeneous equation:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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 magnitude.

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