THE EFFECTS OF TAXATION ON THE REPORTED PROPORTION OF ILLEGAL INCOME

by

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ABSTRACT

The purpose of this paper is to study the effects of different elements in the tax structure on the reported proportion of illegal income. These elements include the penalty rate, the deductible amount of fines or penalties, and the length of imprisonment related to the conviction of tax evasion. By creating a theoretical model of taxpayers' expected utility, I am able to analyze the relation between the tax elements and the reported proportion of illegal income. The results show that a higher penalty rate, a lower level of deductibility, and a longer length of imprisonment increase the taxpayers' percentage of voluntarily reported illegal income. The paper also discusses the model's limitations, implication for public policy, and potentials for future research.

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INTRODUCTION

The magnitude of the U.S. budget deficit is of concern to politicians and citizens. According to the U.S. Department of Treasury (2014a), the budget deficit is the difference between the revenue the government collects and what the government spends. When government spending exceeds government revenues (in other words, when there is a deficit), the Treasury borrows funds to maintain the government's operations, which creates debt. Consequently, debt is the accumulation of deficits. With the current total public debt outstanding of $17.7 trillion (U.S. Department of the Treasury, 2014b), any decrease in the budget deficit is good news for the government. During the first seven months of the government's 2014 fiscal year (FY), the budget deficit picture has improved due to a slowly growing economy, higher tax revenues, and spending cuts. The Congressional Budget Office estimates that the U.S. deficit will total $492 billion in the 2014 FY. This amount equals 2.8% of gross domestic product, marking it the smallest deficit since 2007 (Mitchell, 2014).

Although increasing tax revenues can help reduce the budget deficit because the government will have more funds available to meet its expenses, the severity of the current budget deficit limits the amount of resources available to generate more tax revenues for the government. Since FY 2010, the government has cut the Internal Revenue Service (IRS) budget by nearly eight percent while inflation has risen by about six percent. Along with receiving less funding, the IRS experiences a heavier workload every year. From FY 2004 to FY 2013, individual and business tax returns increased by 10% and 23%, respectively. The increased amount of returns should translate to roughly the same percentage increases in taxpayer service demands, audits, and other processing

and compliance activities (Olson, 2013). The combination of more work and less funding requires the IRS to work more effectively and efficiently in order to close the "tax gap."

The "tax gap" is the difference between the amount of taxes that taxpayers should have paid and what they actually paid on a timely basis (IRS, 2014). Although the tax gap is composed of missing tax revenues that are due on both legal and illegal sources of income, the IRS estimates of the tax gap do not include estimates of missing tax revenues associated with the illegal sector of the economy because of the difficulties in measuring this component. Moreover, the government's interest in pursuing unreported illegal income is to stop the illegal activity, not to tax income derived from the illegal activity (IRS, 2007). Therefore, the IRS seems to neglect the lack of tax compliance associated with illegal income, to the extent illegal income is a significant component of the tax gap. The goal of this paper is to analyze taxpayers' voluntary compliance in reporting illegal income to the IRS.

At the state level, many states have begun to consider legalizing illegal activities, in part to increase state tax revenues by adding income derived from illegal activities to the state's income pool for tax collections. Theoretically, at both the national and state levels, taxes collected already includes income from both legal and illegal sources. However, since there is no documentation of illegal activities and income generated from those activities, it is difficult for the federal government and states to monitor and enforce compliance with tax payments on illegal income. That is why illegal income is not usually considered as a source for tax collections. When a state decides to legalize an illegal activity, the income derived from this activity becomes legal income which makes it easier for the state to monitor and enforce compliance.

In 2012, with the goal of gaining more tax revenue, Colorado legalized retail marijuana. The state estimated that it would be able to generate $33.5 million from two new taxes on retail marijuana in the first six months of 2014. However, the amount of tax revenue that was actually collected from retail marijuana was much smaller than the projected numbers. On September 2, 2014, CNN Money reported that Colorado was missing $21.5 million in marijuana tax revenues (Lobosco, 2014). The lack of full collectability of tax revenue on newly legalized activities did not prevent other states from joining Colorado though. After the midterm election in 2014, Oregon, Alaska, and Washington, D.C. officially become part of the legalize-marijuana movement (Steinmetz, 2014). While it may be too soon to evaluate the success of Colorado's new policy of legalizing retail marijuana, it is important to acknowledge the existence of illegal income as a source for taxation without legalizing the illegal activities.

There is some evidence that criminals report illegal income on their federal tax returns. According to Stephen Moskowitz, a San Francisco tax attorney at Moskowitz LLP, criminals report their illegal income when "they've either been caught during that tax year or think they are about to be caught. […] Their goal is to avoid getting charged twice: once for their initial crime and again for evading the taxes on their windfall" (Hargreaves, 2013, para. 3). Many offenders who commit white-collar crimes (such as anti-trust laws, fraud, or insider trading) are likely to report their illicit gains (Tabbach, 2003) because they know that committing tax evasion increases their risk[1] of getting caught for both the initial crime and tax evasion. Since conviction of a crime related to

[1] Although risk and uncertainty are different from each other in definition. For the purpose of this paper, I use them as if they are interchangeable and convey the same meaning.

income tax evasion is the fastest and surest way to put offenders behind bars for further investigation, the government usually uses income-tax charge as a weapon against the country's most notorious criminals. In the end, tax evasion was what stopped Al Capone, American history's most famous gangster (Eig, 2010).

Another reason for criminals to report their illegal income is that the penalty for tax evasion is stiffer than the penalty for the illegal activity. For example, in Maryland, where prostitution is illegal, the maximum sentence for prostitution is one year in prison and a $500 fine. On the other hand, the tax evasion penalties for failure to pay taxes on revenue from prostitution include five years in jail, a $100,000 fine, and payment of the unpaid taxes and interest (Palmer, 2009). Besides the monetary incentives, IRS Publication 4639, section 6103, provides protection for taxpayers' personal information. According to Section 6103, "tax returns and return information are confidential and are not subject to disclosure, except in the limited situations delineated by the Internal Revenue Code" (IRS, 2012). Legally, the IRS cannot release taxpayers' personal information and tax returns to other law-enforcement agencies unless there is a court order granting access to a specific taxpayer's return or if the situation involves terrorism. Moreover, if the taxpayer pays tax on their initial illegal income, any sum of money paid in compensation for the loss or injury of the other party will be tax-deductible (Hargreaves, 2013). Therefore, criminals have incentives to voluntarily report their illegal income in order to avoid being charged with tax evasion.

Current research shows that taxation affects criminal behavior due to its effects on the trade-off between legal and criminal activities (Tabbach, 2003). There are many research studies that examine the effect of taxation on the amount of criminal activity.

However, there is little academic research on the effect of taxation on the amount of reported illegal income. This paper develops an economic model to examine the effect of taxation on reported illegal income. The model manipulates the tax system through the incorporation of factors such as the level of deductibility, penalty rate, and imprisonment.

The paper is organized as follows. The review of literature section provides legal background, discussion of each element of the model, and a review of relevant prior literature. Next, the method and results section presents the concept of the model, the necessary assumptions for the model's construction, the context of the model, and the development of the model. The discussion section offers a full explanation and discussion of the results along with the limitations of the model. Finally, the implication section demonstrates an example of how the taxing authorities can apply the model to manipulate the voluntary compliance rate of illegal income and its potentials for future research.

REVIEW OF LITERATURE

History of Federal Income Taxation in the U.S.

The history of federal income taxation dates back to 1913, when the sixteenth amendment authorized Congress to tax income derived from any source (Bittker, 1974). However, when Congress exercised the sixteenth amendment for the first time, Congress only imposed a tax on net income from lawful business activities. Three years later, Congress eliminated the qualifying word "lawful" from the statute without explanation. This change did not officially qualify illegal income as a source of taxable income until the landmark decision *James v. United States* (366 U.S. 213 [1961]), which announced that "income from illegal activity is taxable despite the recipient's legal obligation to make restitution" (Bittker, 1974, p. 136). Today, the U.S. federal income tax laws clearly

state that income from illegal activities must be included in taxpayer's income on form 1040, line 21, or on Schedule C or Schedule C-EZ (Form 1040) if the income is generated from taxpayer's self-employment activity (IRS, 2013a). This legitimizes taxation of illegal income and qualifies underreporting illegal income as a means of tax evasion.

The income tax laws not only define what the IRS considers taxable income, but also determine the tax treatment of sanctions. According to Section 162(f) of the Internal Revenue Code, "no deduction shall be allowed […] for any fine or similar penalty paid to a government for the violation of any law" (26 U.S. Code §162f). Nevertheless, the laws state that private penalties such as punitive damages and compensatory payments arising from criminal activities are generally deductible (Tabbach, 2003). This paper emphasizes how criminals react to a revised tax policy that is imposed on illegal income, so reference to the term 'deductibility' in this paper indicates the deductibility of fines or similar penalties paid to the government rather than deductibility of private penalties. Although fines or penalties paid to a government agency have never been deductible, it is important to develop a model which covers all possibilities including non-deductibility, partial deductibility, and full deductibility. This comprehensive approach enlarges the domain of the model and makes it applicable to other situations besides the U.S. federal income tax system.

Elements of the Model

Tax Evasion

Tax evasion is one of the major elements contributing to the tax gap. Tax evasion has a significant impact on the government because it increases the nation's debt burden

and reduces the government's ability to provide public services. Noncompliance not only shifts real resources from honest taxpayers to dishonest evaders, but also moves tax liabilities from present to future generations (Cebula & Feige, 2011). The following figure provides an overview of the relationship between the total tax liability owed to the government, the tax gap, and tax evasion.

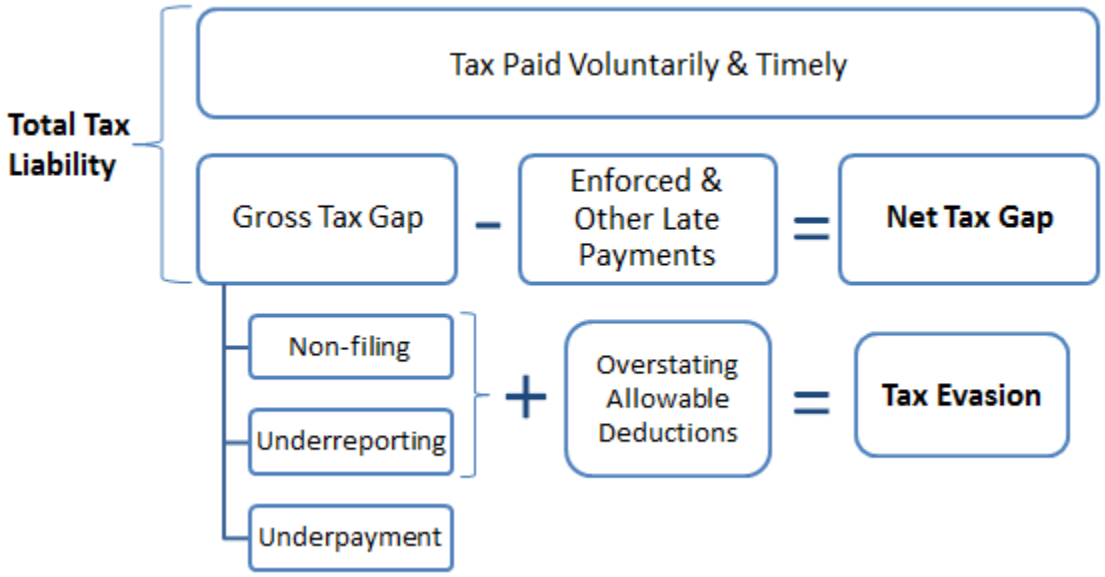


Figure 1. The relationship between the total tax liability, the tax gap, and tax evasion. Adapted from "Reducing the Federal Tax Gap: A Report on Improving Voluntary Compliance," by the IRS, 2007, p. 10.

Taxpayers commit tax evasion by not filing tax returns, underreporting taxable income, and/or overstating allowable deductions. This paper focuses on the underreporting component of tax evasion. There are two primary approaches that the IRS can take to reduce the amount of underreported taxable income: encouraging voluntary compliance and using enforcement tools. Since the foundations of the U.S. tax system are self-assessment and self-reporting, it is essential for the IRS to develop a sustainable

approach to reduce tax evasion through significant long-term voluntary compliance. The goal of this approach is so that the IRS does not have to repeat enforcement for each noncompliant case and create "an endless loop of enforcement action" (Olson, 2013, p. xiii). Since tax evasion is a punishable illegal activity that individuals try to hide, it is difficult to directly measure the magnitude of tax evasion. The IRS estimated that "on average, for every dollar of income detected in the Taxpayer Compliance Measurement Program, another $2.28 went undetected" (Cebula & Feige, 2011, p. 266). In 2006, there was about 16% of tax evasion on income in the U.S. (Freire-Seren & Panades, 2013). This reflects the picture of tax evasion in the U.S. and emphasizes the significance of improving voluntary compliance.

Factors that Affect Voluntary Compliance

Taxpayers decide the amount of income to report based on many factors. Some examples of these factors are taxpayer services, taxpayers' attitudes about the government, taxpayers' perception of fairness in the tax system, the risk (or perception of risk) of getting caught, and the cost (punishment) if caught. While other factors are self-explanatory, taxpayer services include all the necessary services to assist taxpayers and administer the tax filing season. These services include, but are not limited to, the publication of tax forms and instructions, taxpayer outreach and education, availability of tax preparers, and tax-software manufacturers. Although the classic economic model of compliance pays more attention to the study of criminal behavioral responses to detection risk and the cost of failure, research shows that taxpayer services and trust are significant factors in influencing compliance behavior. For the most noncompliant group of taxpayers, trust in the government, trust in the IRS, and trust in the tax system highly

correlate with compliant behavior (Olson, 2013). Taxpayers will be more willing to comply with the tax laws if they believe that the government will use tax revenues to provide better public goods and services, that the IRS will work effectively and efficiently, and that the tax system will treat every taxpayer fairly.

However, in order to achieve better taxpayer services and trust from the taxpayers, the tax administration needs a robust, well-funded, and well-researched system, which is hard to pursue with a limited budget. Budget cuts and heavy workload have already decreased the audit rate in recent years. On April 14, 2014, the Associated Press reported that "this year, the IRS will have fewer agents auditing returns than at any time since at least 1980s" (Ohlemacher, 2014, para. 2). According to the 2013 IRS Data Book, the average audit rate for all individual returns in FY 2013 was 0.96 percent. More importantly, IRS Commissioner John Koskinen expects the audit rate to go down in the future (Ohlemacher, 2014). Therefore, the purpose of this paper is to examine whether the IRS can increase voluntary compliance with factors that do not require significant additional resources from the IRS, such as the penalty rate, the level of deductibility, and imprisonment. Since the Congress is in control of the level of deductibility and the penalty rate, changing these two elements should not incur significant cost to the IRS. Imprisonment, on the other hand, incurs heavy costs to other government agencies outside of the IRS.

According to the Congressional Research Service Report, the federal prison population and cost of incarceration in the U.S. has been skyrocketing in the last ten years. Along with having the largest prison population in the world, the U.S. also has an increasing per capita cost of incarceration for all inmates. The per-capital cost increased

from $21,603 in FY 2000 to $29,291 in FY 2013 (James, 2014). The cost of incarceration is even worse at the state level. Appendix A demonstrates the impact of incarceration costs on state budgets by comparing the cost of incarceration per inmate and the cost of education per student. Because imprisonment comes with heavy costs for the government, the IRS should be mindful when considering any policy related to imprisonment.

Besides harsh punishments and severe penalties, the government also uses methods which appeal to taxpayers' conscience and moral values to improve tax compliance. For example, during Hammurabi's reign in ancient Babylon, the tax collectors used to send out the following notice when taxpayers did not pay their taxes on time: "Why have you not sent to Babylon the 30 lambs as your tax? Are you not ashamed of such behavior?" (Webber & Wildavsky, 1986, p. 58). A more recent example is during World War II, when the U.S. Secretary of Treasury appealed to the citizens' patriotism to encourage taxpayers pay their taxes (Slemrod, 2007). However, researchers have found that moral suasion does not have any significant impact on taxpayers' compliance behavior (Blumenthal, Christian, & Slemrod, 2001 and Torgler, 2004). This result makes policy makers and taxing authorities consider other options such as emphasizing community cohesion, improving tax culture, and reframing individuals' entitlement to income using social norms.

Rational Choice Theory under Uncertainty

An individual's decision-making process to commit tax evasion involves the consideration of effort, additional wealth, and possible penalty. There are many uncertainties related to each element which the individual needs to consider for his/her

final decision. For example, additional wealth may change if the individual gets caught and has to pay a penalty. It is important to note that failure to report one's full income to the tax authorities does not automatically provoke a reaction in the form of a penalty because the IRS detection rate for tax evasion is lower than 100 percent (Allingham & Sandmo, 1972). There is a chance that the IRS will not discover the evasion, and the individual can enjoy his/her illicit gain without consequence. Therefore, the main issue is whether or not the individual gets caught.

Research shows that certainty of punishment not only deters criminal activities, but also has more impact on criminal behaviors than severity of punishment (Block & Heineke, 1975). However, increasing the certainty of punishment is not always the solution for minimizing tax evasion because costly resources must be used to achieve a higher detection rate. With a constrained budget, it is challenging for the IRS to increase its detection rate. Consequently, the IRS should look at other alternatives to increase the voluntary compliance rate. In *Making Honesty the Best Policy*, Singh (1973) found that higher penalty rates could compensate the expenditure required for increasing the detection of tax evasion, and also lower the magnitude of tax evasion without extra spending to improve the detection rate. This finding opens a promising area for further research and testing. With respect to reporting illegal income, Singh's research inspired the idea of using a penalty rate as a variable to study taxpayers' voluntary compliance.

As discussed above, the reporting of income is a decision under uncertainty. This statement applies to the reporting of both legal and illegal income. With legal income, a third party often reports income to the IRS on an individual's behalf. This creates a check and balance point for the IRS and helps detect tax evasion when the income amounts do

not match. However, this third party does not always exist, especially in self-employment cases. Moreover, income generated from self-employment business is not subject to information reports (Slemrod, 2007). Research shows that noncompliance by sole proprietors and small businesses is a principal cause of the U.S. tax gap (Yin, 2012). With illegal income, it is even harder for the IRS to track the full income because there is no documentation that records the illegal activities and the income derived from those activities. Taxpayers have three options: report the full income, report only a portion of the full income, or report nothing. Under uncertainty, taxpayers tend to make the decisions that help them achieve their own objectives given all relevant factors that are beyond their control (Green, 2002). These objectives can be either trying to end up with the largest amount of wealth or choosing the safest option with an acceptable amount of wealth. Since these objectives are subjective, they rely on each individual's appetite for risk.

When taxpayers make a decision regarding the declaration of illegal income for tax purposes, the characteristics of their behaviors conform to the von-Neumann-Morgenstern axioms and rational choice theory for behavior under uncertainty (Allingham & Sandmo, 1972). The six axioms are completeness, transitivity, substitutability, decomposability, monotonicity, and continuity (Perloff, 2011). Originally, the basic rational choice model only dealt with outcomes that are known with certainty. However, over time, researchers develop an extension of the model which allows the existence of uncertainty. This extension uses probability distributions to assign a likelihood to each possible outcome. Researchers usually look at rational choice theory as a useful methodology because "it tends to lead the researcher to novel implications,

thereby making novel confirmation more likely than may be the case with other methodologies" (Green, 2002, p. 12). Moreover, rational choice theory hypothesizes that all individuals, criminals, and non-criminals respond to incentives. If the costs and benefits associated with tax evasion change, the individual's choices are also likely to change (Heineken, 1978). Therefore, researchers can model criminal behavior by giving individuals different incentives. This paper uses the von Neumann-Morgenstern utility function and rational choice theory to model criminal behavior to study the effect of taxation on reported illegal income.

Prior Research on Taxation and Illegal Behavior

Over the years, many researchers have studied the net effect of taxation on crime. However, these researchers did not pay much attention to the compliance rate of individuals with respect to the reporting of illegal income. The two most popular approaches that have been used to model criminal behavior are a portfolio approach and a time allocation problem. While the portfolio approach is concerned with how much wealth the individual decides to put at risk in a criminal activity, the time allocation problem acknowledges the role of non-monetary costs and returns in the decision-making process of the individual. One line of research models the offense decision as a portfolio decision (Allingham and Sandmo (1972), Kolm (1973), Singh (1973), and Tabbach (2003)). A second line of research models the criminal choice problem as a time allocation problem (Becker (1968), Enrlich (1973), Block and Heineke (1975), and Sjoquist (1976)). These authors' research provides a rich framework for modeling criminal choices.

Tabbach, a representative of the first line of research, looked at income-producing crimes as labor supply decisions under uncertainty in his research paper, *Criminal Behavior, Sanctions, and Income Taxation: An Economic Analysis* (2003). In the paper, Tabbach applied the theory of taxation and risk taking to a simple model of crime. He proposed three different models of taxation and analyzed the criminal's response to each model, as well as to the base system of no taxation. The first model incorporates the system of taxing legal income while exempting illegal income. The second model taxes both legal and illegal income with full deductions for fines. The third model also taxes both legal and illegal income, but with no deductions for fines. Although the results varied based on different attitudes toward risk and the level of comparison, they still reflected the general effects of taxation on the amount of income-producing crimes. Tabbach found that taxation affected the level of crime by not only changing relative returns from legal and illegal activities, but also affecting the riskiness of crime and the willingness of offenders to bear risk. Taxation with full deductions for fines reduces the risk associated with crime by reducing the effective level of punishment. In 2005, Tabbach continued his study of the effects of taxation on income-producing crime with variable leisure time while using the assumptions of risk neutral individuals. Tabbach's research (2003 & 2005) provide a good foundation for the development of my paper. However, the difference between Tabbach's research (2003) and my study is that Tabbach focused on the effects of taxation on the amount of crime, whereas I focus on the effects of taxation on the proportion of illegal income that criminals are willing to report.

Within the first line of research, Kolm (1973) took a different approach in his paper by developing a model based on both taxpayers and tax collectors' viewpoint. In his model, the tax collector controlled the penalty rate on unreported income (π) and the probability of detecting fraud (p). Therefore, if the tax collector wants to obtain additional revenue at a minimum cost, the tax collector needs to raise the penalty rate (π) to compensate for the loss of resources used to improve the effectiveness of the detection rate (p). This result implies that π and p are substitutes for each other. However, in reality, the tax collector usually does not have the authority to set the penalty rate for unreported income. Changes in the penalty rate are generally put into effect through legislative action that must be signed by the President or the Governor.

The second line of research contributes many different perspectives on the study of criminal behaviors. In *Crime and Punishment: An Economic Approach*, Becker (1968) addressed two questions: (1) how many resources and how much punishment should the government use to enforce different kinds of legislation, and (2) how many offenses should be permitted and how many offenders should go unpunished? Becker's paper incorporated an assumption that the optimal amount of enforcement depends on the cost of catching and convicting offenders, the nature of punishment, and the responses of offenders to changes in enforcement. Becker found that optimal policies to combat illegal behavior are part of an optimal allocation of resources, and that fines have several advantages over other punishments such as probation, imprisonment, parole, and various restrictions on choice of occupation. To examine the effect of other punishments on reported illegal income, my paper develops a separate model for the case of imprisonment.

Another representative for the second line of research is Block and Lind. In *An Economic Analysis of Crimes Punishable by Imprisonment*, Block and Lind (1975) explained the effects of certainty and severity in punishment on an individual's willingness to engage in crime by modeling changes in an individual's initial wealth and payoff to crime under different punishments. One of the most important discussions in the paper is the reason Block and Lind incorporated the assumption of risk-avoiding behavior for criminals. The authors acknowledged that there was a perception of risk-preferring behavior for criminals. However, they agreed with Becker's argument that criminals did not always prefer risk in all areas of their lives. Criminals might accept the riskiness of the illegal activity itself, but there was no evidence supporting the argument that they are risk-preferring individuals when making decisions that are unrelated to the criminal activity. Block and Lind concluded that criminals were like other individuals who do not engage in illegal activities and that their behavior could be explained by the same assumptions and models used to explain others' behavior. As a result, the majority of research that deals with the analysis of decisions under uncertainty uses the assumption of risk aversion in wealth. Block and Lind's discussion on using risk-avoiding behavior for criminals provides validity to my choice of assuming risk aversion for modeling criminal behavior under uncertainty.

METHOD & RESULTS

Concept of the Model

From the perspective of the taxpayer, declaration of illegal income involves two choices: report or not report. If taxpayers choose to report their illegal income, they need to decide what percentage of the illegal income they want to report in order to maximize

their utility. As mentioned in the introduction of this paper, taxpayers have incentives to report their illegal income. Therefore, it is important for the tax collector to learn how to increase the percentage of reported illegal income. By formulating the reaction of taxpayers to changes in the tax system, this model provides the tax collector the ability to predict an estimated percentage of reported illegal income based on taxpayers' utility functions and the applied tax system.

Assumptions of the Model

There are several important assumptions for the construction of the model. These assumptions revolve around creating both internal and external environments for the model. Internal environment refers to activities and characteristics which are in the taxpayers' control. The first assumption dictates the conditions for taxpayers' utility functions (U(.)) by assuming that taxpayers are risk averters. Risk averters are individuals who would prefer lower returns with certainty over higher returns that involve higher risk and uncertainty. While more wealth is preferable ($U'(.) > 0$), risk averters possess a diminishing marginal utility ($U''(.) < 0$) (Menezes & Hanson, 1970). This characteristic means that the richer the individual is, the smaller the increase in happiness he/she will experience when receiving one more dollar. Figure 2 portrays the behavior of risk averters' utility function when their wealth (.) changes.

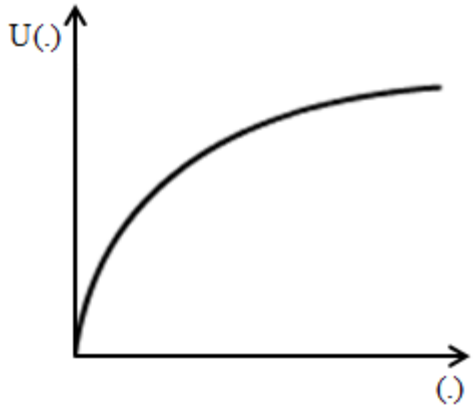


Figure 2. Risk aversion utility function. $U(.) > 0$, $U'(.) > 0$, $U''(.) < 0$

Second, the model assumes that taxpayers pursue income-producing illegal activities for monetary reasons only. Moreover, these individuals are also ethical neutral. "Ethical neutral" is the term used to describe individuals who find legal and illegal activity equally unpleasant and treat them indifferently as "work" (Block & Heineke, 1975). Third, although Cullis & Savoia (2011) claimed that social norms could impact tax compliance by changing individuals' perceptions of their entitlement to income, this model excludes any possible psychological costs from failing to follow the social norms. The combination of the last three assumptions restricts taxpayers' motives and their costs and benefits analysis to monetary driven considerations. Next, the model assumes that taxpayers have enough initial wealth to cover any fines or penalties from the conviction of tax evasion. Furthermore, taxpayers do not specialize in either work or crime, which means they participate in both legal and illegal market. Since the focus of this paper is the percentage of reported illegal income, the model assumes that taxpayers report their full legal income in order to mitigate the risk of committing tax evasion for unreported legal income.

The external environment refers to activities and characteristics which are out of taxpayers' control. The first assumption provides building blocks for this model by using a von Neumann – Morgenstern utility function to formulate taxpayers' behavior. Second, returns from both legal and income-producing illegal activity are monetary and increase proportionately with the amount of time spent on each activity. If a is the amount of time allocated to income-producing illegal activities, c(a) is the net return taxpayers receive from illegal activities, and w(1-a) is the net return taxpayers receive from legal activities. Because a is the only variable in the function of w(1-a), we can shorten the function from w(1-a) to w(a). Since the returns increase proportionately with the amount of time spent on the activity, the marginal utility of both functions is positive: $c'(a) > 0$ and $w'(1-a) > 0$. In other words, if taxpayers spend more time conducting illegal activities, they will spend less time working on legal activities and receive less returns from legal activities. Consequently, we have $w'(a) < 0$. The net returns from both legal and illegal activities also exhibit decreasing marginal returns; therefore, $c''(a) < 0$ and $w''(a) < 0$.

Figures 3 and 4 portray the behavior of taxpayers' function of illegal and legal income, respectively, when the allocated time (a) changes. Moreover, the model assumes that the amount of time taxpayers allocate to leisure activities is fixed and independent with the level of returns from both legal and illegal activities. This assumption prevents taxation from affecting taxpayers' time allocation since a higher tax rate lowers the cost of leisure activities by reducing returns from income-producing activities. Although taxpayers might need assistance to report their illegal income appropriately, the cost of tax preparation for illegal income is not too large to significantly impact the final result.

Therefore, the model assumes that reporting illegal income incurs no additional cost associated with tax preparation for taxpayers.

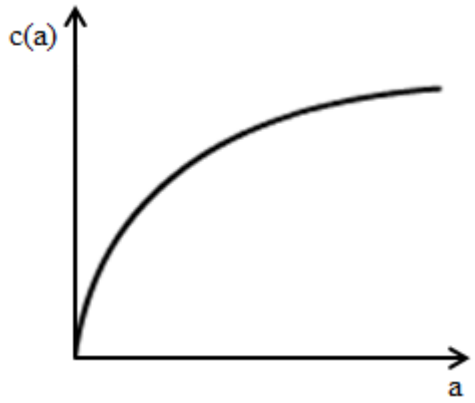


Figure 3. Taxpayers' function of illegal income. $c(a) > 0$, $c'(a) > 0$, $c''(a) < 0$

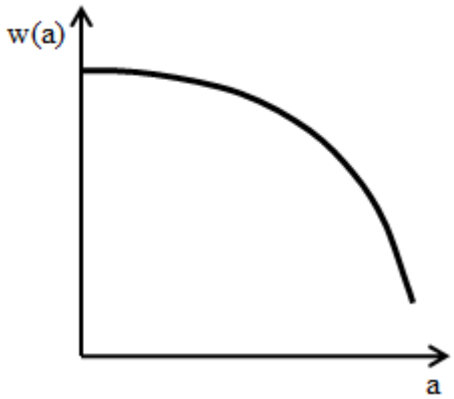


Figure 4. Taxpayers' function of legal income. $w(a) > 0$, $w'(a) < 0$, $w''(a) < 0$

On the other hand, because the government uses tax revenues to finance its spending for public services and other government projects such as transportation, public education, and roads, tax revenues can impact taxpayers' decision to pay tax. Consequently, it is critical to assume that tax revenues affect taxpayers' utility function in a separable fashion. Next, the model assumes that the detection rate is independent of reported income, and that the tax collector uses a strictly random approach to select the targeted tax returns for audit. Although it is possible for the tax collector to wrongfully convict an innocent taxpayer for tax evasion, introducing this type of risk into the model is unnecessary for the study of the effects of taxation on reported illegal income. As a result, the model assumes that the probability of wrong conviction for tax evasion is zero.

Last but not least, I consider two approaches to identify the function of fines and penalties related to tax evasion. The first approach, introduced by Allingham & Sandmo (1972), formulates the penalty function based on the amount of evaded income. The second approach, introduced by Yitzhaki (1974), formulates the penalty function based on the amount of evaded taxes. Each approach has a different impact on tax compliance when the tax collector increases the tax rate. A higher tax rate results in higher evaded taxes, hence a higher penalty in the second approach. However, a higher tax rate will not affect the amount of penalty in the first approach because the amount of evaded income remains the same. Since my model only affects the penalty rate, not the tax rate, there should be no difference between the two approaches.

To prevent the changes of tax rate from affecting the penalty amount, my model uses the first approach for the penalty function. If μ is the percentage of reported illegal income, $(1-\mu).c(a)$ is the unreported, or evaded, illegal income and $t.(1-\mu).c(a)$ is the evaded taxes with the tax rate t. Consequently, $f[(1-\mu).c(a)]$ is the function of penalty in the first approach, while $f[t.(1-\mu).c(a)]$ is the function of penalty in the second approach. Because taxpayers file their tax returns at the end of the year, they already decided their time allocation during the year, which means a is fixed. The model keeps the current tax rate and changes the penalty rate; therefore, the only variable in the function of penalty is μ. As a result, we can shorten the function of penalty as $f(\mu)$. The higher the percentage of reported illegal income (μ), the lower the percentage of evaded illegal income ($1-\mu$), thus the lower the amount of penalty related to tax evasion ($f(\mu)$). As a result, we have $f'(\mu) < 0$. Furthermore, to prevent taxpayers from repeatedly committing tax evasion, the function of penalty exhibits increasing marginal severity which gives us $f''(\mu) > 0$. Figure

5 portrays the behavior of taxpayers' function of penalty related to tax evasion when the percentage of reported illegal income changes.

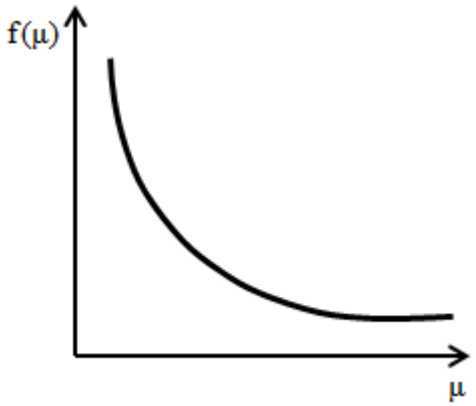


Figure 5. Taxpayers' function of penalty related to tax evasion. $f(\mu) > 0$, $f'(\mu) < 0$, $f''(\mu) > 0$

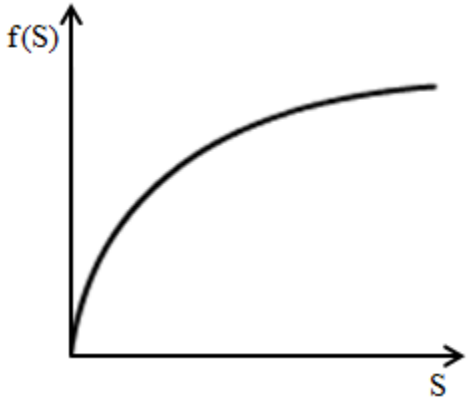


Figure 6. Taxpayers' function of imprisonment related to tax evasion. $f(S) > 0$, $f'(S) > 0$, $f''(S) < 0$

Another punishment related to tax evasion is imprisonment. By using monetary equivalence, the model values the cost of imprisonment to taxpayers with a function that varies according to the length of the sentence determined by the court (S). Although the longer time taxpayers stay in prison, the more money they lose ($f'(S) > 0$), the function of imprisonment exhibits decreasing marginal costs ($f''(S) < 0$). Imprisonment damages individuals' reputation and their ability to generate income after they are released from prison. Therefore, the longer taxpayers stay in prison, the less monetary equivalence their time in prison is. As a result, the cost of imprisonment decreases. Figure 6 above portrays the behavior of taxpayers' function of imprisonment when the length of the sentence changes.

The table below summarizes the assumptions and symbols used in this model.

Table 1. A summary of the assumptions and symbols used in the model

Symbol	Meaning	Condition
Y	The state of the world when taxpayer gets caught committing tax evasion	
X	The state of the world when taxpayer does not get caught committing tax evasion	
U(.)	Taxpayer's von Neumann – Morgenstern utility function	$U(.) > 0$, $U'(.) > 0$, $U''(.) < 0$
W	Taxpayer's initial wealth	$W > 0$
a	The amount of time taxpayer allocates to illegal activities	$0 < a < 1$
w(a)	Taxpayer's total legal income	$w(a) > 0$, $w'(a) < 0$, $w''(a) < 0$
c(a)	Taxpayer's total illegal income	$c(a) > 0$, $c'(a) > 0$, $c''(a) < 0$
μ	The percentage of reported illegal income	$0 < \mu < 1$
S	The length of the sentence decided by the court	$S > 0$
$f(\mu)$	Total fines related to tax evasion	$f(\mu) > 0$, $f'(\mu) < 0$, $f''(\mu) > 0$
f(S)	Monetary equivalent of imprisonment	$f(S) > 0$, $f'(S) > 0$, $f''(S) < 0$
p	Probability of detection	$0 < p < 1$
t	The income tax rate for reported legal and illegal income	$0 < t < 1$
t_μ	The penalty rate for unreported illegal income	$0 < t_\mu < 1$
δ	The deductibility level: ▪ Fully deductible ▪ Partially deductible ▪ Non deductible	$0 \leq \delta \leq 1$ $\delta = 1$ $0 < \delta < 1$ $\delta = 0$
.	Indication of multiplication. For example, t.c(a) means t multiplies c(a).	

Context of the Model

The context of this model is the end of the tax year when taxpayers have already spent a certain amount of time in both legal and illegal activities. The taxpayers are considering the percentage of the illegal income they should report to achieve their optimal utility value. The special part about this model is that it can separate the effects

of taxation on reported legal and illegal income. By maintaining the current tax rate and changing the penalty rate, the deductibility level applied to illegal income, and the length of imprisonment related to tax evasion of illegal income, the model only records taxpayers' reactions associated with reported illegal income. Taxpayers respond to the changes in the tax system by altering their time allocation between legal, illegal, and leisure activities for the next tax year, but for this tax year, the changes in the tax system should only affect the percentage of reported illegal income.

For better understanding, imagine the following scenario: John is a full-time investment banker. During last year, he conducted insider trading (an illegal activity) and received $50,000 of illegal income for his 10-hour work. At the end of the year, John earned $180,000 of legal income from his job as an investment banker and $50,000 in illegal income from insider trading. Now it is February and John must file his tax return. However, the IRS just released a new tax structure which includes a new penalty rate for unreported illegal income, a new deductibility level for fines related to tax evasion, and a new sentence structure for imprisonment related to tax evasion. John is considering the percentage of the illegal income he should report to the IRS in order to achieve the maximum utility.

Development of the Model

For the purpose of this model, there are two states of the world. The first state is when the taxpayer has a positive amount of unreported illegal income and gets caught committing tax evasion. We call this state Y. The second state is when the taxpayer has a positive amount of unreported illegal income, but does not get caught committing tax evasion. We call this state X. In both Y and X, the taxpayer has initial wealth (W), legal

income (w(a)), illegal income (c(a)), tax liability for legal income (t.w(a)), and tax liability for reported illegal income (t.μ.c(a)). The differences between these two states are the costs of getting caught committing tax evasion. These costs include tax liability for unreported illegal income (t_{μ}.(1-μ).c(a)), penalty related to tax evasion (f(μ)) minus the deductible amount of the penalty (δ.t.f(μ)), and the cost of imprisonment (f(S)). Following the description for each state, we have:

$$Y = W + w(a) + c(a) - t.w(a) - t.\mu.c(a) - t_{\mu}.(1 - \mu).c(a) - [f(\mu) - \delta.t.f(\mu)] - f(S)$$

$$= W + (1 - t).w(a) + (1 - t.\mu).c(a) - t_{\mu}.(1 - \mu).c(a) - (1 - \delta.t).f(\mu) - f(S)$$

and

$$X = W + w(a) + c(a) - t.w(a) - t.\mu.c(a)$$

$$= W + (1 - t).w(a) + (1 - t.\mu).c(a)$$

The goal of the taxpayer in this context is to find the optimal percentage of reported illegal income (μ*) that maximizes his/her total expected utility. Expected utility is the function of different outcomes and their probability. Since p is the detection rate and Y is the state of the world when taxpayer gets caught evading tax, p is the probability that outcome Y happens. Similarly, since (1-p) is the probability that the tax return does not get audited and X is the state of the world when a taxpayer does not get caught evading tax, (1-p) is the probability that outcome X happens. We have:

$$\max_{\mu} E[U(.)] = p.U(Y) + (1 - p).U(X)$$

In order to achieve the interior maximum of the expected utility function above, the first-order condition requires that:

$$\frac{dEU}{d\mu^*} = G = p.U'(Y).Y_{\mu} + (1 - p).U'(X).X_{\mu} = 0$$

$$\Rightarrow \quad \frac{X_\mu}{Y_\mu} = -\frac{p.U'(Y)}{(1-p).U'(X)}$$

$$\Rightarrow \quad Y_\mu = \frac{X_\mu}{1}.\left(-\frac{(1-p).U'(X)}{p.U'(Y)}\right) = -\frac{X_\mu.(1-p).U'(X)}{p.U'(Y)}$$

We have $X_\mu = -t.c(a) < 0, (1-p) > 0, U'(X) > 0, p > 0, and\ U'(Y) > 0$; therefore, $Y_\mu > 0$.

The second-order condition requires that:

$$\frac{d^2EU}{(d\mu)^2} = D = p.U''(Y).\left(Y_\mu\right)^2 + p.U'(Y).Y_{\mu\mu} + (1-p).U''(X).\left(X_\mu\right)^2$$

$$+ (1-p).U'(X).X_{\mu\mu} < 0$$

where $Y_\mu = -t.c(a) + t_\mu.c(a) - (1-\delta.t).f'(\mu) > 0$ (result from the first-order condition)

$$X_\mu = -t.c(a) < 0$$

$$Y_{\mu\mu} = -(1-\delta.t).f''(\mu) < 0$$

and $X_{\mu\mu} = 0$

By differentiating the first-order condition with respect to t_μ and solving for $\partial\mu^*/\partial t_\mu$, we can examine the effect of penalty rate (t_μ) on the percentage of reported illegal income (μ). According to the implicit functions theorem with two variables, we have:

(1) $$\frac{\partial\mu^*}{\partial t_\mu} = -\frac{\partial G/\partial t_\mu}{\partial G/\partial\mu^*} = -\frac{1}{D}.\frac{\partial G}{\partial t_\mu}$$

$$= -\frac{1}{D}.\left[p.U''(Y).Y_\mu.Y_{t_\mu} + p.U'(Y).Y_{\mu t_\mu} + (1-p).U''(X).X_\mu.X_{t_\mu}\right.$$

$$\left. + (1-p).U'(X).X_{\mu t_\mu}\right]$$

where $Y_{t_\mu} = -(1-\mu).c(a) < 0$

$Y_{\mu t_\mu} = c(a) > 0$

$X_{t_\mu} = 0$

and $X_{\mu t_\mu} = 0$

Therefore, we have:

(1) $$\frac{\partial \mu^*}{\partial t_\mu} = -\frac{p.U''(Y).Y_\mu.Y_{t_\mu}}{D} - \frac{p.U'(Y).Y_{\mu t_\mu}}{D} > 0$$

Similarly, we can examine the effect of the deductibility level (δ) on the percentage of reported illegal income (μ) by differentiating the first-order condition with respect to δ and solving for $\partial\mu^*/\partial\delta$.

(2) $$\frac{\partial \mu^*}{\partial \delta} = -\frac{\partial G/\partial \delta}{\partial G/\partial \mu^*} = -\frac{1}{D}.\frac{\partial G}{\partial \delta}$$

$$= -\frac{1}{D}.\left[p.U''(Y).Y_\mu.Y_\delta + p.U'(Y).Y_{\mu\delta} + (1-p).U''(X).X_\mu.X_\delta \right.$$

$$\left. + (1-p).U'(X).X_{\mu\delta}\right]$$

where $Y_\delta = t.f(\mu) > 0$

$Y_{\mu\delta} = t.f'(\mu) < 0$

$X_\delta = 0$

and $X_{\mu\delta} = 0$

Therefore, we have:

(2) $$\frac{\partial \mu^*}{\partial \delta} = -\frac{p.U''(Y).Y_\mu.Y_\delta}{D} - \frac{p.U'(Y).Y_{\mu\delta}}{D} < 0$$

Using the same technique, we can examine the effect of the length of imprisonment (S) on the percentage of reported illegal income (μ).

(3) $\frac{\partial \mu^*}{\partial S} = -\frac{\partial G/\partial S}{\partial G/\partial \mu^*} = -\frac{1}{D}.\frac{\partial G}{\partial S}$

$$= -\frac{1}{D}.\left[p.U''(Y).Y_\mu.Y_S + p.U'(Y).Y_{\mu S} + (1-p).U''(X).X_\mu.X_S + (1-p).U'(X).X_{\mu S}\right]$$

where $Y_S = -f'(S) < 0$

$Y_{\mu S} = 0$

$X_S = 0$

and $X_{\mu S} = 0$

Therefore, we have:

(3) $\frac{\partial \mu^*}{\partial S} = -\frac{p.U''(Y).Y_\mu.Y_S}{D} > 0$

DISCUSSION

Meaning of the Results

The model shows three interesting results. The first result (1) $\partial \mu^*/\partial t_\mu > 0$ indicates a positive relationship between the percentage of reported illegal income and the penalty rate. This implies that taxpayers will respond to a higher (lower) penalty rate with a higher (lower) percentage of reported illegal income. The penalty rate affects taxpayers' decisions by adding an additional cost to tax evasion. While the gain derived from tax evasion, if successful, remains unchanged, the cost of getting caught increases when the penalty rate increases. As the cost gets larger, the risk of losing money gets bigger. Consequently, taxpayers will try to reduce the risk of losing money to an acceptable level by increasing the percentage of reported illegal income. Although the acceptable level of risk will vary according to an individual's risk preference, taxpayers

are more likely to not evade taxes or to reduce the amount of evaded income when tax evasion is associated with higher risk.

An important question is how high the penalty rate can be. According to Graetz and Wilde (1985), no matter how much the potential theoretical advantages are, punishments, including penalty rate, fines, and imprisonment, should be reasonable and proportionate with the crime. This not only prevents the government from drastically increasing the punishment for tax evasion, but this also makes the government aware of other issues related to harsher punishment. When the punishment is harsher, the prosecution process will need to be more detailed and cautious to avoid mistakes that can force harsh punishments on innocent citizens. Harsher punishment also makes the courts more reluctant to convict taxpayers of tax evasion. Even though changing the penalty rate is costless to the tax collector, intense investigations and detailed prosecutions incur extra costs for the administration. Therefore, the government should pay attention to the interaction between the penalty rate and administrative costs before deciding to raise the penalty rate (Alm, McClelland & Schulze, 1992).

The second result (2) $\partial\mu^*/\partial\delta < 0$ indicates a negative relationship between the percentage of reported illegal income and the level of deductibility. This implies that if the tax system allows taxpayers to deduct a larger amount of the fines related to tax evasion, taxpayers will report a smaller percentage of illegal income. The level of deductibility affects taxpayers' decisions by acting like a type of insurance in case taxpayers have to pay fines for conviction of tax evasion. Without the ability to deduct any amount of fines related to tax evasion ($\delta = 0$), taxpayers will have to pay the full amount of fines ($f(\mu)$) from their total income. However, with a partial deductibility ($0 <$

$\delta < 1$), taxpayers will be able to deduct a portion of their fines ($\delta.f(\mu)$) from their total income. This deductibility reduces taxpayers' tax liability by $t.\delta.f(\mu)$. Consequently, taxpayers only effectively pay $f(\mu) - t.\delta.f(\mu)$ as the amount of fines related to tax evasion. Similarly, with full deductibility ($\delta = 1$), taxpayers will be able to save $t.f(\mu)$ from their tax liability, thus effectively paying $f(\mu) - t.f(\mu)$ as the amount of fine. The deductibility of fines (either $t.\delta.f(\mu)$ or $t.f(\mu)$) make the government a partner of tax evaders because the tax collector helps pay part of the tax evaders' fines. Ironically, besides the tax collector, no other company or organization offers this type of insurance, so the tax collector becomes a unique partner of the tax evaders (Tabbach, 2003). In sum, increasing the level of deductibility encourages tax evasion because it lowers the expected costs of being convicted of tax evasion. Therefore, taxpayers will report less illegal income if the level of deductibility increases.

The third result (3) $\partial\mu^*/\partial S > 0$ indicates a positive relationship between the percentage of reported illegal income and the length of imprisonment related to tax evasion. This implies that taxpayers will respond to a longer sentence of imprisonment with a higher percentage of reported illegal income. The length of imprisonment affects taxpayers' decisions by increasing the costs of being convicted with tax evasion. Imprisonment restricts offenders' choices of location and activities. It affects offenders' present and future income, and also limits the choices of entertainment that offenders can enjoy. Furthermore, imprisonment leaves a negative impact on offenders' reputation and opportunities when seeking employment. In short, imprisonment has negative long-term effects on both offenders' income and utility. Therefore, the longer the length of imprisonment, the larger the percentage of illegal income taxpayers are willing to report.

However, similar to the penalty rate, the length of imprisonment needs to be proportionate with the crime. In addition, since imprisonment incurs heavy costs for the government, the tax collector needs to pay attention to the interaction between tax revenue, tax evasion, and the cost of incarceration.

Limitations of the Model

Although the model indicates how the penalty rate, the level of deductibility, and the length of imprisonment affect the percentage of reported illegal income, the results of the model are only true when the applied situation satisfies all the assumptions. These assumptions create limitations in three areas: audit scheme, risk attitude, and targeted taxpayers.

The audit scheme is how a tax collector selects the tax returns to be audited. There are three different types of audit schemes: (1) random, (2) cut-off, and (3) conditional (Collins & Plumlee, 1991). In the first type (random), the tax collector randomly chooses the audited tax returns without using any additional information. In the second type (cut-off), the tax collector uses the reported income in the returns as the basis for choosing the audited returns. This type of audit scheme looks for tax returns with low reported income because those returns have a higher probability of underreporting taxable income. In the third type (conditional), the tax collector uses an estimate of true income, in addition to the reported income, to select audit cases. This type of audit scheme looks for taxpayers with the ability to earn a large income, and then compare the estimated income with the reported income. If the variance between the estimated income and the reported income is large, there is a higher likelihood that taxpayers are underreporting their true income. Because of the additional information used, each type of audit scheme has different

effects on the underreported income. To study these effects, Collins and Plumlee (1991) conducted an experimental study in which the facilitator informed participants the type of audit scheme used by the tax authority and recorded their underreported income under each type of audit scheme. Figure 7 below shows the result of the study on how each type of audit scheme affected the average underreported income when the income tax rate and the penalty rate were low/low, low/high, high/low, and high/high, respectively.

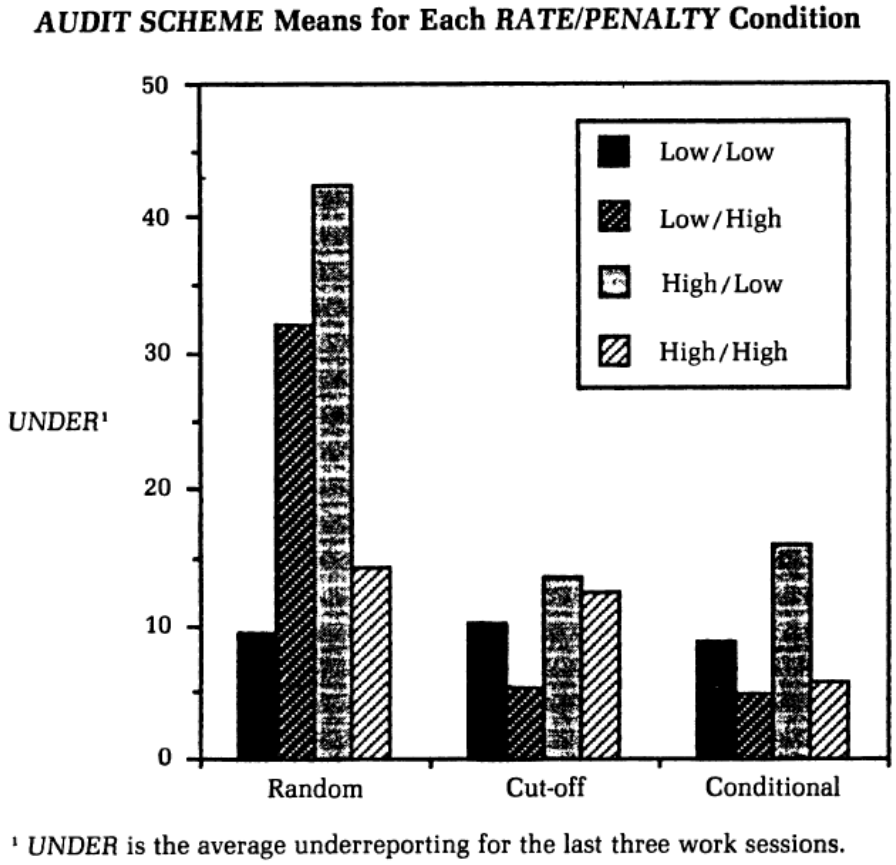


Figure 7. The relationship between audit scheme, rate/penalty condition, and the amount of underreporting income. Adapted from "The Taxpayer's Labor and Reporting Decision: The Effect of Audit Schemes," by Collins, J. H. & Plumlee, R. D., 1991, p. 571.

As shown in Figure 7, taxpayers respond differently to the same income tax rate/penalty rate condition under different audit schemes. While taxpayers' responses to the low/low condition are quite consistent among the three audit schemes, their responses to the other three conditions contain vast differences between different types of audit scheme. Since my model operates under the assumption of a random audit scheme, the results may not be reliable in a tax environment that applies a cut-off or conditional audit scheme.

Besides, taxpayers have an extremely diverse range of behaviors. To study these behaviors, researchers try to categorize people into different groups based on their risk attitude such as risk aversion, risk neutrality, and risk loving. Each group responds to risk, uncertainty, and incentives differently. Therefore, the results of my model are limited to risk-averse individuals. Since taxation has no effect on risk-neutral taxpayers who only focus on the expected returns (Tabbach, 2003), researchers can conduct more studies about the effect of taxation on risk-loving individuals.

Another limitation of my model is that it requires taxpayers to have all the necessary information before making the final tax declaration. Without providing information about the current penalty rate, the level of deductibility, the length of imprisonment related to tax evasion, and the benefits of reporting illegal income, the model cannot predict the effects on taxpayer behavior. Moreover, if a taxpayer does not have a basic understanding of the tax law and its protection of taxpayers' privacy, there is likely to be little incentive for taxpayers to report their illegal income and run the risk of getting caught conducting illegal activities. Consequently, my model is more applicable

in predicting the behaviors of taxpayers who have a sufficient understanding of the tax law.

IMPLICATION

The implication of the model can help improve total tax revenue for the IRS. Appendix B shows that under a penalty rate of 90%, taxing authorities can improve the percentage of reported illegal income from 58% to 76%. An 18% in the proportion of reported illegal income might not seem like a big difference compared to the increase in penalty rate from 35% to 90%. However, it would amount to a significant amount of additional revenue since there are billions of dollars in taxable income derived from illegal activities. For example, in 1981, the IRS estimated that there was $34.2 billion of illegal source income from drugs, illegal gambling, and prostitution (Cebula & Feige, 2011). If this iteration of the model were applied to the year 1981, an 18% increase in the percentage of reported illegal income would have brought the IRS an extra $6.156 billion in revenue.

Future Research

In addition to affecting the proportion of reported illegal income, the model also has the potential to provide a positive impact on the effort of reducing the amount of crimes by decreasing the final return on income-producing illegal activities. Using the same logic, DeMattei (1951) suggested applying a higher tax rate for specified illegal income to reduce the total gross income derived from illegal activities, hence reducing the incentive for criminals to conduct crimes. Notwithstanding, if criminals do not report their illegal income, the taxing authorities have no means to apply special tax treatment to illegal income. My model provides a solution for this issue because it offers incentives

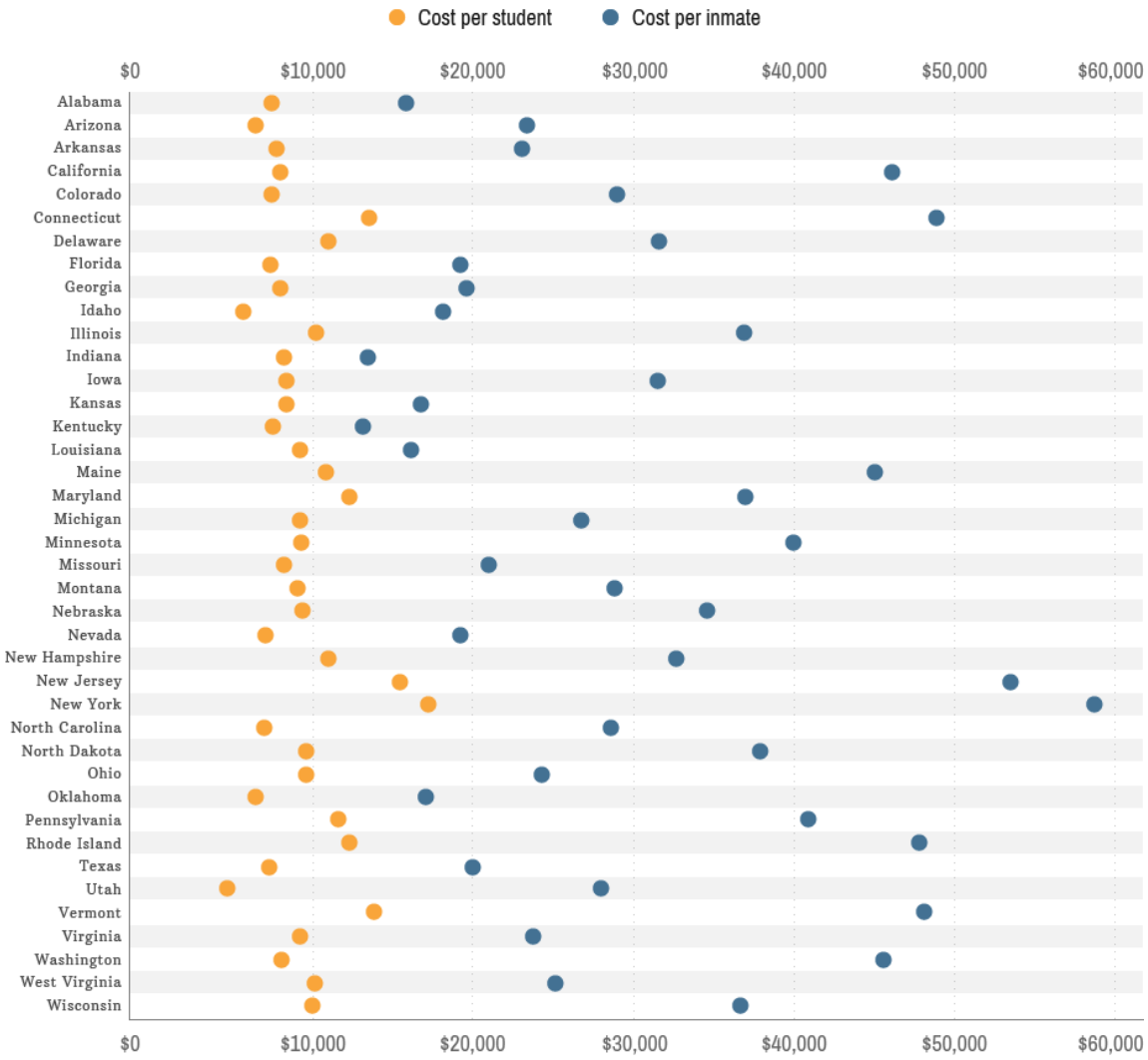
for criminals to voluntarily report illegal income. The equation below indicates the relationship between the percentage of reported illegal income (μ) and the amount of time allocated to illegal activities (a) under my model:

$$\frac{\partial \mu^*}{\partial a} = -\frac{\frac{\partial G}{\partial a}}{\frac{\partial G}{\partial \mu}} = -\frac{1}{D}.\frac{\partial G}{\partial a}$$

$$= -\frac{1}{D}.[p.U''(Y).Y_{\mu}.Y_a + p.U'(Y).Y_{\mu a} + (1-p).U''(X).X_{\mu}.X_a + (1-p).U'(X).X_{\mu a}]$$

Because $\partial \mu^* / \partial a$ can be either positive or negative, the relationship between μ and a is unclear. Although the model yields an ambiguous result on the relationship between the percentage of reported illegal income (μ) and the amount of time allocated to illegal activities (a), future research can focus on providing a better understanding of this relationship. Future research must consider the fact that while the current U.S. tax system is progressive, the majority of theoretical models are based on a linear tax function. Freire-Seren and Panades (2013) suggested this to be a possible explanation for the contradiction between many theoretical and empirical results. In addition, a higher percentage of voluntarily reported illegal income (μ) might improve the effectiveness of the government's ability to detect unreported illegal income by allowing the government to focus its resources on tax returns with a larger amount of evaded income.

APPENDIX A: THE COST OF INCARCERATION



Source: Education versus Prison Costs. Adapted from "Education vs prison costs," by Yellin, T., 2012, *CNN Money. Retrieved from http://money.cnn.com/infographic /economy/education-vs-prison-costs/*

APPENDIX B: A NUMERICAL EXAMPLE OF HOW TAXING AUTORITIES CAN APPLY THE MODEL

In this example, we assume that a taxpayer has an initial wealth of 1,000 (W = 1,000) and follows the utility function of $\sqrt{(.)}$ (U(.) = $\sqrt{(.)}$ ⇨ $U'(.) = \frac{1}{2} * (.)^{-\frac{1}{2}}$). The taxpayer's legal income is a function of the time allocated to income-producing legal activities (w(1-a) = w(a) = $\sqrt{1-a}$), and the taxpayer's illegal income is a function of the time allocated to income-producing illegal activities (c(a) = $3\sqrt{a}$). During the year, taxpayer spent half of his time on illegal activities (a = 0.50). Because the current U.S. income tax law does not allow deductible fines/penalties, this numerical example also does not allow deductible fines/penalties (δ = 0). At the end of the tax year, we assume that the detection probability is twenty percent (p = 0.20), the income tax rate is thirty-five percent (t = 0.35), the function of penalty is μ^{-1}(f(μ) = μ^{-1}), and the monetary equivalent of imprisonment is a function of the length of imprisonment (f(S) = $5\sqrt{S}$). Currently, the highest level of imprisonment for tax evasion is five years (U.S. Department of the Treasury, 2015). This example also uses five years as the length of imprisonment (S = 5).

Except for the detection probability, which taxpayer can estimate based on historical data, other elements such as the income tax rate, the fine function, and the length of imprisonment for the current tax year are public information. Therefore, taxpayer can obtain enough information for their tax declaration decision. Of course, this assumes that the taxpayer makes the effort to obtain this information. According to the model, when the penalty rate is equal with the income tax rate ($t_\mu = t = 0.35$), we have:

$$Y = W + (1-t).w(a) + (1-t.\mu).c(a) - t_\mu.(1-\mu).c(a) - (1-\delta.t).f(\mu) - f(S)$$

$$= 1{,}000 + (1 - 0.35) * \sqrt{1 - 0.5} + (1 - 0.35 * \mu) * 3\sqrt{0.5} - 0.35 * (1 - \mu) * 3\sqrt{0.5}$$
$$- (1 - 0 * 0.35) * \mu^{-1} - 5\sqrt{5}$$
$$= 1{,}000 + 0.4596 + 2.1213 - 0.7425\mu - 0.7425 + 0.7425\mu - \mu^{-1} - 11.18$$
$$= 990.66 - \mu^{-1}$$

$$X = W + (1 - t).w(a) + (1 - t.\mu).c(a)$$
$$= 1{,}000 + (1 - 0.35) * \sqrt{1 - 0.5} + (1 - 0.35 * \mu) * 3\sqrt{0.5}$$
$$= 1{,}000 + 0.4596 + 2.1213 - 0.7425\mu$$
$$= 1{,}002.58 - 0.7425\mu$$

With the above Y and X, we have:

$$G = p.U'(Y).Y_\mu + (1 - p).U'(X).X_\mu = 0$$

$$\Leftrightarrow 0.2 * \left[\frac{1}{2} * (990.66 - \mu^{-1})^{-\frac{1}{2}}\right] * \mu^{-2} + (1 - 0.2) * \left[\frac{1}{2} * (1{,}002.58 - 0.7425\mu)^{-\frac{1}{2}}\right]$$
$$* (-0.7425) = 0$$

$$\Leftrightarrow 0.1 * \mu^{-2} * (990.66 - \mu^{-1})^{-\frac{1}{2}} - 0.297 * (1{,}002.58 - 0.7425\mu)^{-\frac{1}{2}} = 0$$

$$\Leftrightarrow \mu^4 * (990.66 - \mu^{-1}) = 2.97^{-2} * (1{,}002.58 - 0.7425\mu)$$

$$\Leftrightarrow 990.66\mu^4 - \mu^3 + 0.084\mu - 113.66 = 0$$

$$\Leftrightarrow \mu = 0.58\ (with\ \mu > 0)$$

Based on the above result, if the tax system consists of a thirty-five percent penalty rate, no deductibility, and five-year imprisonment, taxpayers will be willing to report fifty-eight percent of their total illegal income to the IRS.

Now, keeping everything else the same, instead of using the thirty-five percent as the penalty rate, the penalty rate is increased to ninety percent ($t_\mu = 0.90$). With the new penalty rate, we have:

$$Y = W + (1-t).w(a) + (1-t.\mu).c(a) - t_{\mu}.(1-\mu).c(a) - (1-\delta.t).f(\mu) - f(S)$$

$$= 1{,}000 + (1-0.35) * \sqrt{1-0.5} + (1-0.35*\mu) * 3\sqrt{0.5} - 0.9*(1-\mu)*3\sqrt{0.5}$$

$$- (1-0*0.35)*\mu^{-1} - 5\sqrt{5}$$

$$= 1{,}000 + 0.4596 + 2.1213 - 0.7425\mu - 1.9092 + 1.9092\mu - \mu^{-1} - 11.18$$

$$= 989.48 + 1.1667\mu - \mu^{-1}$$

$$X = W + (1-t).w(a) + (1-t.\mu).c(a)$$

$$= 1{,}000 + (1-0.35) * \sqrt{1-0.5} + (1-0.35*\mu) * 3\sqrt{0.5}$$

$$= 1{,}000 + 0.4596 + 2.1213 - 0.7425\mu$$

$$= 1{,}002.58 - 0.7425\mu$$

With the above Y and X, we have:

$$G = p.U'(Y).Y_{\mu} + (1-p).U'(X).X_{\mu} = 0$$

$$\Leftrightarrow 0.2 * \left[\frac{1}{2} * (989.48 + 1.1667\mu - \mu^{-1})^{-\frac{1}{2}}\right] * (1.1667 + \mu^{-2}) + (1-0.2)$$

$$* \left[\frac{1}{2} * (1{,}002.58 - 0.7425\mu)^{-\frac{1}{2}}\right] * (-0.7425) = 0$$

$$\Leftrightarrow (0.12 + 0.1\mu^{-2}) * (989.48 + 1.1667\mu - \mu^{-1})^{-\frac{1}{2}} - 0.297 * (1{,}002.58 - 0.7425\mu)^{-\frac{1}{2}}$$

$$= 0$$

$$\Leftrightarrow (0.12 + 0.1\mu^{-2})^{-2} * (989.48 + 1.1667\mu - \mu^{-1})$$

$$= 0.297^{-2} * (1{,}002.58 - 0.7425\mu)$$

$$\Leftrightarrow \mu = 0.76\ (with\ \mu > 0)$$

As the calculation indicates, if the IRS increases the penalty rate from 35% to 90%, the percentage of reported illegal income increases 18% from 58% to 76%.

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