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### The Theory of Tax evasion and Policy Formulation: A Game Theoretic Approach

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**Abstract:** Taxation is the major source of revenue for many countries. But the major thing worrying these nations is the lack of compliance among taxpayers in paying taxes (tax evasion) thus lowering the expected revenue and also leading to a black market. The governments of these nations often audit the taxpayers and impose penalties if they are found evading the tax. This paper models the above situation as a game between the governments which chooses whether or not to audit a taxpayer and the taxpayers who choose whether or not to be honest in paying their taxes. We have modeled this as a simultaneous move game. This is a game of imperfect information as the assumption that the government does not know the actual income of each of the taxpayer has been made. The results of this model suggest that the tax compliance can be increased by increasing the penalties of tax evasion or by creating an efficient audit system so that the costs of auditing are minimized. As the tax rate increases, the government has to audit more number of taxpayers at the equilibrium. Also, as the income of the taxpayers increases, it is found that their compliance behavior increases. The equilibrium compliance rate is found to be independent of the tax rate in this setting of simultaneous moves.

**Keywords:** Revenue; Evasion; Audit; Simultaneous; Imperfect;

#### I. Introduction

The Taxation is an important and major source of revenue to the government of any nation. Tax evasion has been a problem to almost all the countries. Tax evasion is an illegal practice where a person, organization or corporation intentionally avoids paying his/her/its true tax liability. Those caught evading taxes are generally subject to criminal charges and substantial penalties. The formal economic theory of tax evasion is of considerably more recent origin and was developed only from 1970's. Its beginning can be dated to 1972 with the publication of the article [1]. Tax evasion was treated as a risky asset, which is usually determined by Tax Audit and penalty rate. The behavior of tax compliance has been popularly explained by the punishment oriented policies, like tax audit and penalty rate. Other work on this lines include [5], [6], [8].

Recent decades have also seen a number of attempts to provide empirical estimates of the size of the "hidden economy". The empirical work in this area was little. But the empirical work and the policy discussions that followed from it gave inspiration to further theoretical work, and that theory also gave new directions for empirical investigations. The survey of the literature through 1980's was done by [2]; other surveys include [3], [7], [9].

In the present paper, we have modeled the entire tax system as a game between the government and individual income tax payers, and tried to arrive at some conclusions regarding the tax compliance behavior and optimal policy formulation. The case of individual income tax has been considered. The behavior of both the government and tax payers with the changes in tax rate, penalty rate and cost of auditing are also analyzed.

#### II. The Model

The model we have adopted is a modified form of Allingham and Sandmo (A-S) model [1]. We present the model as a game between the government and the tax payers. The ingredients of the game are as follows:

##### The Players:

The players in this game theoretic model are the government and individual tax payers.

##### Strategies:

The tax payer has to choose between correctly disclosing his income and not disclosing. This means that he has to choose between Honest (H) and Cheat (C). Also, we will assume that he can disclose his entire income correctly or not disclose any. This means that when he cheats and not audited by the government, he need not pay any tax. The government has to choose between auditing (A) and not auditing (NA) the taxpayer.

##### Payoffs:

We will assume that the income of a particular tax payer be 'X'. The government has no knowledge about the actual income of any particular taxpayer. It comes to know about the exact income of a taxpayer when

he/she is audited. The tax charged is a proportional tax i.e. a proportion 't' of the income has to be paid as tax. We also assume that the cost to the government for auditing any tax payer is 'C'. Further, when a taxpayer Cheats and is audited, he will be found to be guilty and has to pay a penalty as a proportion 'T' (>t) of the income 'X'. The payoff for the taxpayer is taken as the income remaining after the taxation. The payoff for the government is the tax revenue obtained less the cost of auditing (in case if the government audits the tax payer). An assumption made in this model is that the taxpayers know how much it costs the government to audit a taxpayer i.e. 'C'. This game can be shown in the Normal form as given below:

| Government/ Tax payer | Honest (H)       | Cheat (C)        |
|-----------------------|------------------|------------------|
| Audit (A)             | $tX - C, X - tX$ | $TX - C, X - TX$ |
| Not Audit (NA)        | $tX, X - tX$     | $0, X$           |

### III. The Solution to the Game

The solution to this game and hence the equilibrium actions of each of the players can be obtained by finding the Nash Equilibrium to the above game. The best responses for each of the player are as follows:

For Government: Best Response against Honest (H) is Not Audit (NA)

Best Response against Cheat (C) is Audit (A)

For Tax-payers: Best Response against Audit (A) is to be Honest (H)

Best Response against Not Audit (NA) is to Cheat (C)

We can thus see that there is **NO Pure strategy Nash Equilibrium**.

So, we claim that the possible Nash Equilibrium existing in this model has to be a Mixed Strategy Nash Equilibrium. We assume that the government mixes A and NA with probabilities of 'p' and '(1-p)' respectively. The taxpayers mix H and C with probabilities 'q' and '(1-q)' respectively. The payoff table with this mix can be shown as:

| Government/ Tax payer |       | Honest (H)       | q | Cheat (C)        | (1-q) |
|-----------------------|-------|------------------|---|------------------|-------|
| Audit (A)             | p     | $tX - C, X - tX$ |   | $TX - C, X - TX$ |       |
| Not Audit (NA)        | (1-p) | $tX, X - tX$     |   | $0, X$           |       |

The expected payoff of mixed strategy is the weighted average of the payoffs of each of the pure strategies in the mix. The mixed strategies shown above for each of the players should be best responses to the mix of each of the other players in the game so that the combination could be a Nash Equilibrium. An important property of mixed strategies is that "If a mixed strategy is a best response to a particular strategy, then each of the pure strategies in the mix must themselves be best responses to that particular strategy.

In particular, each pure strategy in the mix must yield the same expected payoff against that particular strategy". We use this important idea to calculate the equilibrium mixes of both government and tax payers.

#### Mix of government:

The tax payers are using (q, 1-q) against the mix (p, 1-p) of government. If this mix of taxpayers has to be a best response to the mix of government, the expected payoff to the taxpayers from H and C against the government's mix should be equal. The expected payoff to the taxpayers against the government's mix (p, 1-p) from:

**Honest (H):**  $p*(X-tX) + (1-p)*(X - tX)$     **Cheat (C):**  $p*(X-TX) + (1-p)*X$

The both payoffs should be equal. By equating both, we get the mix of government as:

$$p = \frac{t}{T} \quad \text{and} \quad 1 - p = \frac{T - t}{T}$$

#### Mix of Taxpayers:

The government is using (p, 1-p) against the mix (q, 1-q) of taxpayers. If this mix of government has to be a best response to the mix of taxpayers, the expected payoff to the government from A and NA against the taxpayers' mix should be equal. The expected payoff to the government against the taxpayers' mix (q, 1-q) from:

**Audit (A):**  $q*(tX-C) + (1-q)*(TX-C)$     **Not Audit (NA):**  $q*(tX) + (1-q)*(0)$

The both payoffs should be equal. By equating both, we get the mix of taxpayers as:

$$q = \frac{TX - C}{TX} \quad \text{and} \quad 1 - q = \frac{C}{TX}$$

Thus, we have obtained the mixed strategy Nash Equilibrium as:

$$\left( \left( \frac{t}{T}, \frac{T-t}{T} \right), \left( \frac{TX-C}{TX}, \frac{C}{TX} \right) \right)$$

This equilibrium can now be analyzed and we can try to recommend some policy actions.

#### IV. Discussion

In the mixed Nash equilibrium obtained above, the mix of government is a literal randomization i.e. they audit  $(t/T)$  proportion of the taxpayers. We can take this proportion of taxpayers being audited as the Audit rate. At this mix, the taxpayers are indifferent between H and C as their payoffs for both are equal against this mix. Similarly, the mix of the taxpayers is a mix in the population i.e.  $((TX-C)/TX)$  of taxpayers pay taxes correctly and the remaining cheat. We can call this proportion of taxpayers correctly paying tax as the Compliance rate. At this mix, the government is indifferent between A and NA as its payoffs for both (A and NA) are equal against this mix.

As the tax rate ' $t$ ' increases, the government has to audit more number of taxpayers but the no. of taxpayers paying taxes correctly remains the same (audit rate increases and the compliance rate is unchanged). This can be explained as follows. As ' $t$ ' increases, the direct consequence is that more no. of taxpayers tend to evade the tax. But the government, knowing that more people will evade tax at this increased rate, increases the no. of taxpayers audited. Hence the no. of tax evaders should decrease at this increased audit rate. This is a strategic effect or indirect effect. Because of these two opposing forces, the overall effect is that the no. of taxpayers paying tax is unaffected whereas the audit rate has increased. Same argument as above can be applied to see that at a decreased tax rate, the audit rate decreases, with taxpayers being honest at the same rate.

When the penalty rate ' $T$ ' increases, we see that the tax compliance increases and the audit rate decreases. As ' $T$ ' increases, this causes more no. of taxpayers to be honest, thus increasing the compliance rate. As more no. of taxpayers are now Honest, this induces the government to decrease the audit rate. Similarly, a decrease in ' $T$ ' decreases the tax compliance rate and increases the audit rate (no. of taxpayers audited).

Ref [4] showed that one of the reasons for Japan having a higher level of compliance than Korea is the higher penalty rates in Japan than in Korea.

Finally, coming to the case of Cost of audit ' $C$ ', a high cost causes the compliance rate to decrease and a low cost causes the compliance to be high. When the costs are high, the government cannot afford to audit many taxpayers and the taxpayers possessing this information of high costs, tend to be non-compliant. Similarly, when the costs are low, government can easily audit majority of the taxpayers. This information of low costs available to the taxpayers makes them to be more compliant. This leads to an important requirement for a good tax system that the costs of tax administration must be low.

When the cost of auditing is equal to the penalty amount to be paid (for a particular group of taxpayers with income  $x$  such that  $Tx = C$ ), then it turns out that Cheating (C) is the best response for those group of taxpayers. Thus, even when  $C$  is small, some persons with small incomes (say  $x$  so that  $Tx = C$ ) tend to evade tax always.

The tax compliance can be improved either by increasing the penalties ( $T$ ) or by decreasing the cost of audit ( $C$ ) which can be done by formulating efficient audit methods.

We also see that with the increase in the income of the people, the tax compliance rate increases. This implies that when a taxpayer has a high value of ' $X$ ' (more money has to be paid as tax, implying more money is at stake) i.e. when he/she is rich, this does not mean that the particular taxpayer is going to cheat more. He/she is going to be more honest in paying their taxes because of the fear of more penalties to be paid if caught cheating. This is consistent with [1] which says that in the absence of knowledge about actual income, a person with low income is more likely to be an evader.

In this simultaneous setting where we have assumed that both government and taxpayers will be choosing their actions simultaneously, the equilibrium audit rate is found to be independent of the income of the individual taxpayer.

#### V. Conclusions

It is very important for any economy to raise the revenue through taxation to cater the needs of development of the economy. Tax Compliance has become an important issue in the tax system. This paper models the tax-paying system as a game between the government and taxpayers and tries to address the issue of tax compliance. The results of this model suggest that the tax compliance can be increased by increasing the penalties of tax evasion or by creating an efficient audit system so that the costs of auditing are minimized. When the cost to the government of auditing a taxpayer is made very low or nearly '0', then this model suggests that compliance rate up to 100% can be achieved. When the government sets a high tax rate, it has to audit more number of taxpayers at the equilibrium. The number of taxpayers to be audited will decrease with the increase in the penalty rate.

This paper can be extended to include much more types of penalties (may be an absolute value of penalty levied on any taxpayer who cheats) and also satisfaction can be taken to increase with the amount of tax paid (we considered an absolute value of satisfaction for any tax payer). Also, we have considered that the taxpayer discloses his/her whole income or not disclose any. We can also model by allowing the taxpayers to disclose a

portion of his/her income (as done by [1]). Also, we can consider the taxpayers to have a sense of “tax morale” i.e. a moral obligation to pay the taxes correctly and the satisfaction thus obtained by contributing to the economic growth.

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