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AN ANALYTICAL MODEL OF TAX EVASION

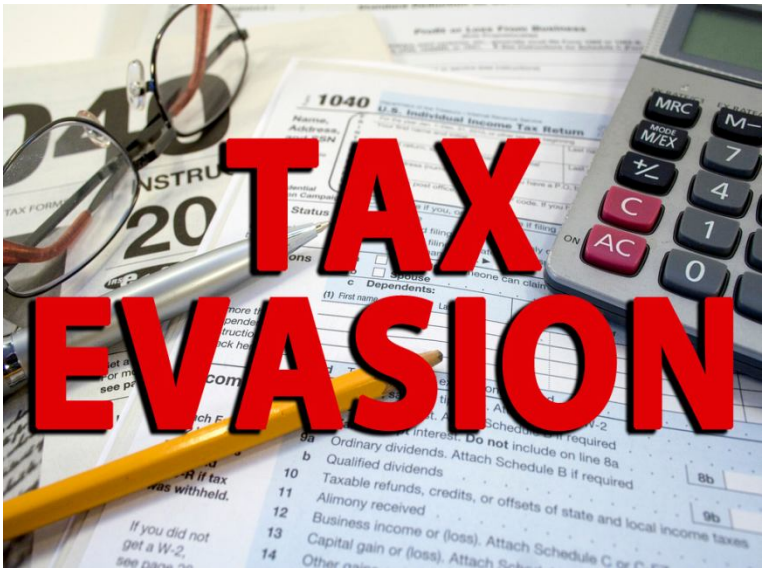
Sarvesh Bandhu
Assistant Professor , Department of Economics , Shri Ram College of Commerce, Delhi University.

Short Profile :

Sarvesh Bandhu is working as a Assistant Professor at Department of Economics in Shri Ram College of Commerce, Delhi University.

Co – Author Details :

Krittika Tiwari
Assistant Professor , Department of Economics , Shri Ram College of Commerce, Delhi University.



ABSTRACT
This paper tries to build an analytical model on tax evasion. It is an extension of the principal-agent model of Nadeem Ul Haque and Ratna Sahay. The original model assumes the tax auditor is honest and the probability of detection only depends on his skills, the relative wage of the tax auditor has no relation with the number or magnitude of detection and also probability of detection or audit is the same as punishment. And so it concludes that higher tax rate can have ambiguous effect on tax collection. However, if the tax auditor himself is dishonest it has been shown in the model that tax rate increase will unambiguously increase tax collection.

KEYWORDS:
Tax evasion, bribery, corruption

INTRODUCTION

According to Swiss Coalation of Development Organisations, harmful tax practices are leading to a loss of at least USD 50 billion a year for the Developing Countries. This amount is equivalent to the amount required by the World Bank and UNDP to achieve its Millenium Development Goals. It is also equivalent to the annual official aid given by the OECD countries to Developing Countries. And the tax burden is ultimately shifting from the rich to the poor.

After the opening up of the financial markets tax evasion and money laundering have come up as serious problems for macroeconomists. Even though tax evasion was always a concern for the economists it has now increased to a much larger extent, due to the fact that many of the new financial markets assist the tax evaders by providing them with an easier way of hiding their black money. This amount which would have been used for economic and social development purposes is used for either criminal activities or for riskier low-quality investments like gambling. This money on entering the stock market also brings about a lot of instability.

In a study done by Alex Cobham, for low-income countries, shadow economy forms 32.7% of the GDP and also has potential tax revenue of 13.7%. And therefore, by bringing down tax evasion a lot of funds can generated and used for more welfare oriented investments.

REVIEW OF LITERATURE

The first classical model on tax evasion was made by Allingham and Sandmo in 1972 where an individual tries to maximise his expected utility from evasion of taxes. The model considers a monetary fine along with a loss of reputation as a penalty and had static as well as dynamic versions of the same. It also included comparative static results with respect to actual income, tax rate, penalty and probability of detection concluded that probability of detection and penalty rate both or a combination of the two can be used for reducing tax evasion. But they assumed that fines are assessed on income evaded by the tax payer. So, the affect of increase in taxes was unclear as the substitution effect (higher marginal tax rate makes evasion more attractive) and income effect (high tax rate lowers income) offset each other in case of risk aversion(as low income makes taxpayer less willing to take risk).

However, in 1974 Yitzhaki showed that substitution disappears when fines are assessed on taxes evaded and not income evaded and solved the ambiguity related to effect of tax rate in Allingham-Sandmo model. After this the Allingham-Sandmo-Yitzhaki model was used as the benchmark for all other later models. All these models assumed the tax payer to be corrupt but not the tax collector which may be true for the developed nations but not for the developing countries. However, the models by Becker and Stigler (1974), Rose-Ackerman (1975), Klitgaard (1989 &1995), Basu Bhattacharya and Mishra (1992) Mookherjee and Png (1995) and Nadeem Ul Haque and Ratna Sahay (1996) assume tax collector be corrupt as well and used the principle-agent problem to find the solution to tax evasion and corruption. Among these the model by Nadeem Ul Haque and Ratna Sahay shows that by increasing the incomes of government employees more skilled individuals can be attracted to the job and also higher government wages also weakens the incentive compatibility condition of corruption, for the tax collector thereby reducing corruption and tax evasion. Generally all these models assume the tax payer to be dishonest but the model by Brian Erard and Jonathan S.Feinstein assumed that not all tax payers are dishonest and used an asymmetric information static

game to build up their model and had results very dissimilar to the others.

The theoretical models made till now still have a lot of scope to come closer to the reality of corruption present in the developing countries. As most of the results depend on the kind of assumptions regarding who are considered to be honest or dishonest, it is difficult to choose and say which one is more appropriate.

AN ANALYTICAL FRAMEWORK

This is an extension of the Nadeem Ul Haque and Ratna Sahay model. The original model consists of four sets of players: the government, the tax collectors, the auditors and the private sector firms. Each private sector firm produces $\mathbf{y_i}$, on which the government imposes a uniform tax rate of **t**, such that the total tax accruing to the government is $\mathbf{T= \Sigma t y_i = t\Sigma y_i}$. So the tax paid by each firm is $\mathbf{T_i = ty_i}$.

But the actual tax reported by the private firms is $\boldsymbol{\tau_i =}$ $\mathbf{T_i}$, $\mathbf{0< <1}$. There is perfect information between government and tax auditor as well as between the tax collector and the private firm. But there is imperfect information between the tax auditor/government and tax collector/private firm. This means that every action of the government is observable by the tax auditor and vice-versa and the same is true for the tax collector and the private firm also. But the actions of the tax collector/firm are not observable by the auditor/government. And so, the private firm and the tax auditor engage in mutually beneficial agreement in which the firm underreports its tax as $\boldsymbol{\tau_i}$ and gives a bribe of $\mathbf{b_i}$ for cooperating with it. Thus the firm gains $\mathbf{T_i – \tau_i – b_i}$ from tax evasion and because the firm and tax collector share in gains from tax evasion $\mathbf{b_i \leq T_i – \tau_i}$ has to hold.

But the government is aware of this kind of cooperation between the firms and the tax collectors so it sets up institutional arrangements to monitor this kind of behaviour. It hires tax auditors who are capable of detecting tax evasion with a probability $\mathbf{p, 0 \leq p \leq 1}$. This **p** is directly proportional to the skill of the auditor which in turn is dependent on his /her relative wage $\boldsymbol{\alpha = (w_g/w_p)}$, where $\mathbf{w_g}$ is the wage of the government employee and $\mathbf{w_p}$ is the wage of the private sector employee. The assumption behind this argument is that, a higher wage will be able to attract more skilled people into the job of an auditor and so a more skilled auditor will be able to detect tax evasion and corruption more efficiently thus increasing **p**. And so, **p** is an increasing function of **α**. **p** is also directly proportional and increasing function of the amount of tax evaded, as the chances of detection increases. And so, $\mathbf{p = p(\alpha, T- \tau).}$ The function **p** is assumed to be differentiable, increasing and convex in both arguments, i.e. $\mathbf{\partial p/\partial \alpha > 0 \text{ and } \partial p/\partial (T-\tau) > 0}$, where $\mathbf{T = \Sigma\ ty_i}$ and $\boldsymbol{\tau = \Sigma\ \mu T_i}$, which is observable to the government and so in a way **p** is a choice variable for the firms. After detection both firms and tax collector are fined and the penalty is larger than the amount cheated. The amount of penalty or fine charged is proportional to the amount of tax evaded. It is $\boldsymbol{\delta_p (T_i - \tau_i)}$ for the private firms, where $\boldsymbol{\delta_p > 1}$ and $\boldsymbol{\delta_g (T_i - \tau_i)}$ for the tax collector , where $\boldsymbol{\delta_g > 1.}$

Based on the above mentioned details the firm maximized its gains from evasion by choosing **.** And the gains from tax evasion were divided between the firm and the tax collector depending on their respective bargaining powers, which determined the bribe $\mathbf{b_i}$ given to the tax collector. After maximization the amount of tax evasion $\boldsymbol{\tau_i}$ was found to be a function of the policy variables of the government. Therefore $\boldsymbol{\tau_i = \tau_i (\alpha , \delta_p , \delta_g , T_i)}$ and total derivatives with respect to $\boldsymbol{\alpha , \delta_g , \delta_p}$,were found to be positive.[3] This means that as the relative wages of the auditors is increased (probability of detection raised) or the penalties are increased tax collection improves. But the effect of an increase in tax rate and thus $\mathbf{T_i}$ is ambiguous, as an increase in tax rate can have two effects one direct effect

which increases tax collection and another indirect effect which increases tax evasion and so the overall effect need not be necessarily positive or negative.

The most important results of the Nadeem Ul Haque and Ratna Sahay model are that by increasing the relative wages of the tax collector and the auditor, the government budget deficit can actually reduce if the increase in tax collection turns out to be higher than the increase in wage expenditure.

Criticisms

a) The implicit assumption of this model (also the other principle-agent models) is that the tax auditor is honest and the probability of detection only depends on his skills, is not very convincing. It is similar to the assumptions made in the initial models where the tax collector was assumed to be honest and only the tax payer was dishonest. These models also incorporate the same flaw of arbitrarily assuming some people to be honest and others to be dishonest. It is very well possible that if the gains from tax invasion are too high the evader might actually make the auditor also collude with him/her as the amount at stake in case of higher gains is also higher. It is very unlikely that the evader would passively let the detection depend upon something exogenous but would rather endogenies the probability of detection which is possible by bribing the the auditor as well . And it is reasonable to assume this as corruption in low-income countries is not restricted to one level or a group of people but is present at multiple levels and overtime becomes a part of the system.

b) The other assumption of probability of detection or audit being the same as punishment is also not that appropriate. In real life it is not always that if an individual is detected he / she will be automatically punished as unless it is proved in the court that the individual is guilty of tax evasion there is no effect of detection. As it is the case with most of the developing countries the judicial system is not very efficient. Firstly, it takes quite a lot of time in giving the judgment and so a delay in judgment always increases the benefit from evasion because the punishments are discounted more with delays and do not remain as threatening. Secondly, even after a lot of delays (and many a times due to delays) the evader may not be proved guilty due to lack of evidence (there is a possibility of corruption there as well). As a result of both these factors the effective probability of punishment, which is the actual probability that would be considered by the tax payer while making the decision of evading taxes goes down drastically. And generally this is case in most developing countries where a large proportion of raids (most used method of detection) do not result in punishment.

Thus, the probability of punishment is the appropriate probability to be used in this model. And a simple application of the model without taking into account the effective probability may not give the desired results.

c) It is assumed that an increase in wage will bring in more skilled workers and so automatically will increase detection. But having a more skilled worker does ensure an incentive to detect also. Higher skill may imply higher ability to detect but not necessarily more will or incentive to detect. And so, it is equally important for there to be incentive along with skill to have better detection mechanism. Otherwise, plainly increasing the wages of the tax auditor might be a futile exercise which is one results of the Nadeem Ul Haque and Ratna Sahay model. *So, there should be rewards for detection*

for the auditor to have an incentive to work more efficiently. These rewards can be explained as the promotions and some monetary gains (also some non-monetary gains like appreciation and improvement in status) which government officers get in real life. Therefore, successful detections (the ones for which punishment is given) should determine wages and not the other way round.

THE MODEL

In this framework, there are three players: the government, the tax payer or the private firm and the auditor. Here both the tax payer as well as the auditor is considered to be rational i.e. the auditor will be ready to take a bribe if it maximizes his expected gains by doing so. The tax collector has not been included as it firstly, does not make any difference to the working or the results of the model and secondly because if the the firm can bribe the auditor himself bribing the tax collector does not make any difference.

The tax rate, each firms produce and tax collected or reported are the same as in the original model **t, y_i, τ_i** respectively, which implies $\mathbf{T_i}$ and are also the same as before.

One major departure from the original model is that now instead of one probability of detection there will be a combination of the probability of audit and the probability of punishment in case of an audit. Thus, now the required probability **p** will be a product of the probability of audit $\mathbf{p_1}$ and the probability of punishment after the audit (successful proving of tax evasion in the courts) $\mathbf{p_2}$. So, $\mathbf{p = p_1 * p_2}$. The penalty imposed on the firm in case of punishment is the same $\delta_p[\ T_i - \tau_i\ ]$, where $\delta_p > 1$. The firm is also assumed to be risk neutral.

Another change is that, the auditor will now get a reward for successful detection of tax evasion. The reward shall be a proportion **r** of the amount evaded and so that the higher the amount of tax evaded the higher the incentive to detect. If the reward will be an amount which is irrespective of the amount of tax evaded, there can be a tendency on the part of the auditor to maximize the number of audits without finding the proper evidence rather than maximizing the amount of tax collection. The reward should also be only for those audits in which there has been successful punishment, so that the auditor cannot claim reward on those audits where there was no tax evasion. Therefore, there should be two parts of the remuneration of the auditor one the fixed, regular wage $\mathbf{w_g}$ and so the relative wage $\boldsymbol{\alpha(=w_g/w_p)}$ and the second, the variable component of the wage $\mathbf{r}\sum_i(\mathbf{T_i} - \tau_i)$, **i** here implies number for all the firms which have been punished for tax evasion**.** This mechanism would ensure the maximum effort from the auditor without giving him/her any undue advantage.

ANALYSIS

A) Conditions for minimizing corruption –

In this case any collusion between the firm and the auditor would take place only if the following two Incentive- Compatibility-Conditions are satisfied:-

a) The gain from corruption should be higher than expected gain from no corruption for the firm. i.e. giving bribe to the tax auditor should be more beneficial than not giving.

$$(T_i - \tau_i) - b_i \geq (T_i - \tau_i) - p_1 * p_2 \{ \delta_p [T_i - \tau_i] \}$$

$$\Rightarrow p_1 * p_2 \{ \delta_p [T_i - \tau_i] \} \geq b_i \quad \text{---(1)}$$

Equation **(1)** implies that it is compatible for the firms to collude with tax auditor: if the expected penalty from punishment which takes place only if evasion is first audited and second verified in the court should be greater than the bribe offered to the auditor.

b) The gain from taking a bribe should be higher than the gain from the expected reward. This implies if the auditor is offered a bribe he would assess his chances of getting the reward after auditing in comparison to the bribe he would get for not auditing:

$$b_i \geq p_2 \{ r [T_i - \tau_i] \} \quad \text{--- (2)}$$

From equations **(1) & (2)** for both the Incentive-Compatibility-Conditions to meet simultaneously we need:

$$\Rightarrow p_1 * p_2 \{ \delta_p [T_i - \tau_i] \} \geq p_2 \{ r [T_i - \tau_i] \} \quad \text{--- (3)}$$

Equation (3) imply:

$$\Rightarrow \delta_p * p_1 \geq r$$

Therefore, if $r > \delta_p * p_1$ then no corruption on the part of the firm or the auditor would take place.

This means that if an amount slightly greater than the entire penalty amount is given to the auditor there will be no incentive for corruption from both the parties.

B) Conditions for maximizing tax collection without corruption:

The expected gains for the firm in case of no corruption are –

$$\text{Max}_{\tau_i} \; (T_i - \tau_i)[(1- p_1) + p_1(1 - p_2)] - \delta_p(T_i - \tau_i)[p_1 * p_2]$$

$$\Rightarrow \text{Max}_{\tau_i} \; (T_i - \tau_i)[1-p_1 * p_2] - \delta_p [(T_i - \tau_i)(p_1 * p_2)]$$

The First Order Conditions are:

$$- (1 - p_1 * p_2) + \delta_p(p_1 * p_2) + \delta_p * \tau_i * p_2 * (\partial p_1/\partial \tau_i) - \delta_p * T_i * p_2 * (\partial p_1/\partial \tau_i) = 0$$

[as p_1 is an increasing function of $(T_i - \tau_i)$ or a decreasing function of τ_i]

$$\Rightarrow \quad \tau_i = \frac{(1 - p_1 * p_2) - \delta_p(p_1 * p_2) + \delta_p * T_i * p_2 * (\partial p_1/\partial \tau_i)}{[\delta_p * p_2(\partial p_1/\partial \tau_i)]}$$

C) Conditions for maximizing tax collection with corruption:

The expected gains for the firm in case of corruption:
Max $(T_i - \tau_i - b_i)$
τ_i

Max $(T_i - \tau_i) - r\{p_2[T_i - \tau_i]\}$ **[as the lower the b_i the higher the profits and b_i =**
τ_i **$p_2\{r[T_i - \tau_i]$ is the lowest possible b_i]**

Max $(T_i - \tau_i) - (\delta_p * p_1)\{p_2[T_i - \tau_i]\}$ **[as $r = \delta_p * p_1$ is the maximum possible value of r**
τ_i **which is exogenously given for the firm]**

The first order condition is

$$-1 - \delta_p * T_i * p_2 * (\partial p_1/\partial \tau_i) + \delta_p(p_1 * p_2) + \delta_p * \tau_i * p_2 * (\partial p_1/\partial \tau_i) = 0$$

$$\Rightarrow \quad \tau_i = \frac{1 + \delta_p * T_i * p_2 * (\partial p_1/\partial \tau_i) - \delta_p(p_1 * p_2)}{\delta_p * p_2 * (\partial p_1/\partial \tau_i)}$$

POLICY IMPLICATIONS

Given the above results it is now possible to see what can the government do to maximize tax collection (τ_i) :

1) Increase the probability of punishment after the audit , p_2 :

$(\partial \tau_i / \partial p_2) > 0$ for both the cases whether with corruption or without [as **$(\partial p_1/\partial \tau_i) < 0$] .**
Therefore, increasing the probability of punishment reduces tax evasion. So, reducing the delays in punishment and improving the efficiency of the legal system definitely helps in reduction of tax evaded.

2) The rate of reward r should be equal to $\delta_p * p_1 + \varepsilon$:

A slight or **ε** increase in **r** can increase the tax collection by an amount equal to the difference between tax collected in case of corruption and tax collected in case of no corruption which is $-p_1/[\delta_p * p_2 * (\partial p_1/\partial \tau_i)]$ (which is positive as $(\partial p_1/\partial \tau_i)$ is negative). So, unlike the results of the earlier models, although both $(\partial \tau_i / \partial p_1)$ and $(\partial \tau_i / \partial \delta_p) > 0$ in both the cases, an increase in δ_p or an increase in p_1 without a corresponding increase in **r** can lead to corruption and therefore, actually lower the tax collection instead of increasing it.

Thus, while increasing δ_p or p_1 the equality $r = \delta_p * p_1 + \varepsilon$ should be kept intact and **r** should also be increased accordingly.

3) Increase in tax rate t to increase tax collection:

Unlike the original model, where it was possible for tax collection to decline with an increase in statutory tax rate **t ,** in this model the tax collection monotonically increases with the statutory tax rate in the both the cases whether corruption is present or absent.

CONCLUSION

As the low-income countries are always in need of funds to meet their development objectives, it is important that the domestic funds are used as efficiently as possible. On the contrary, quite a large amount of funds do not get used in the most productive activities due to corruption and tax evasion. Instead of looking for more grants from the developed countries if these countries bring down the level of corruption, the surplus funds from these channels can be used to maximize the social welfare.

Apart from the above mentioned reason, another reason why it is an important issue is that ,a lot of this money goes into illegal and anti-social activities like terrorism , smuggling of drugs etc. If the funds for these activities are stopped many of these activities can be kept under check.

Therefore, by improving the legal machinery of the country in terms of lesser delays in judgments and by developing a reward system for the auditor where the rate of reward is slightly greater than the product of his probability of detection and penalty, we can have lesser corruption and tax evasion.

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