Wages and Penalties in Fighting Hierarchical Corruption

(The Case of Tax Administration)

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Summary: The general aim of this paper is to contribute to the study of factors that decrease corruption in the public sector and especially in tax administration. A matter of particular interest will be the effect of raising civil servants' wages and penalties on the behavior of agents in the case of tax evasion. We will also look into the role of civil society and the dismissal sanction in a country with high level of unemployment in the fight against corruption. Using a model of partial analysis referring to a typical agency problem, we will demonstrate how the coalition among civil servants and the firm may be broken in order to curb tax evasion and the incidence of corruption.

Keywords: Governmental corruption, tax evasion, coalition, game theory, behavioral of economic agents, wages and penalties in public sector.

JEL Classification: C02, C61, C7, D73, H1, H26, H3.

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Corruption is an age-old societal problem, perhaps even as old as life itself. Since it is a problem of allocating resources and relates in particular to the well-being of people, corruption is an interesting object of economic analysis. Before pushing the point any further, it is necessary to explain the meaning of corruption though it is difficult to give an accurate definition of it as it can have multiple aspects. The following paper will look into government corruption, which can be defined as the selling by a public official of a good or service belonging to the state in exchange for a bribe. For instance, an employee in the Passports Office could deliver a passport to a citizen only in return for a bribe.

In fact, there are almost as many economic policies for fighting corruption as there are forms of corruption. It is therefore difficult to remedy all forms of corruption. In the following paper, we have chosen a particular form of corruption that is tax evasion. In this case, it is about a firm (taxpayer) that should pay taxes to the government and an inspector who should levy these taxes: both enter into negotiations so that the taxpayer benefits form a tax break while the inspector receives a bribe. Therefore, the government receives a lesser amount of revenues. It is thus in the government's interest to find means to counter this collusion. Some of the proposed solutions for curbing corruption include raising the penalties imposed on defrauders and raising the salaries of public officials. Moreover, the existence of a strong civil society may contribute to curbing corruption.

First of all, let us look deeper into the role of penalties. A more severe penalty may constitute a good policy to lessen tax evasion provided that it is efficiently implemented in order for it to be credible. Indeed, one would have to be naïve to believe that all those in charge of implementing penalties are incorruptible. Furthermore, the types of penalties that could be implemented must abide by the constraint of limited liability. For instance, it would be totally irrelevant for an inspector to be fined 10,000 euros if he/she is found guilty of accepting a 100 euros bribe as the inspector who cannot afford to pay this fine could be nevertheless tempted to accept a bribe.

On the other hand, when public officials' salaries are insufficient, they might think about raising them, hence the policy of raising their wages. However, raising these wages does not guarantee that they will be less corrupted. After all, our consumption is maximized and so is our revenue. Thus, if the wages of some types of officials are raised to the exclusion of others, the former might simply grow more demanding and require a more substantial bribe. If the wages of all officials are

raised, it would have repercussions pertaining to the state budget and to the costs of public services. In this respect, a strong civil society can certainly contribute to decreasing corruption, but it is not a policy that comes directly under the government's responsibility.

The general aim of this paper is to contribute to the study of factors that decrease corruption in the public sector. A matter of particular interest will be the effect of raising civil servants' wages, penalties and the role of civil society on the behavior of agents in the case of tax evasion. Using a model of partial analysis referring to a typical problem of sharing the cake rather than to an agency problem, we have demonstrated when firms have no bargaining power, if penalty levels are linked to public officials' wages and if corruption is rampant among the different stages of the public service (both auditors and inspectors are corruptible), then raising an agent's wage simultaneously increases the penalty to be imposed on the other in case the collusion is detected. Hence, this raise in wages does no longer have any direct effect on the level of corruption or the bribe amount (as in the model of Haque and Sahay), but rather an indirect effect (even ambiguous) through the sanctions which will be proportional to the increase in wages while the amount of the requested bribe increases as well. Thus, the public officials – and more importantly the taxpayers – will be less incited to conspire or to cooperate on a tax evasion scheme; hence, tax evasion decreases then the incidence of corruption decreases. We showed also when the government imposes non-monetary sanctions like the dismissal; a raise in the unemployment rate will curb the amount of tax evasion, hence reducing the incidence of corruption.

This paper is divided as follows: the following section will offer a review of the economic literature pertaining mainly to the problematic issue of the efficiency of raising civil servants' wages in order to fight against corruption. As our model is not the first of its kind, the second section will be a criticism of the fiscal administration model of Ul Haque and Sahay[1]. The third section will describe our model of fighting against corruption and the instruments of the fight against the corruption, which are developed in this model. The fourth section explained the relation between the unemployment rate and corruption when sanctions are non-monetary. Finally, we will draw conclusions by summing up the main results of the model.

[1] Ul Haque, N., Sahay, R. (1996), "Do Government Wage Cuts Close Budget Deficits? Costs of Corruption", *IMF*, Staff Papers, Vol. 43 (December); p. 754-778.

1- Review of the literature

Because most problems are rooted in lax budgetary policies, general government budget are usually the focal point for corrective measures. A common advice given to governments, particularly by international institutions and donor groups, is to cut "excessive" expenditure items. As public investment expenditures are generally viewed favorably in light of economic growth objectives, the natural targets are current expenditures, particularly government wages. A common rule of thumb that is often employed is to cut (or maintain) the wage bill in real (or even nominal) terms. Governments in developing countries have been reluctant to shed labor, given relatively high unemployment rates and poorly developed social safety nets. In these circumstances, a real reduction in government salaries is among the common austerity measures taken (Besley et McLaren, 1993)[2].

Despite the complexities involved in determining the appropriate salary levels for civil servants, there can be little disagreement that paying salaries that ensure public administrative efficiency is important for several reasons:

- First, the pervasive nature of government activity in developing countries and transition economies creates vast opportunities for bureaucratic discretion. Unless the right incentives, of which adequate pay is an integral part, are set for government employees, public resources are likely to be misallocated.
- Second, the civil servants in these economies are expected to play a crucial role in helping transform underdeveloped economic structures and rudimentary institutions into advanced, market-based ones ; to facilitate the process quickly and efficiently, governments must attract skilled human capital by compensating workers adequately. Underpaid civil servants have been known to illegally spend a substantial part of their office time on rent-seeking activities, thus diminishing civil service productivity.
- Finally, with recent liberalization of economic regimes in several countries and the growth of the private sector, wages in the last sector are likely to rise rapidly. To preclude mass exodus of skilled government employees to the private sector, government pay scales, especially of those holding key positions in the government, must rise in tandem with the trends in the private sector.

[2] Besley et McLaren (1993), "Taxes and bribery: the role of wage incentives". *Economic Journal* 103, p. 119 - 141.

In a provocative paper, Klitgaard (1989)[3] charges governments in developing countries with "incentive myopia", a term used to describe the shortsightedness of policymakers in attempting to close budget deficits by cutting real wages in the public sector. Klitgaard argues that an approach leads to a collapse of incentives in the public sector. Despite the evidence presented in several anecdotal studies, there has been little economic analysis or systematic empirical investigation of the phenomenon. In particular, no attempts have been made to link public wage policy with the quality of output in public administration. A genuine problem, of course, is that reliable and consistent time-series data, even on the structure of public sector wage and employment, are not available for most countries. Some studies (such as those by the World Bank and the International Labor Organization) provide snapshots of key issues on the basis of sparse and disjointed databases. These studies are important in that they demonstrate the nature of problems in the public sector.

A recent econometric study by Van Rijckeghem and Weder (1996)[4] provides direct evidence of a negative relationship between public wages and corruption. Using a panel data estimation procedure for a sample of 20 countries over 1982-1994 period, they find that the ratio of civil service wages to manufacturing wages was a significant determinant of the corruption index. In the countries studied, the simple correlation between relatives wages and the corruption index was more than 0.8. The results of their model show that if we want to eradicate corruption almost completely, wages in the civil service should be 2 to 8 times higher than in the private sector according to countries, all things being equal.

However, according to Tanzi (1994)[5], less-developed countries may be prone to corruption than industrial countries because of differences in "cultural factors" and because the administrative system and institutions are poorly developed and government wages are low, he argues that a policy that advocates cuts in the wages of civil servants “leads to a growing inefficiency of civil servants, especially when the public sector is called upon to play an important role in the economic restructuring”. Officials who are in charge of levying the taxes are an interesting example that demonstrates this possible inefficiency. As governments look to increase their revenues, they want to have honest and competent tax collectors. If their wages are low, they are more prone to accepting bribes. Therefore, there will be tax evasions and governments will have lower revenues. Consequently, it is often suggested to raise the wages of tax collectors so that they make more efforts when collecting taxes.

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[3] Klitgaard, R. (1989), "Controlling Corruption", *University California Press, Berkeley.*

[4] Van Rijckeghem, C. and Weder, B. (2001), "Bureaucratic corruption and the rate of temptation: do wages in the civil service affect corruption, and by how much?", *Journal of Development Economics*, Vol. 65; p. 307-331.

[5] Tanzi, V. (1994), "Corruption, Governmental Activities, and Markets", *IMF* Working Paper No.94/99

While much anecdotal evidence on public administration inefficiency and corruption in developing countries and transition economies exists, there is a dearth of formal analysis in the current literature of the macroeconomic relationships among public wages policy and public administration activity. A model of public administration is developed in this paper to understand better the links between wage policy, penalties and administrative efficiency. Specifically, we investigate these issues in the area of revenue collection[6] to see how different public policies and institutional settings affect the fiscal policy. Empirical studies of bureaucratic corruption point to three main factors that determine the extent of corruption: opportunities (the size of government as in Tanzi 94), low salaries and poor policing. We address the last two factors in our analysis, by recognizing that a distinction can be made between bureaucratic corruption (characterized by bribes) and bureaucratic inefficiency (owing to low levels of skills and management), although the two may observationally be the same, for example resulting in low rates of tax collection.

Well known models of tax evasion (Allingham and Sandmo, 1972[7] and Srinivasin 1973[8]) are based on asymmetric honesty between taxpayers (who could be dishonest) and tax collectors (who are honest by assumption). Although this scenario is likely in industrial countries, it's not a reasonable assumption in most developing countries. Our model allows for the possibility that both tax collectors and taxpayers are corrupt (and even the auditor). Virmani (1987)[9] also allows for symmetric dishonesty and considers different bureaucratic regimes (honest and dishonest, depending on what he calls a social weakness factor) that are independent of the incentive scheme for tax collectors. Within the dishonest regimes, he determines optimal incentive schemes that ensure the honesty of bureaucrats in "corruption-deterring" societies and "weak" societies. He shows how, if bribe exist, evasion does not increase in a corruption-deterring society when penalties merely lead to transfer rents from payer to collector. In a weak society, however, larger penalties lead to increased evasion. The intuition for the latter outcome is that, if penalties are increased, it becomes more profitable for the tax evader and collector to collude. In contrast to Virmani's model, our model does not assume a priori that some regimes are more corruptible than others; the emergence of corruption is simply a result of the incentive mechanisms in the administrative system.

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[6] The model we develop can be generalized to study other aspects of public administration as well, such as public procurement for example.

[7] Allingham M. and Sandmo A. (1972), "Income tax evasion : a theoretical analysis", *Journal of public economics*, Vol 1, November, p. 323-38

[8] Srinivasan T.N. "Tax evasion, a model", *Journal of public economics*, Vol. 2, November, p.339-46.

[9] Virmani, Arvind (1987), "Tax Evasion, Corruption and Administration : Monitoring the People's Agents under Symmetric Dishonesty." DRD 271 Discussion Paper. Washington, DC: *World Bank*, Development Research Department.

Following Becker and Stigler (1974)[10], Rose-Ackerman (1975)[11], Klitgaard (1989 and 1995[12]), Basu and Mishra (1992)[13] and Mokherjee and Png (1995)[14], our model also focuses on the principal-agent problem of corruption. The model presented below, which is an extension of the model of Haque and Sahay (1996), analyzes the interaction between the government (the principal), on the one hand, and the tax collector and the private sector firm (the agents), on the other, to determine how penalties and public wages policy determine the level of tax evasion, bribes and the incidence of corruption. In addition to examining ways of motivating the agent to be honest, we derive how a non-monetary sanctions like the dismissal, in a country where the unemployment rate is high, will curb the amount of tax evasion, hence reducing the phenomenon of corruption.

2- Extension of the model of Ul Haque and Sahay

The theoretical model that best explains the abovementioned empirical study is that of Ul Haque and Sahay. Indeed, the latter developed a theoretical model of fiscal administration that highlights the causes of tax evasion. They reach the following conclusion: increasing the auditors' wages only (to the exclusion of the tax inspectors' wages) has a positive effect on the fight against tax evasion and on the incidence of corruption. In addition, an increase in penalties imposed on inspectors has no efficient effect on corruption, while penalties on firms leave the bribe amount unchanged (ambiguous effect). However, in order to reach this conclusion, they had to venture several hypotheses:

(i) The auditor is incorruptible, which does not always correspond to the reality on the ground,

(ii) The penalties imposed on corrupt civil servants are independent of their level of wages, which constitutes a clear violation of the constraint of "limited liability".

[10] Becker G. and Stigler G. (1974), "Law enforcement, Malfeasance and compensation of enforcers", *Journal of legal studies*, vol. 3 (January), pp. 1-18.
[11] Rose-Ackerman S. (1975), "The economics of corruption", *Journal of public economics*, Vol. 4 (February), pp.187-203.
[12] Klitgaard R. (1995), "Institutional Adjustment and Adjusting to Institutions", *World Bank* Discussion Papers, N. 303.
[13] Basu P. and Mishra A. (1992), "Notes on Bribery and the control of corruption", *Journal of public economics*, Vol. 48, pp. 349-59.
[14] Mokherjee D. and Png I.P.L. (1995), "Corruptible law enforcers : How should they be compensated?", *Economic Journal*, Vol. 105, (January), pp. 145-59.

According to Transparency International, corruption is present in all sectors and at all levels of public service. Many current events lead to think that even the higher ranked civil servants can be corrupted. In the model of Ul Haque and Sahay, the highest ranked civil servant is the auditor, and only the authors of the study assume that he/she is incorruptible. Thus, the matter to be answered is the following: if this hypothesis is dropped, would the conclusion reached by Ul Haque and Sahay still stand? According to this model, the auditor has no incentive whatsoever to act in all honesty and may even find some advantages in collaborating with the inspector. Given that the risk he incurs is close to nil, this would in fact allow him to increase his revenues by asking for his own share of the tax evasion. On the other hand, the authors of the study assume that the probability of detection is strictly proportional to the level of the auditor's wage, which implies that the higher his wage, the more zealous he will be, thus increasing the chances of exposing defrauders. Nevertheless, there are no guarantees whatsoever that, by increasing the auditor's wage, he will make more efforts in order to detect frauds. Indeed, as there is no control whatsoever on his efforts, it would be even more advantageous for him to make no efforts, or just the minimum level of required efforts, while simply benefiting from a higher wage.

Moreover, Ul Haque and Sahay suppose that the penalty imposed on the inspector is independent of his salary. Consequently, the incidence of corruption is also independent of this salary level. Hence, one can deduce that, if the penalty imposed on the inspector became linked to his salary (for instance unpaid leave, loss of his job), this penalty would have an effect on the level of the bribe that respects his participation constraint. Now, Ul Haque and Sahay reject this possibility without any further explanation. They even reach the conclusion that the inspector's wage does not play any role in curbing corruption. In fact, their analysis suggests that the only means of fighting against corruption are more severe penalties and better earning auditors. However, this implies that penalties are always implemented and that auditors are totally incorruptible. Any sensible observer of current events would agree that this is a rather naïve view according to reality. In this paper, we propose to take into consideration all these aspects in an explicit manner, including the fact that the auditor is corruptible. When adding these new elements to the existing literature, we hope to gain a better understanding of the relation between wages in the public service and corruption.

3- The theoretical model

- Taxpayers without bargaining power

In order to highlight the role of the level of wages in the public service and the penalties imposed within the framework of the fight against corruption, we will construct a microeconomic model of tax administration. The fundamental analysis underlying this model, which we are hereby summing up, is that corruption is a problem of asymmetrical information. This model includes four types of economic agents: the government, an auditor, an inspector and a private firm or contractor (or a taxpayer). The latter performs in a particular sector and has a turnover M. The government taxes this turnover according to a certain rate $\tau \in$ (0, 1). The firm is thus indebted for a tax amount $T = \tau M$. However, the government does not have accurate information regarding the level of the firm's turnover. It establishes a tax administration, which includes an inspector in charge of collecting the tax as well as an auditor in charge of supervising the inspector and watching out for frauds. Only the firm and the inspector know the exact level of this turnover, and consequently the amount T of taxes. The government pays the auditor and the inspector respectively w^A and w^I, while only the firm and the inspector know the exact level of this turnover, and consequently the amount T of taxes. The firm could thus be tempted to corrupt the inspector in order to reduce its taxes by paying him a bribe. This is a classical case of tax evasion. The role of the auditor is to prevent such frauds and expose them when they take place. If the inspector and the auditor are found guilty of corruption by evading taxes, they are respectively exposed to a penalty at a rate $\delta^I < 1$ and $\delta^A < 1$ of the amount of their wage whereas a penalty is also imposed on the taxpayer at a rate $\delta^F < 1$ and of the amount of tax evasion.

If the inspector and the taxpayer are honest, the inspector will submit to the government a tax return amounting to T. On the other hand, if the inspector is corruptible, he (and the auditor) could team up with the taxpayer to organize a tax evasion scheme and submit a tax return $\tilde{T} = \mu T$, $\mu \in$ [0, 1). If $\mu = 1$, there is no tax evasion, i.e., the taxes declared are equal to the taxes owed. However, if $\mu < 1$, there is a tax evasion. In other words, when there is a tax evasion, the total evaded amount is

$$\theta = T - \tilde{T} = \tau(1-\mu)M \qquad (1)$$

Since auditors, who are supposed to detect the tax evasion, are now heterogeneous and can be corruptible or honest, we suppose that there has to be another entity responsible for detecting corruption. It seems more realistic to assume, as Cooter (1996)[15] did, that civil society (which can be compensated by a proportion on the evaded amount) can detect corruption (in addition to the honest auditors). To be more precise, we assume that this combined force has a given probability, referred to as ρ, for detecting frauds relating to elements that it can observe, i.e., the amount and strength of tax evasion, the latter of which is an exogenous factor. Therefore, we define the detection probability ρ by $\rho = \rho(\theta, x)$ with $\rho(.)$ acting as an increasing and strictly convex function in each of these arguments. The inspector acts as an intermediary between the firm and the auditor. The first stage includes a negotiation between the auditor and the inspector to determine the level of the bribe b^A granted to the auditor provided that the latter succeeds in detecting the collusion between the inspector and the taxpayer with a probability of β[16]. Given b^A, the inspector and the taxpayer then enter into negotiations in order to determine the total bribe *b*, that both civil servants will receive from the latter (thus determining the bribe b^I received by the inspector). Finally, given the total bribe *b*, the level of tax evasion θ is determined. As b^A and b^I depend on wages w^A and w^I, while θ depends on b^A and b^I, we will be able to examine, among other factors, the role of civil servants' wages in determining the amount of tax evasion, and thus the level of corruption.

Before solving the model and characterizing its solution, it is necessary to discuss the relevance of including the auditor in the model. Indeed, it can be debated that, if both the auditor and the inspector are corrupt, the matter could be restricted to a single actor, an inspector and auditor in one, who collaborates with the firm to organize a tax evasion scheme and receives a total bribe *b*. However, we have the feeling that the presence of the auditor in the model is not trivial. It allows for a look into an interesting side to the issue of corruption, i.e., the effect of the multiplication of stages in the public service on the level of corruption, which is a rather controversial issue. Finally, in order to solve the model, we consider that the three parties conduct negotiations inspired by the Nash model. We use the same modeling technique as Ul Haque and Sahay. Moreover, it is necessary to stress on the fact that payments are made in the end. Therefore, if the fraud is not detected, the bribes are paid and the firm benefits from tax evasion. If the fraud is detected, everyone pays his penalty and no one receives anything. Now that the bases of the model are set, we shall examine the conditions governing the participation of each of the three agents.

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[15] Cooter. (1996), "The Rule of State Law and the Rule-of-Law State", In Bruno, Michael and Pleskovic, Boris' edition: *Annual World Bank Conference on Development Economics*.

[16] The probability of detecting frauds by the inspector is defined by α.

a. Conditions governing the participation of the auditor

The government pays the auditor a wage w^A, which is fixed and of his/her competences. Knowing that he is the highest ranking civil servant in the governmental sphere, nothing prevents from thinking that the auditor is corruptible. In fact, it may dawn on him that being corrupt is more advantageous as he could benefit from an extra form of revenue in the shape of a bribe by striking an alliance with the firm and the inspector to evade taxes. For more simplicity, β is the probability that the dishonest auditor detect the collusion between the inspector and the contributor, so ignoring the preferences of honest auditors. In all cases, the auditor's potential revenue corresponds to w^A if he is honest and $\overline{w}^A$ if he is corruptible.

If the auditor chooses to be dishonest and accepts to be corrupted, he can hope to receive the bribe b^A, in addition to his wage w^A if he detects the collusion between the inspector and the taxpayer with a probability of β and if the fraud was not detected by the government or the civil society with a probability of $(1 - \rho)$. However, if the fraud is detected, the auditor would be compelled to pay a penalty amounting to $\delta^A w^A$. Supposing that the auditor is neutral to risk, the expected revenue from corruption $\overline{w}^A$ [17] corresponds to:

$$\overline{w}^A = (1-\rho)\left\{\beta(w^A + \alpha N b^A) + (1-\beta)w^A\right\} + \rho\alpha\beta(1-\delta^A)w^A \text{ [18]}$$

The auditor will be corrupted if the revenue he hopes to gain from corruption is at least equal to his revenue if he is honest, i.e., if $\overline{w}^A \geq w^A$ or even if $\overline{w}^A - w^A \geq 0$, thus implying that:

$$\varphi^A = \overline{w}^A - w^A = \alpha\beta(1-\rho)Nb^A - \rho w^A[1-\alpha\beta(1-\delta^A)] \geq 0 \quad \textbf{(1)}$$

One can then deduce that the auditor will accept to be corrupted if the bribe he is offered corresponds to the following condition:

$$b^A \geq \frac{\rho}{\alpha N\beta(1-\rho)} w^A[1-\alpha\beta(1-\delta^A)] \quad \textbf{(2)}$$

[17] We supposed that auditor receive the bribe only if he detects (with a probability of β) the collusion between the inspector and the taxpayer which is produced with a probability of α. From where the term $\beta(w^A + \alpha N b^A)$.

[18] In a one-period model, N is the number of corrupt acts (a continuous variable).

In particular, if the evasion is never detected, ρ = 0, the auditor will accept to be corrupted whenever he is offered a bribe, no matter how insubstantial. However, if detection is certain, ρ = 1, an infinitely higher bribe will be needed to convince the auditor to take part in the coalition for tax evasion. Anyway, with $0 < \rho < 1$, the condition (1) defines the constraint of the auditor's participation as a function of his bribe with $\partial\varphi^A / \partial b^A \geq 0$. It becomes also apparent that, by equalizing both terms of the condition (2), one can determine the minimum level of bribe above which the auditor would accept to collude with the firm and the inspector to implement a tax evasion scheme:

$$\underline{b}^A = \frac{\rho}{\alpha\beta N(1-\rho)} w^A[1-\alpha\beta(1-\delta^A)] \quad \textbf{(3)}$$

b. Conditions governing the participation of the inspector

Like the auditor, the inspector is a public official, and he receives a wage w^I from the government in order to collect the taxes of the firm. He is also confronted with the same choice of accomplishing his mission in all honesty or accepting to be corrupted with the firm. If he chooses to be honest, he will only receive his wage w^I. However, if he is corrupted, he can receive an extra revenue, referred to as $\overline{w}^I$. Thus, the inspector's revenue is characterized as follows:

If the inspector chooses to be dishonest and accepts to be corrupted, he can hope to receive the bribe b^I in addition to his wage w^I, if the fraud is not detected and the auditor succeeds in detecting the collusion, which happens with a probability $\alpha\beta(1-\rho)$. Nevertheless, if the auditor does not succeed in detecting this collusion, the inspector receives $b = b^A + b^I$, which happens with a probability $\alpha(1-\beta)(1-\rho)$. However, if the civil society exposes the fraud, he will have to pay a penalty proportional to his wage and amounting to $\delta^I w^I$, which happens with the probability ρ. The potential revenue of the corrupt inspector $\overline{w}^I$ is then given by

$$\overline{w}^I = (1-\rho)\{\alpha[(1-\beta)(w^I + Nb) + \beta(w^I + Nb^I)] + (1-\alpha)w^I\} + \rho\alpha(1-\delta^I)w^I \quad \textbf{(4)}$$

The inspector will take part in the coalition with the auditor and the firm if the revenue he hopes to gain from corruption $\overline{w}^I$ is at least equal to his revenue if he is honest w^I. By replacing $\overline{w}^I$ with its value and rearranging its terms, the constraint of the inspector's participation is found to be as follows:

$$\varphi^I = \overline{w}^I - w^I = \alpha(1-\rho)[Nb^I + (1-\beta)Nb^A] - \rho w^I[1-\alpha(1-\delta^I)] \geq 0 \qquad \textbf{(4')}$$

One deduces that, after replacing b^A with $\underline{b}^A$ in the condition (4) (refer to 3), the inspector will accept to be corrupt if the bribe he is offered fulfils the condition:

$$\underline{b}^I = \frac{\rho}{\alpha N(1-\rho)} w^I[1-\alpha(1-\delta^I)] - \frac{(1-\beta)}{\beta} \times \frac{\rho}{\alpha N(1-\rho)} w^A[1-\alpha\beta(1-\delta^A)] \quad \textbf{(5)}$$

By using the conditions (3) and (5) and the fact that $b = b^A + b^I$, it's possible to determine the minimum level $\underline{b}$ of bribes :

$$\underline{b} = \underline{b}^A + \underline{b}^I = \frac{\rho}{\alpha N(1-\rho)} \left\{ w^A[1-\alpha\beta(1-\delta^A)] + w^I[1-\alpha(1-\delta^I)] \right\} \quad \textbf{(6)}$$

In this context, it is necessary to remind that the three agents (the firm, the auditor and the inspector) define the amount of tax evasion θ by anticipating the effect of the level of tax evasion on their respective parts, and particularly on the bribes b^A and b^I. In reality, the sequence of events is as follows: the taxpayer and the inspector define first the amount θ of the tax evasion and the amount of the total bribe *b*, which is received by the inspector and the auditor. The inspector and the auditor then negotiate the sharing of *b* into respective parts b^A and b^I. Hence, the countdown induction can be implemented at two levels:

(i) In the case of a given total bribe $\hat{b}$ to be demanded from the taxpayer, the inspector and the auditor conspire to receive their respective bribes $\hat{b}^I$ and $\hat{b}^A$,

(ii) In the case of a given $\hat{b}$, the taxpayer and the inspector conspire to define the total amount $\hat{\theta}$ of the tax evasion. However, since defining the auditor's share *b* determines the inspector's share b^A in the case of a given total bribe *b*, it is possible to determine at first the auditor's bribe b^A before seeking to determine the amount θ of the tax evasion.

c. Determining the auditor's bribe

Having determined the constraints of the auditor's and the inspector's participation, it is possible to define the bribe to be paid to the auditor. Since both agents enter into a Nash negotiation of their parts b^A and b^I of the amount *b*, it is possible to calculate the share b^A of the auditor as a solution to the problem:

$$\max_{0 \le b^A \le b} P(b^A) = \left\{ \varphi^A(b^A) \times \varphi^I(b^I) \right\}$$

The result is as follows:

Lemma 1 : *For* $\rho \in$ *[0, 1), the problem has one unique solution* $b^A > \underline{b}^A$ *for which next conditions are verified:*

$$\varphi^A(b, w^A, w^I, \rho) = \frac{1}{2}\left\{\alpha(1-\rho)Nb - \rho\left[w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I))\right]\right\} \quad \textbf{(7)}$$

$$\varphi^I(b, w^A, w^I, \rho) = \frac{1}{2}\left\{\alpha(1-\rho)Nb - \rho\left[w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I))\right]\right\} \quad \textbf{(8)}$$

Proof: For $\rho \in$ [0, 1), $\varphi^A(b^A) \times \varphi^I(b^I)$ define a second degree polynomial function, the solution $P(b^A) = 0$ is given by $\Delta = b^2 - 4ac$. For $b > \underline{b}$, $P(b^A) = 0$ has two solutions defined by b_1^A and b_2^A knowing that $P'(b^A) = 0$ is given by

$$\hat{b}^A = \frac{b}{2N\beta} + \frac{\rho}{2N\alpha\beta(1-\rho)}\left\{w^A(1-\alpha\beta(1-\delta^A)) - w^I(1-\alpha(1-\delta^I))\right\} \quad \textbf{(9)},$$

After replacing $\hat{b}^A$ in conditions (1) and (4), conditions (7) and (8) appear.

Upon examining the lemma 1, one notices that the new constraints of the inspector's and the auditor's participation are the same given the total bribe *b*. This pertains to the fact that both agents have the same negotiation power: if the tax evasion is not detected, which happens with a probability of (1 − ρ), they will equally share the amount *b* paid by the firm. However, if the evasion is detected, which happens with a probability ρ, they will have to pay a total amount of penalty $\rho\{w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I))\}$ which they will equally share. All in all, they unite to organize the tax evasion scheme and split the gains $\alpha(1-\rho)Nb$ and costs evenly $\rho\{w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I))\}$.

The relations (7) and (8) highlight this fact as well as the condition that the revenues both agents hope for will be positive as long as there exists a reasonable probability that the fraud will not be exposed by the civil society. These relations also permit to examine, albeit in an informal fashion, the effect of raising civil servants' wages on corruption incentives. Indeed, starting with the equations (7) and (8), one notices that the derivatives $\partial\varphi^i / \partial w^i$ are negative (with i = A, I), which entails the fact that a raise in wages reduces corruption incentives. One could be tempted to conclude that raising civil servants' wages would allow for a drop in corruption. In fact, this is not entirely true as the corruption incentive is lower after a raise in wages:

⇨ This is not due to the fact that the agents are contented with their wages and renounce corruption revenues, but rather as raising wages increase the cost of the penalty if the fraud is detected, all things being equal however.

The most interesting fact in lemma 1 is that the crossed derivatives $\partial\varphi^A / \partial w^I$ are negative. Thus, raising an agent's wage simultaneously leads to the increase of the penalty to be imposed on the other if the corruption collusion is discovered, which reduces the lure of collaborating to commit a tax evasion. Therefore, raising the wage of one of the agents has a heavy impact not only on one, but also on both of them.

Proposition 1: *When corruption becomes rather hierarchical (both the auditor and the inspector are corruptible), raising an agent's wage simultaneously leads to the increase of the penalty to be imposed on the other if the corruption collusion is discovered, which reduces the lure of collaborating to commit a tax evasion and consequently the incidence of corruption.*

d. Determining the civil servants' bribe b

Having calculated the auditor's bribe, it is necessary next to determine the total bribe *b*, which is paid by the firm to civil servants. As is the case with the latter, the firm has to decide whether to be honest by declaring the true amount of its revenues and paying all of its taxes, or whether to contact the inspector in order to organize a tax evasion scheme, which would allow it to reduce its tax payments. By being honest, the firm would pay all of its taxes, which reduces its net revenues and brings them back to a level referred to as nil for the sake of simplification. However, if it chooses to evade taxes, it can hope for limiting its tax payments and sparing money θ if the auditor and the inspector accept to cooperate. Nevertheless, it faces the risk of paying a penalty if the fraud is ever detected. Its revenues are thus variable and will be referred to $\overline{R}^F = (1-\rho)\left[\alpha(\theta - b) + (1-\alpha)\theta\right] - \rho\delta^F\theta$.

Being neutral to risk, the firm will take part in the coalition along with the inspector and the auditor if the revenue it hopes for by being dishonest $\overline{R}^F$ is higher than its revenue if it is honest. Hence, the constraint of the firm's participation is: $\overline{R}^F \geq 0$. By replacing $\overline{R}^F$ with its expression, and by rearranging the terms, the result is:

$$\varphi^F = \theta[1 - \rho(1 + \delta^F)] - \alpha(1-\rho)b \qquad \textbf{(10)}$$

One immediately deduces the condition for the amount of the total bribe b to be accepted by the firm as the highest ceiling of the bribe it is willing to pay as a function of the tax evasion amount, the penalty parameter and the probability of detection.

Noting $\bar{b}$ this highest ceiling, leads to the following:

$$\bar{b} = \frac{\theta}{\alpha}\left[1 - \frac{\rho}{(1-\rho)}\delta^F\right] \quad \textbf{(11)}$$

If $\hat{b}$ is the optimal level of bribe that would drive the firm and the inspector to conspire in order to organize a tax evasion scheme, it is evident that $\hat{b} \in [0,\ \theta]$ has to satisfy the participation constraints of both parties. This amount is actually determined by "Nash" negotiations between the firm and the inspector, and is the solution to the following problem

$$\max_{0\le b\le\theta}\left\{\hat{\varphi}^I(b, w^I, w^A, \rho) \times \hat{\varphi}^F(b, w^I, w^A, \rho)\right\}$$

The first order condition for this problem leads to:

$$\hat{\varphi}^F = \frac{2\hat{\varphi}^I(b, w^I, w^A, \rho)}{N} \quad \textbf{(12)}$$

Lemma 2 *: this maximization admits one unique solution for which next conditions are verified.*

$$\hat{\varphi}^F(b, w^I, w^A, \rho) = \frac{1}{2}\left\{(1-\rho)N\theta - \rho[w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I)) + \delta^F N\theta]\right\}$$

(13)

$$\hat{\varphi}^A(b, w^I, w^A, \rho) = \frac{1}{4}\left\{(1-\rho)N\theta - \rho[w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I)) + \delta^F N\theta]\right\}$$

(14)

$$\hat{\varphi}^I(b, w^I, w^A, \rho) = \frac{1}{4}\left\{(1-\rho)N\theta - \rho[w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I)) + \delta^F N\theta]\right\}$$

(15)

Proof: By rearranging (12), we obtain the optimal value of $\hat{b}$

$$\hat{b} = \frac{1}{2N}\left\{\frac{\theta N}{\alpha}[1 - \frac{\rho}{(1-\rho)}\delta^F] + \frac{\rho}{\alpha(1-\rho)}[w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I))]\right\} \quad \textbf{(16)}$$

By replacing $\hat{b}$ in conditions (7), (8) et (10), we obtain conditions (13), (14) et (15).

A closer look into relations (13), (14) and (15) reveals two facts: (1) the constraints of the inspector's and the auditor's participation are identical, and (2) the constraint of the firm's participation corresponds to the sum of the constraints of the inspector's and the auditor's participation. The equal constraints of the inspector's and the auditor's participation indicates, as has been observed before, that these agents evenly share the hoped for gains and costs linked to tax evasion, which now directly depend on the amount of tax evasion θ and the firm's penalty in addition to the other wage and penalty parameters. The constraint of the firm's participation being equal to the sum of the constraints of the inspector's and the auditor's participation reveals a new fact: the firm shares with both civil servants (i.e. the inspector and the auditor, considered as the only other party to negotiation) the gains and costs hoped to be derived from the tax evasion. It is also interesting to notice that this sharing is even. Thus, it is as though the firm and the inspector shared evenly the gains and costs hoped to be derived from the tax evasion, and both civil servants would then evenly split their share of the fraud.

Examining the equation (16) leads to another interesting result at this level: given the amount of tax evasion θ, the impact of wages on the optimal bribe $\hat{b}$ to be paid by the firm corresponds to half the higher and lower sums defined by the civil servants and the firm respectively : $\hat{b} = (1/2)(\overline{b} + \underline{b})$. This is due to the simple fact that both parties (the civil servants and the firm) have an equal negotiation power and settle on a bribe amount situated halfway between their respective demands. Moreover, the effect of wages on participation constraints remains unchanged except that the firm is now concerned: by raising the wage of one of the civil servants, the corruption incentive for him and for the two other actors $\partial\varphi^i / \partial w^j$ is reduced and negative. Yet, in this case as well, it is a penalty effect: an increase in one of the civil servants' wage increases the amount of the penalty to be paid by the other parties to the fraud, thus reducing the lure of striking alliances to evade taxes. However, the effect of wages on the bribe is not perfectly clear, unlike the case of Sahay and Haque (refer to relation 16), but depends on the sign of $\partial\hat{\theta} / \partial w$.

Finally, it is necessary to look into the effect of the increase in the amount of tax evasion θ on participation constraints. By establishing a difference among each of the relations (13), (14) and (15) compared with θ, the result is

$$\frac{\partial \varphi^i}{\partial \theta} = N\left[1 - \rho(1+\delta^F)\right] - \rho'_\theta\left[w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I)) + \theta N(1+\delta^F)\right] \textbf{(17)}$$

By examining this last result, one notices that:

Proposition 2: *An increase of the amount θ has a double effect corresponding to both terms of the equation (17): the first effect, which is measured by the left term, is a direct effect and illustrates the fact that an increase of θ increases the revenue hoped to be derived from corruption by $(1-\rho)$ as well as the hoped for costs by $\rho\delta^F$ with a net positive effect. As for the second effect, which is measured by the right term, it is rather indirect and illustrates the fact that an increase of θ also increases the probability of detection ρ, thus giving all participants less incentives to cooperate to tax evasion schemes, hence the net negative effect.*

If the coalition for tax evasion is formed, the arbitration which i twill face in order to determine the ultimate amount of tax evasion is apparent: it will be the arbitration between the direct positive effect and the indirect negative effect. The optimal θ will then be chosen when both effects will totally compensate one another, thus implying – among other things – that there will be a tax evasion, and thus collusion if and only if the probability of detection ρ fulfills the condition: $\rho \in [0, \overline{\rho})$. We are hereby interested in the problem of determining the optimal level of θ.

e. Determining the amount of the tax evasion θ

Once the coalition between the firm and the civil servants is formed, and given the rule for sharing fraud gains and costs that is derived from the preceding section, it becomes evident that determining the optimal amount of tax evasion θ aims at maximizing the sum of the participants' respective shares while taking into account the effect of this choice on the probability of detection. Formally, the problem is thus the following:

$$\max_{0\le\theta\le T} \sum_{j=A,I,F} \hat{\varphi}^j(w^I, w^A, \theta, \rho)$$

$$\text{S. c. } \rho = \rho(\theta, x)$$

With $\rho_i > 0$, $\rho_{ij} > 0$ (i, j = θ, x). The first condition order for this problem admits one solution:

$$N(1-\rho(\hat{\theta},x)(1+\delta^F)) - (1+\delta^F)N\hat{\theta}\frac{\partial\rho(\hat{\theta},x)}{\partial\theta} - \left[w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I))\right]\frac{\partial\rho(\hat{\theta},x)}{\partial\theta} = 0 \quad \textbf{(18)}$$

If we isolate θ from (18), we obtain:

$$\hat{\theta} = \frac{1}{(1+\delta^F)\hat{\rho}'_\theta} - \frac{\hat{\rho}}{\hat{\rho}'_\theta} - \frac{w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I))}{(1+\delta^F)N}, \quad \rho \in [0, \overline{\rho}) \quad \textbf{(19)}$$

Knowing that $\hat{\rho} = \rho(\theta, x)$ et $\hat{\rho}'_\theta = \partial\rho(\hat{\theta}, x)/\partial\theta$ and given the triplet $\delta^A, \delta^I, \delta^F$, the optimal level of tax evasion $\hat{\theta}$ is a function of the inspector's and the auditor's wages and the strength of the civil society *x*, which – in turn – is measured by the probability of detection ρ, i.e.

$$\hat{\theta} = \hat{\theta}(w^A, w^I, x) \quad \textbf{(20)}$$

By interpreting the amount $\hat{\theta}$ of tax evasion as a measure of the level of corruption as Ul Haque and Sahay did, the analysis suggests that there are three possible means to fight against corruption through:

- The penalties imposed on defrauders,
- The wages of civil servants, and
- The role of civil society in the management of public affairs.

However, in terms of policies, the government has only two instruments: the wages of its civil servants (w^A, w^I) and the anti-fraud legislation ($\delta^A, \delta^I, \delta^F$). The efficiency of each of these instruments is thus immediately questioned. Another interesting aspect to this issue pertains to the role of civil society in this fight: does a sufficiently strong civil society contribute to curbing corruption? Answers to these questions can be obtained based on the model that is developed here, and particularly based on the relations (18) and (19), one can establish that:

Lemma 3: *for* $\rho''_{\theta\theta} > 0$, $\rho''_{\theta x} > 0$ *et* $\rho \in [0,1)$, *next conditions are verified :*

$$\frac{\partial\hat{\theta}}{\partial w^A} < 0 \quad \textbf{(21)}$$

$$\frac{\partial\hat{\theta}}{\partial w^I} < 0 \quad \textbf{(22)}$$

$$\frac{\partial\hat{\theta}}{\partial x} < 0 \quad \textbf{(23)}$$

Proof: the first order condition given in (18) can define the function $\zeta(.)$ as follows:

$$\xi(w^{A,I}, \delta^{A,I,F}, \theta, x) = N(1-\hat{\rho}(1+\delta^F)) - \hat{\rho}'_\theta[w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I)) + (1+\delta^F)N\hat{\theta}] = 0$$
(24)

On the optimum, we have:

$$\xi'_\theta = -\left\{2N(1+\delta^F)\rho'_\theta + [w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I)) + (1+\delta^F)N\theta]\rho''_{\theta\theta}\right\} < 0 \quad \textbf{(25)}$$

By applying the implicit function on (24) we obtain:

$$\frac{\partial\theta}{\partial w^j} = -\frac{\xi'_{w^j}}{\xi'_\theta} \quad \text{Et} \quad \frac{\partial\theta}{\partial x} = -\frac{\xi'_x}{\xi'_\theta} \quad \text{avec } j = A,\ I$$

Finally, one can verify, by differentiating (24) relatively to w^j and x, that:

$$\xi'_{w^A} = -\hat{\rho}'_\theta(1-\alpha\beta(1-\delta^A)) < 0 \text{ and } \xi'_{w^I} = -\hat{\rho}'_\theta(1-\alpha(1-\delta^I)) < 0$$

$$\xi'_x = -\left\{N(1+\delta^F)\rho'_x + [w^A(1-\alpha\beta(1-\delta^A)) + w^I(1-\alpha(1-\delta^I)) + (1+\delta^F)N\theta]\rho''_{\theta x}\right\} < 0$$

Proposition 3: *When all parties have the same bargaining power, a raise in the civil servants' wages will curb the amount of tax evasion, hence the incidence of corruption (refer to relations 21 and 22). The more powerful civil society is, the more often it can detect tax evasion in order to decrease the incidence of corruption (refer to relation 23).*

These results hide the intuition that a wage increase (to a level lesser than the one leading to the public officials' honesty) does no longer have a direct effect (even ambiguous, sign of $\partial\hat{b}/\partial\overline{w}$ [> <] 0) on the reduction of corruption measured by the bribe amount ($\partial\hat{b}/\partial\overline{w} < 0$ in the model of Haque and Sahay, knowing that a lower *b* does not reflect necessarily a lower corruption). However, it increases the penalty imposed on civil servants if the tax evasion is exposed, thus increasing the costs of their participation in the fraud. Hence, civil servants react by demanding ***a higher total bribe b*** in order to compensate the increase of their costs.

If $\underline{b} > \overline{b}$, the taxpayer will be incapable to pay the bribe demanded by the public official, hence cooperation cannot be completed. But if $\underline{b} < \overline{b}$, taxpayer accept to pay the bribe but it will require that the tax evasion relates to a higher amount θ. (because a raise in *b* reduces the firm's share in the tax evasion revenues). But having optimally started with a perfect equality of gains (the direct effect) and costs (the indirect effect), an increase by θ would make the costs greater than gains, which is thus impossible. However, it remains possible to decrease θ, which leads to the reduction of the probability of detection ρ and that of the direct and indirect effect as well. Therefore, there will be a decrease of θ until the gains resulting from the decrease of ρ compensate exactly the loss incurred due to the increase of the civil servants' bribe.

These conclusions refute some of the conclusions in the model of Haque and Sahay in many directions, in which authors have demonstrated that a raise in auditor's wage (and not inspector's wage, which is not the case in our model) reduce the amount of bribe *b* hence a reduce in corruption, knowing that *b* determine the level of corruption in the sense that a higher demand for cooperation (from taxpayers) push our public officials to increase the bribe which can explain that corruption is expanded in the administration. But this causality : demand (taxpayer) create offer (officials) is not very reasonable, if corruption is really expanded so corrupt public officials are numerous and finally taxpayers will cooperate with other public officials who demand lower bribes due to the fact that competition will certainly reduce *b*.

Therefore, the amount of bribe does not reflect the level of corruption, instead the number of corruption acts or collusion acts (N) and the number of dishonest officials explain the level of our phenomenon; in the same way, a high bribe is the consequence of either repressive policies against corruption or the limited number of dishonest officials (capable to cooperate) what reflect the cost of corruption and the difficulty of succeeding collusion acts and is not always the criteria of high level of corruption. However, the higher is the bribe the higher is the probability that taxpayers will not accept the cooperation and the payment of bribes which can reduce collusion acts.

In this logic, if the final impact of raising wages on *b* is negative ($\partial b / \partial w^i < 0$), public officials will reduce $\underline{b}$ (after a decrease in ρ due to a decrease in θ) than collusions will take place again, so we have to prevent that a raise in wage reduce the bribe amount. If we calculate the first order condition of b :

$$\frac{\partial \hat{b}}{\partial w^A} = -\frac{1}{2\alpha N} \times \frac{\left(1-\rho-\rho\delta^F\right)}{\left(1-\rho\right)} \times \frac{\left[1-\alpha\beta(1-\delta^A\right]}{\left(1+\delta^F\right)} + \frac{1}{2\alpha N} \times \frac{\rho\left[1-\alpha\beta(1-\delta^A\right]}{1-\rho}$$

$$\Rightarrow \quad \partial b / \partial w^i > 0 \text{ if and only if } \rho > \frac{1-\rho(1+\delta^F)}{1+\delta^F} \Rightarrow \quad \rho > \rho' = \frac{1}{2(1+\delta^F)}$$

Moreover, in order for the raise in the officials' wages to have a bearing on the reduction of corruption, the raise in wages must not reduce the bribe amount because taxpayers will accept to cooperate after a decrease in θ if bribe is lower. That's why the probability of detection ($\rho'_\theta > 0$) must stop decreasing below ρ'. So by maintaining $\rho' < \rho < \overline{\rho}$, we guaranty that the evaded amount will decrease while bribe will increase, the taxpayers will be less inclined to conspire or to cooperate on a tax evasion scheme, which will reduce the number of collusion acts, hence reducing the incidence of corruption ($\partial N / \partial w_i < 0$). Hence, the problem of corruption can be solved by fighting against the object of the collusion (the tax evasion) and the origin of bribe payment (the taxpayer or the one offering bribes).

Since the auditor is now corruptible in our model, there has to be an entity that is capable of detecting the tax evasion. The stronger and more organized it is, the more susceptible it is of detecting tax frauds and corruption. As for the consequences of a stronger civil society, an increase of x only increases the probability of detection ρ, thus reducing, all things being equal, the revenues and increasing the costs hoped to be derived from tax evasion. To begin with, the only optimal way to level the hoped for costs and revenues would be to reduce θ in order to compensate the effect of the increase in x on ρ.

- Taxpayers with bargaining power

Up to now, we have considered the case where firms have no bargaining power in their relationship with public officials. In such situation, bureaucrats are able to extract the entire surplus arising from this interaction. In this section, we examine the effects of firms possessing some bargaining powering their dealings with public officials. The sequence of events remains the same as before. The only difference is that we assume the sharing of the bargaining power between firms and bureaucrats. We denote the bargaining power of firms by η and that of bureaucrats by $(1-\eta)$. If we assume that in their negotiation process bureaucrats and firms act optimally given the other players' incentives, their joint optimization problem is :

$$\max_{0\le b\le\theta}\left\{(\hat{\varphi}^I)^{1-\eta}\times(\hat{\varphi}^F)^{\eta}\right\}$$

$$\max_{0\le b\le\theta}\left\{\alpha(1-\rho)[Nb-\beta Nb^A]-\rho w^I[1-\alpha(1-\delta^I)]\right\}^{1-\eta}\times\left\{\theta[1-\rho(1+\delta^F)]-\alpha(1-\rho)b\right\}^{\eta}$$

The first term in this optimization problem corresponds to the firm's objective, which is to minimize its bribe payment relative to its fiscal obligation. The second term corresponds to the bureaucrat's objective, which is to maximize the bribe received relative to the opportunity cost. Using a generalized Nash solution, we obtain the following from the first order conditions : $\hat{b}=\eta\underline{b}+(1-\eta)\overline{b}$. We see that when firm have no bargaining power ($\eta=0$), they pay $\overline{b}$ the highest ceiling (the maximum level). While when firms' bargaining power increases, the amount of bribe decrease, when they have complete negotiation power $(\eta=1)$ they pay a bribe equivalent to the bureaucrat's opportunity cost $\underline{b}$ which is the minimum level. ***So firms with high bargaining power (naïve view according to reality) are able to reduce their bribe payments and raising wages policy becomes less efficient, uncertain and more ambiguous.***

4- Unemployment Rate and Dismissal Sanction

Until now we have considered that an individual who obtain a gain by committing a harmful act, if he does commit it, he will be caught with some probability and then have to pay a monetary fine, in general he will commit the act if and if his expected utility from doing so, taking into account his gain and the chance of his being caught and sanctioned, exceeds his utility if he does not commit the act. In this section, we introduce the fact that the government imposes a non monetary sanction on every corruptible public official who will lose their job and all their income if they are detected. Garoupa and Klerman (2004)[19] analyzes the effect of corruption on the use of non-monetary sanctions, they found that it is optimal to use (or at least threaten to use) higher non-monetary sanctions in a corrupt environment, because it transforms the socially costly non-monetary sanction into a monetary bribe. Although corruption thus reduces deterrence, non-monetary sanctions are still useful, because they allow officials to extract higher bribes, thus restoring some deterrence.

By following our first model and keeping the same economic agents : the government, the auditor, the inspector and the contributor or the firm, we are going to analyze the relation between the unemployment rate and the incidence of corruption in tax administration when the sanction is a non-monetary one (a dismissal). The government pays the auditor and the inspector respectively w^A and w^I, we assume that the unemployment rate is noted by λ, while (1 - λ) represent the probability of employment or the possibility to find a job in the private sector once the public official is dismissed from the public sector.

Now that the bases are approximately the same, we shall examine the conditions governing the participation of each of the three agents.

a. Conditions governing the participation of the auditor

If the auditor chooses to be dishonest and accepts to be corrupted, he can hope to receive the bribe b^A, in addition to his wage w^A if he detects the collusion between the inspector and the taxpayer with a probability of β and if the fraud was not detected by the government or the civil society with a probability of $(1 - \rho)$. However, if the fraud is detected, the auditor would be dismissed, he will lose his job and all his income, but with a probability (1 - λ) he will be employed in the private sector, receiving a wage w^P. Supposing that the auditor is neutral to risk, the expected revenue from corruption $\overline{w}^A$ corresponds to:

[19] Garoupa and Klerman (2004), "Corruption and the optimal use of non-monetary sanctions", *International Review of Law and Economics*, Vol. 24, p. 219–225

$$\overline{w}^A = (1-\rho)\left\{\beta(w^A + \alpha N b^A) + (1-\beta)w^A\right\} + \rho\alpha\beta(1-\lambda)w^P$$

The auditor will be corrupted if the revenue he hopes to gain from corruption is at least equal to his revenue if he is honest, i.e., if $\overline{w}^A \geq w^A$ or even if $\overline{w}^A - w^A \geq 0$, thus implying that:

$$\varphi^A = \overline{w}^A - w^A = \alpha\beta(1-\rho)Nb^A - \rho[w^A - \alpha\beta(1-\lambda)w^P] \geq 0 \quad \textbf{(1bis)}$$

One can then deduce that the auditor will accept to be corrupted if the bribe he is offered corresponds to the following condition:

$$\underline{b}^A = \frac{\rho}{\alpha\beta N(1-\rho)}[w^A - \alpha\beta(1-\lambda)w^P] \quad \textbf{(2bis)}$$

b. Conditions governing the participation of the inspector

If the inspector chooses to be dishonest and accepts to be corrupted, he can hope to receive the bribe b^I in addition to his wage w^I, if the fraud is not detected and the auditor succeeds in detecting the collusion, which happens with a probability $\alpha\beta(1-\rho)$. Nevertheless, if the auditor does not succeed in detecting this collusion, the inspector receives $b = b^A + b^I$, which happens with a probability $\alpha(1-\beta)(1-\rho)$. However, if he was exposed, his potential revenue from the corrupt act $\overline{w}^I$ is then given by:

$$\overline{w}^I = (1-\rho)\left\{\alpha[(1-\beta)(w^I + Nb) + \beta(w^I + Nb^I)] + (1-\alpha)w^I\right\} + \rho\alpha(1-\lambda)w^P$$

The inspector will take part in the coalition with the auditor and the firm if the revenue he hopes to gain from corruption $\overline{w}^I$ is at least equal to his revenue if he is honest w^I . By replacing $\overline{w}^I$ with its value and rearranging its terms, the constraint of the inspector's participation is found to be as follows:

$$\varphi^I = \overline{w}^I - w^I = \beta(1-\rho)[Nb^I + (1-\alpha)Nb^A] - \rho[w^I - \beta(1-\lambda)w^P] \geq 0 \quad \textbf{(3bis)}$$

By proceeding similarly to the first model, it's possible to determine the minimum level $\underline{b}$ of bribes:

$$\underline{b} = \underline{b}^A + \underline{b}^I = \frac{\rho}{\alpha N(1-\rho)}\left\{[w^A - \alpha\beta(1-\lambda)w^P] + [w^I - \alpha(1-\lambda)w^P]\right\} \quad \textbf{(6bis)}$$

c. Conditions governing the participation of the inspector

The conditions are the same as in the section 3.

If $\hat{b}$ is the optimal level of bribe that would drive the firm and the inspector to conspire in order to organize a tax evasion scheme, it is evident that $\hat{b} \in [0, \theta]$ has to satisfy the participation constraints of both parties. This amount is actually determined by "Nash" negotiations between the firm and the inspector, and is the solution to the following problem:

$$\max_{0 \le b \le \theta} \left\{ \hat{\varphi}^I (b, w^I, w^A, \rho) \times \hat{\varphi}^F (b, w^I, w^A, \rho) \right\}$$

The first order condition for this problem leads to:

$$\hat{\varphi}^F = \frac{2\hat{\varphi}^I (b, w^I, w^A, \rho)}{N}$$

By rearranging $\hat{\varphi}^F$, we obtain the optimal value of $\hat{b}$:

$$\hat{b} = \frac{1}{2N} \left\{ \frac{\theta N}{\alpha} [1 - \frac{\rho}{(1-\rho)} \delta^F] + \frac{\rho}{\alpha(1-\rho)} [(w^A - \alpha\beta(1-\lambda)w^P) + (w^I - \alpha(1-\lambda)w^P)] \right\}$$

The first order condition of the last relation and by supposing that θ is exogenous showed the positive relation between the bribe and the unemployment rate:

$$\frac{\partial \hat{b}}{\partial \lambda} = \frac{\rho}{2\alpha N(1-\rho)} \left\{ \alpha\beta w^P + \alpha w^P \right\} > 0$$

These results hide the intuition that an increase in the unemployment rate will increase the costs of public officials' participation in the fraud. Hence, civil servants react by demanding ***a higher total bribe b*** in order to compensate the increase of their costs. Nevertheless, this reduces the firm's share in the tax evasion revenues, and one might think that it will require that the tax evasion relates to a higher amount *θ*. Yet, having optimally started with a perfect equality of gains (the direct effect) and costs (the indirect effect), an increase by *θ* would make the costs greater than gains, which is thus impossible. However, it remains possible to decrease *θ*, which leads to the reduction of the probability of detection *ρ* and that of the direct and indirect effect as well. Therefore, there will be a **decrease of *θ*** until the gains resulting from the decrease of ρ compensate exactly the loss incurred due to the increase of the civil servants' bribe, so by maintaining $\rho' < \rho < \overline{\rho}$, we guaranty that the evaded amount will decrease while bribe will increase ($\partial \hat{b} / \partial \lambda > 0$) hence the progressive ***decrease of the incidence of corruption*** ($\partial \overline{w_i} / \partial N < 0$). Therefore, the decrease in θ is showed by the negative first order condition of the evaded amount:

$$\frac{\partial \hat{\theta}}{\partial \lambda} = -\frac{(\alpha\beta w^P + \alpha w^P)}{(1+\delta^F)N} < 0$$

Knowing that $\hat{\theta}$ is noted by:

$$\hat{\theta} = \frac{1}{(1+\delta^F)\hat{\rho}'_\theta} - \frac{\hat{\rho}}{\hat{\rho}'_\theta} - \frac{(w^A - \alpha\beta(1-\lambda)w^P) + (w^I - \alpha(1-\lambda)w^P)}{(1+\delta^F)N}, \quad \rho \in [0, \overline{\rho})$$

Proposition 4 : *When the government impose non-monetary sanctions like a dismissal, a raise in the unemployment rate will curb the amount of tax evasion, hence reducing the incidence of corruption, because it increases the costs of public officials' participation in the fraud. Hence, civil servants react by demanding a higher total bribe b in order to compensate the increase of their costs.*

Conclusion

We have highlighted the inspector's wage and the presence of the civil society as means to fight against the corruption when firms have no bargaining power. In particular, we have demonstrated that, if penalty levels are linked to civil servants' wages and if corruption is rampant among the different stages of the public service (both auditors and inspectors are corruptible), then raising an agent's wage simultaneously increases the penalty to be imposed on the other in case the collusion is detected. Hence, this raise in wages does no longer have any direct effect on the level of corruption, but rather an indirect effect (even ambiguous on the reduction of b which increases with high wages, right term of 16, but decreases with low θ which decreases through high wages, left term of 16) through the sanctions which will be proportional to the increase in wages while the amount of the requested bribe increases as well. Thus, the public officials – and more importantly the taxpayers – will be less inclined to conspire or to cooperate on a tax evasion scheme; hence, the incidence of corruption decreases. So the problem of corruption can be solved by fighting against the object of the collusion (the tax evasion) and the origin of bribe payment (the taxpayer or the one offering bribes).

Therefore, the more rampant the corruption among the different stages of the public function (the auditors and the inspectors are corruptible), a policy for fighting against corruption by raising wages – knowing that penalties are linked to wages – is efficient only when the taxpayer decreases the incidence of tax evasion (object or cause of the corruption). Therefore, the direct reducing effect on the level of corruption disappears and becomes more ambiguous, especially knowing that a raise in wages increases the amount of the bribe originally requested, but after a decrease in θ, b will decrease also. It is also a costly but quite efficient policy especially when there are multiple stages in the public service knowing that a raise in the auditor's and the inspector's wages becomes indispensable (unlike the model of Ul Haque and Sahay in which only the auditor's wage plays an efficient role). Hence, the problem of corruption can be solved by fighting against the object of the collusion (the tax evasion) and the origin of bribe payment (the taxpayer or the one offering bribes).

Moreover, in order for the raise in the officials' wages to have a bearing on the reduction of corruption, there has to be an entity that is capable of detecting it since all civil servants are corruptible. The civil society can detect tax evasion. Indeed, when the civil society is strong, the probability of detection increases, thus decreasing tax evasion and corruption incentives. We showed also when the government imposes non-monetary sanctions like the dismissal; a raise in the unemployment rate will curb the amount of tax evasion, hence reducing the incidence of corruption.

However, only a raise in the civil servants' wages would not eradicate corruption in developing countries, especially those with budget constraints. It is therefore necessary to continue analyzing the different forms of corruption and finding the mechanisms needed to fight against governmental or bureaucratic corruption.

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