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TAX EVASION IN A CORRUPT ECONOMY

by

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Tax Evasion in a Corrupt Economy

Edimon GINTING*

Abstract

Tax evasion has been studied intensively in the context of developed countries in which the institutional environment assumes a pervasive respect for the rule of law. In many developing nations such an assumption is not warranted. The objective of this paper is to develop a model of tax evasion apposite to an institutional set up in which corruption is endemic. The services of corrupt intermediaries are required by otherwise legitimate producers in order to navigate the informal 'laws' put in place by rent seekers with good connections. The model developed here posits a service providing industry which produces legitimate public services and corrupt intermediation as joint products which exploit economies of scope available to senior bureaucrats. The model can be used in various ways; in this paper a cut in the tax rate on income from capital is examined. Under certain conditions such a cut can lead to *increased* government revenue, giving a new explanation of how a kind of Laffer curve may operate in economies with endemic corruption.

JEL classification: H2, O1.

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1. Introduction

After the seminal work of Allingham and Sandmo (1972), the economic literature on tax evasion has grown enormously. In their recent paper, Andreoni et al. (1998) review some of the important progress that has been made in the field. According to Andreoni et al., despite the many advances in refining Allingham and Sandmo's theoretical model and the related empirical studies, further work remains to be done if we are to develop a fully satisfactory understanding of this intrinsically complex subject. One among promising areas that require greater attention is the institutional framework of tax compliance — the relationship between the tax authority and the sovereign government (bureaucrats).

The majority of the existing studies in the field focus on the case of developed countries and hence naturally assume the existence of a developed institutional framework of tax compliance. This paper attempts to address the issue in the context of a developing country, such as Indonesia, where a developed institutional framework of tax compliance does not exist in practice. The rule of law in general is weak by design to benefit the ruler. As a result, the enforcement of law is rarely effective and this leads to endemic corruption at all levels. McLeod (1999) argues that this should not be interpreted as an unintended shortcoming of the regime ruling the country. Rather, it reflects a conscious effort to generate and harvest rents. In the absence of properly functioning formal law, informal law dominates in practice. This creates demand by businesses and individuals for informal arbitration and corrupt intermediation, with the high ranking bureaucrats and their associates as the suppliers. The behaviour the bureaucrats described above is consistent with the standard assumption adopted in the public choice literature (Brennan and Buchanan 1980) — like other economic agents, they are maximising their utility (here defined as incomes).

The objective of this paper is to develop a model of tax evasion to suit institutional set up in which corruption is endemic. Corrupt intermediation in general is motivated by two reasons (Rose-Ackerman 1997); (i) to obtain government benefits; and (ii) to avoid costs. In line with Rose-Ackerman, we assume that taxpayers, due to the dominance of the informal law in practice, need to use some resources to buy informal/corrupt intermediation (CI) in their attempt to reduce their tax payment. A model to describe taxpayer demand for CI services is developed in section 2. Like the theoretical model developed by Allingham and Sandmo and its refinements, our model also is stylised in nature. The supply CI is outlined in section 3. The model is designed to be flexible enough to include both constant and non-constant returns to scale properties. This way, it can readily be incorporated into a larger economy-wide economic model which usually have constant returns to scale properties. A standard closure of the model and a qualitative partial equilibrium analysis of tax policy change are set out in section 4. Section 5 illustrates how the model can be used in examining the reactions of representative taxpayers, whose productivity in use of corrupt intermediation (CI) activity differs, to a change in the tax policy. This reveals a mechanism for the operation of a type of Laffer curve. Section 6 offers a brief concluding remarks.

2. The demand for corrupt intermediation

The representative firms in this model are assumed to take seriously the prospect of reducing the tax payments via the purchase of the services of corrupt officials (hereafter called, CI, corrupt intermediation). For simplicity it is assumed that the levels of output and of attainable pre-tax profit are independent of CI. Hence firms engage in two levels of profit decision making, the first with respect to ordinary inputs and the second with respect to the purchase of CI services, which can assist in their efforts to reduce tax payments. At this stage, no further explanation is necessary with respect to the firm's first level profit maximisation problem, which is along standard neo-classical lines. In the following, therefore, we focus just on its second level problem, taking pre-tax profit as given.

Having maximised gross profit with respect to ordinary inputs, we assume that firms are also maximising net-profit by engaging in CI. The firm's objective function at this second stage is assumed to be:

$$U = u(\Pi) \quad , \tag{1}$$

where Π is after-tax profit. Because tax evasion is a risky activity, net profit is assumed to be a stochastic variable. We assume that the function $u(\Pi)$ is the statistical expectation of Π; that is, we assume firms maximise expected after-tax profit and that they are risk neutral.

Equation (1) implies that it is the after-tax profit alone that determines the firm's utility. Two main alternatives are available to the firm in maximising its utility. Firstly, it may simply pay the full tax so that it gets the following after-tax profit:

$$\Pi\,(0) = H - T \quad , \tag{2}$$

where

$$H = Q_H\, P_H \quad . \tag{3}$$

and

$$T = tH \tag{4}$$

P_H is the unit price of the profit and Q_H is real profit. H and T respectively are gross nominal profit and the profit tax calculated according to the official tax rate t.

Secondly, the firm may purchase CI and obtain expected net-profits as follows:

$$E(\Pi (Z)) = H - B(Z)\ T - M(Z) - J(R)\ G \ , \qquad (5)$$

where $0 \leq B \leq 1$ is the effective tax quotient after engaging in CI, Z is the real input used in CI and M(Z) is nominal value of resources spent. R denotes the firm's stock of political influence. J is the probability of the firm being fined for engaging in CI and is assumed to depend on the endowment of political influence, which in turn also depends on Z (to be explained below). G is the amount the firm has to pay if convicted of tax evasion.

Since this second choice involves uncertainty, it depends on the firm's attitudes toward risk. These attitudes are encapsulated the shape of the firm's objective function defined in (1). As stated above, in this model we have assumed that firms are risk-neutral which implies indifference between the sure prospect $\Pi(0)$ = \$500 and the unsure prospect involved when $Z > 0$ and expected profit is $\Pi(Z)$ = \$500. Note that this assumption can be relaxed without difficulty to accommodate risk-averse or risk-loving behaviour by simply modifying the firm's objective function.

It is clear that a necessary condition for CI to take place – that is, for Z to exceed zero – is:

$$E(\Pi (Z)) > \Pi (0) \quad \text{for some } Z > 0. \qquad (6)$$

For the necessary condition (6) to be satisfied, the tax reduction obtained by the firm must be less than the sum of resources spent on CI, and the expected cost of being fined. Assuming that the price of Z and the amount of fine G are given, we can obtain the optimum value of Z (and thence the additional net profit) by maximising Π

with respect to Z. Before we do this, however, we need to discuss how each component of (5) is defined. The next sub-sections cover such discussion.

2.1 Effective tax quotient schedule, B(Z)

The effective tax quotient B is defined as the fraction of the tax liability that is actually paid to the government. In this model we assume that B is a displaced and modified logistic function of the CI input Z. This type of function has been used in economic applications, such as financial information analysis, population growth and market share estimations. The essential qualitative feature of the logistic function is that for small values of Z, it resembles an exponential function, while for larger values of Z, it levels off and approaches closer and closer to a limiting value. It is easy to set the function up with parameters that result in a declining, rather than a rising, curve. This is the approach followed here in specifying the B(Z) schedule (which corresponds in shape, roughly, to the half of a declining logistic to the right of its inflection point).

In equation (7) we define the dependence of B on Z ($0 \le B \le 1$). In the chosen functional form it can be expressed as:

$$B = \theta_1 + \frac{(1 - \theta_1)(1+\theta_1)}{1 + \theta_1 e^{\gamma A}} \tag{7}$$

where

$$A = \varepsilon_B Z + (1 - \varepsilon_B)(Z/Q_H), \tag{7'}$$

and $0 \le \varepsilon_B \le 1$. Note that Z is normalised in equation (7') to allow (7) to posess constant returns to scale (CRTS) properties when $\varepsilon_B = 0$. The case of increasing returns to scale is obtained when ε_B is set to 1. The parameter θ_1 is the minimum tax quotient, which means even if firms use a very large Z ($Z \to \infty$), they can only reduce

B to θ_1. The value of γ is positive, and represents a 'technological' parameter related to the effectiveness of the CI input Z in reducing tax payments. Note that the function takes the value of B = 1 when Z is zero, representing the case where the firm does not engage in CI. The higher the value of γ, the more efficient is the tax evading 'technology' of the firm, meaning that using the same quantity of input Z, the firm is able to obtain higher benefits in terms of tax reduction.

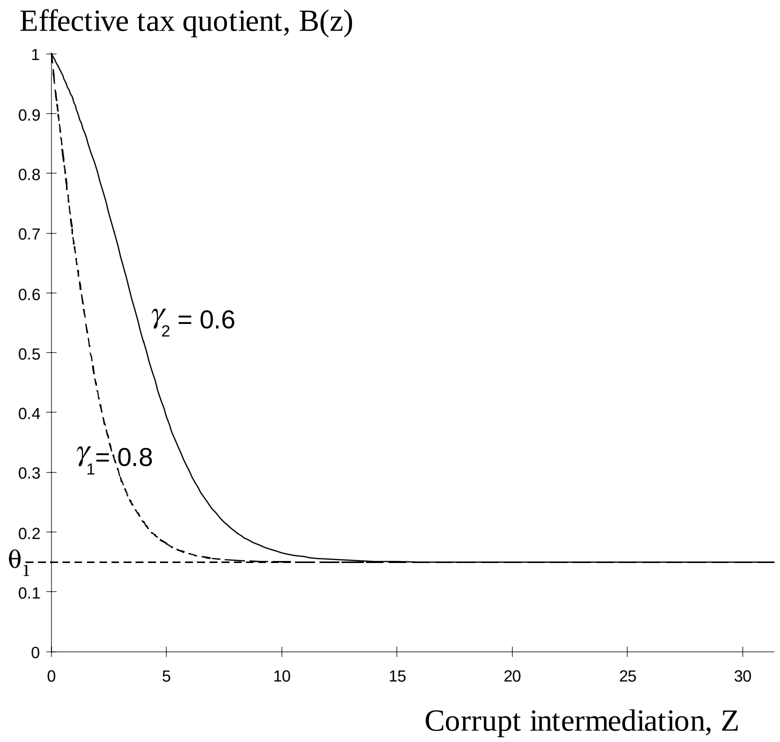

Figure 1: Two hypothetical schedules showing different 'productivity' in use of CI. The industry whose parameter is γ_1 is more 'efficient' than the industry with parameter γ_2 in reducing its tax payments.

2.2 Cost of rent-seeking activity

The firm is assumed to have no control over the price of Z. The nominal value of resources transferred by each firm into CI activity (M) therefore depends on the price and the firm's choice of Z. The accounting identity relating M and Z is defined in equation (8), where P_Z is the price of Z.

$$M = P_Z Z \quad . \tag{8}$$

2.3 Schedule of fines for tax infringements, J(R)

The expected fine schedule has two elements, the nominal amount of fine (G) and the probability of being fined (J). G is normally set by law and hence is given to all firms. It leaves firms with only one channel with which to minimise the expected fine, that is, to lower the probability of being fined (J).

In this model J is assumed to depend on the stock of political influence possessed by firms via a function with similar properties to those of B. The choice of the stock of political influence R as the determinant of J is based on the characteristics of the Indonesian economy for which we design the model. It is assumed that firms with a large stock of political influence are more likely to be able to ensure that enforcement of the tax law is slack than are less influential firms. It is reasonable in such a case to assume that J is determined by R, as shown in equation (9).

$$J = \theta_2 + \frac{(1 - \theta_2)(1+\theta_2)}{1 + \theta_2 e^{\gamma S}} \tag{9}$$

where

$$S = \varepsilon_J Z + (1 - \varepsilon_J)(R/Q_H), \tag{9'}$$

and $0 \le \varepsilon_J \le 1$. As in (7) R is also normalised in equation (9') to allow (9) to posess constant returns to scale (CRTS) properties when $\varepsilon_J = 0$. The parameter θ_2 is the risk 'floor' or minimum probability of being fined, meaning that even if firms happen to have very large R $(R \to \infty)$, they can only reduce J to θ_2. The parameter α has a positive value and measures the effectiveness of firms' 'technology' in reducing J. The higher the value of α, the more efficient is the firm in reducing J — using the same quantity of R, a firm with a higher value of α is able to obtain a higher benefit in terms of a lower probability of being fined. The graph of J against R is strongly analogous to that of B against Z.

Further we assume that R is to be determined by Z, the real amount of resources the firm spends on CI. The version of the model presented here is designed to describe the behaviour of established firms in a stationary equilibrium. In such circumstances the flow of resources devoted to CI balances the natural attrition (or 'depreciation') of the stock of political influence. Thus

$$R(t+1) = R(t)(1-\delta) + Z(t) \quad . \tag{10}$$

With R = R(t+1) = R(t), this implies

$$R = Z/\delta \quad . \tag{11}$$

An important point to note about CI in this steady-state formulation is that real input Z produce strictly joint products: (i) the reduction in the effective tax rate (described by the schedule B(Z)), and (ii) the reduced probability of incurring a fine (described by the schedule J(R)). There is no sense in which the expenditure M can be split between these two: all of M produces both effects simultaneously.

2.4 The optimum spending on corrupt intermediation

Having defined all elements of (5) we can now turn to the firm's optimum spending on input Z. It can be derived by taking the first derivative of Π and then setting it to zero as follows:

$$\frac{d\Pi}{dZ} = -\frac{dB}{dZ} T - \frac{dM}{dZ} - \frac{dJ}{dR} \frac{dR}{dZ} G = 0 \quad . \tag{12}$$

By taking the first derivatives of (7), (8), (11) with respect to Z and (10) with respect to R and then substituting them into (12) we get the following condition:

$$\frac{d\Pi}{dZ} = -\frac{-\gamma(B-\theta_1)^2\theta_1 e^{\gamma A}}{(1-\theta_1)(1+\theta_1)} T/Q_H - P_Z - \frac{-\alpha(J-\theta_2)^2\theta_2 e^{\alpha S}}{(1-\theta_2)(1+\theta_2)\,\delta} G/Q_H = 0 \ . \tag{13}$$

Equation (13) can be rearranged to obtain the following form:

$$P_Z = \frac{\gamma(B-\theta_1)^2\theta_1 e^{\gamma A}}{(1-\theta_1)(1+\theta_1)} T/Q_H + \frac{\alpha(J-\theta_2)^2\theta_2 e^{\alpha S}}{(1-\theta_2)(1+\theta_2)\,\delta} G/Q_H = 0 \ . \tag{14}$$

Equation (14) implies that to optimise spending on CI, the firm employs input Z up to the point where marginal cost of using an additional unit (P_Z) equals the marginal joint benefit obtained from the reductions in B and J. The latter benefits, namely those due to the reduction in the effective tax quotient and to the reduced probability of being fined, are the two right-hand terms of (14).

3 The supply of corrupt intermediation services

3.1 A simple model

We assume that CI services are supplied by the service providing sector. This sector engages in the joint production of (legitimate) services which are sold to government, and corrupt intermediation services which are sold to the private sector. Government is assumed simply to purchase the (legitimate) public services from the service providing sector; such services may consist of public administration, defence, education and the provision of other public goods.

At this stage no attempt is made to further elaborate a more complicated theory of government behaviour[1]. Therefore, the model to be constructed below concentrates on the behaviour of the service providing sector. This is an abstraction that is meant to capture the behaviour of a (possibly large) portion of the civil service, army, police force, plus some private sector activities where the clientele is either the government or those seeking to influence the government.

As already noted, we assume that the service providing sector supplies legitimate public services (S_G) to the government as well as CI (Z) to the private sector. The service providing sector's production frontier is assumed to take the following CET form:

$$N_T^{-\rho} = \Lambda^{-\rho}(\mu\, S_G^{-\rho} + \beta Z^{-\rho}) \qquad (15)$$

where N_T is the sector's production capacity, S_G is the quantity of public services and Z is the real quantity of CI services provided. The elasticity of transformation between S_G and Z is given by $\tau = 1/(1+\rho)$ where $\rho < -1$ and $\mu + \beta = 1$. The transformation elasticity is always negative to ensure that the production possibility frontier for service providers is concave viewed from the origin as shown in Figure 2.

[1] Whilst it may be more realistic to include another class of agent who holds ultimate power and extracts benefits from the corrupt intermediaries, we leave this extension for a separate paper (see Ginting and Powell 1999).

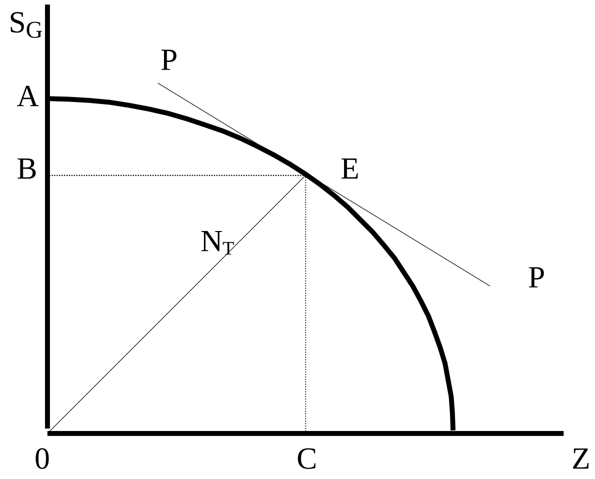

Figure 2 Production possibilities frontier for public services and corrupt intermediation services.

Since the quantity of public services purchased by government is exogenous to the service providers, S_G is given at OB. If we assume competition in this sector so that the service providers take the prices of both S_G and Z as given (and the slope of the price line PP in Figure 2 therefore is given), then the service providers' net revenue maximisation decision can be formulated as follows:

$$\text{Maximise net revenue} = S_G P_G + Z P_Z - N_T P_N \qquad (16)$$

subject to equation (15), where $P_{G,}$ P_Z and S_G are all given (P_G and P_Z are the prices of public services and CI, respectively). $N_T P_N$ is the joint cost of providing both services: it is the product of the quantity of inputs N_T and the price paid for those inputs.

The solution to the service providers' profit maximisation problem can be derived in two steps:

(i) finding the ratio of optimal S_G/Z from the given P_G/P_Z and the parameters of the CET function specified in equation (15),

(ii) finding the capacity N_T subject to the optimal Z, given P_G/P_Z and S_Z.

To work out the first step, we know that the optimum solution must satisfy the following condition:

$$\left.\frac{\partial S_G}{\partial Z}\right|_{N_T \text{ is const}} = -\frac{P_Z}{P_G} \quad . \tag{17}$$

Taking the total differential of equation (15), we obtain:

$$d(N_T^{-\rho}) = \Lambda^{-\rho} \{\mu\, d(S_G^{-\rho}) + \beta\, d(Z^{-\rho})\} \quad . \tag{18}$$

The trade-off between S_G and Z at a fixed level of N_T ($dN_T = 0$) can be found from

$$0 = \mu(-\rho)\, S_G^{-(\rho+1)}\, dS_G + \beta(-\rho) Z^{-(\rho+1)}\, dZ \, , \tag{19}$$

which is a restatement of (18) when N_T held fixed. From equation (19) we can find the differential quotient dS_G/dZ and take the limit as $dZ \rightarrow 0$, obtaining:

$$\frac{\partial S_G}{\partial Z} = \frac{-\beta Z^{-(\rho+1)}}{\mu S_G^{-(\rho+1)}} \quad . \tag{20}$$

Equating (20) and (17), we can solve for the optimum output ratio as a function of the output price ratio:

$$S_G/Z = \left[(\mu\, P_Z)/(\,\beta P_G)\right]^{\tau} \quad . \tag{21}$$

This completes the first step. By rearranging (21) we can also derive the supply of CI service as follows:

$$Z \quad = S_G \left[(\mu\, P_Z)/(\beta P_G)\right]^{-\tau} \quad . \tag{22}$$

Hence

$$d \ln Z = d \ln S_G - \tau\,(d \ln P_Z - d \ln P_G) \quad . \tag{23}$$

Since τ is negative, the quantity of Z supplied by the service provider is positively related to its price P_Z, *ceteris peribus.*

The remaining task of finding the value of N_T that is consistent with producing the optimal quantity of Z at the lowest cost can be accomplished by first rearranging equation (15) into:

$$N_T = \Lambda\,(\,\mu S_G^{-\rho} + \beta Z^{-\rho}\,)^{-1/\rho} \quad . \tag{24}$$

Then, by substituting the supply of CI from (22) into equation (24), we get the desired solution for N_T as follows:

$$N_T = \Lambda(\, S_G^{-\rho}\,\{\mu + \beta([\mu P_Z]/[\beta P_G\,])^{\rho\tau}\})^{-1/\rho} \quad . \tag{25}$$

As regard to P_N, the price of N_T, dual to the CET transformation function set out in equation (15) is the following unit revenue function:

$$P_N = (1/\Lambda)\,[\mu^{\tau} P_G^{\rho\tau} + \beta^{\tau} P_Z^{\rho\tau}]^{1/\rho\tau} \quad . \tag{26}$$

If we model the service provider as a price-taker who hence operates under zero pure profits, (26) also represents the service providers' unit cost in providing public services and CI services.

3.2. The determinants of production capacity N

In the previous section we have demonstrated how the service providers supply public services to the government and CI to the private sector. We have not discussed how the service providers obtain the capacity to produce both public services and CI. This section is devoted to discussing this issue. First we assume that the capacity to produce N_P is a CES function of two types of labour,

$$N_P = \Omega[\kappa L_1^{-\lambda} + \nu L_2^{-\lambda}]^{-1/\lambda} \quad , \tag{27}$$

where L_1 is ordinary labour and L_2 is privileged labour. Both κ and ν are positive parameters with $\kappa + \nu = 1$. The substitution elasticity between the two types of labour is $\phi = 1/(1+\lambda)$, where $\lambda > -1$.

Dual to the CES production function set out in equation (27) is the following unit cost of producing N_P, which is an aggregate of the unit costs of the two types of labour:

$$C_P = (1/\Omega)[\kappa^{\phi} P_1^{\lambda\phi} + \nu^{\phi} P_2^{\lambda\phi}]^{1/\lambda\phi} \quad , \tag{28}$$

where P_1 is the economy-wide hourly wage rate for ordinary labour and P_2 is the price per hour of privileged labour endogenous to this part of the model.

Further we assume zero pure profit in the production of N_P, so that

$$P_N = C_N \quad , \tag{29}$$

and also assume that all the N_P produced is transformed into the production of legitimate public services (S_G) and CI (Z), so that the scalar measures of the aggregate output of the service providing sector and of input to that sector are equal:

$$N_T = N_P \ . \tag{30}$$

It is necessary that $P_2 > P_1$ because it is assumed that the privileged labour is able to appropriate rent. We also assume that the endowment of privileged labour, people in “connection”, is exogenously set at L_2. In general, CI activity withdraws some resources from productive activity. In this model we allow such possibility through the transfer of L_1 from other sectors into the service providing sector where it is used (in part) to produce corrupt intermediation. A summary of the production structure is shown in Figure 3. Note that with L_2 exogenously fixed, the rental per privileged member of the service-providing sector, P_2, will be endogenous in most closures of the model. It is assumed that there are sufficient barriers to entry (viz., lack of appropriate “connections”), to ensure that the existence of high returns to privileged labour ($P_2 > P_1$) does not lead to an increase in L_2 such as to equalise the returns to the two types of labour.

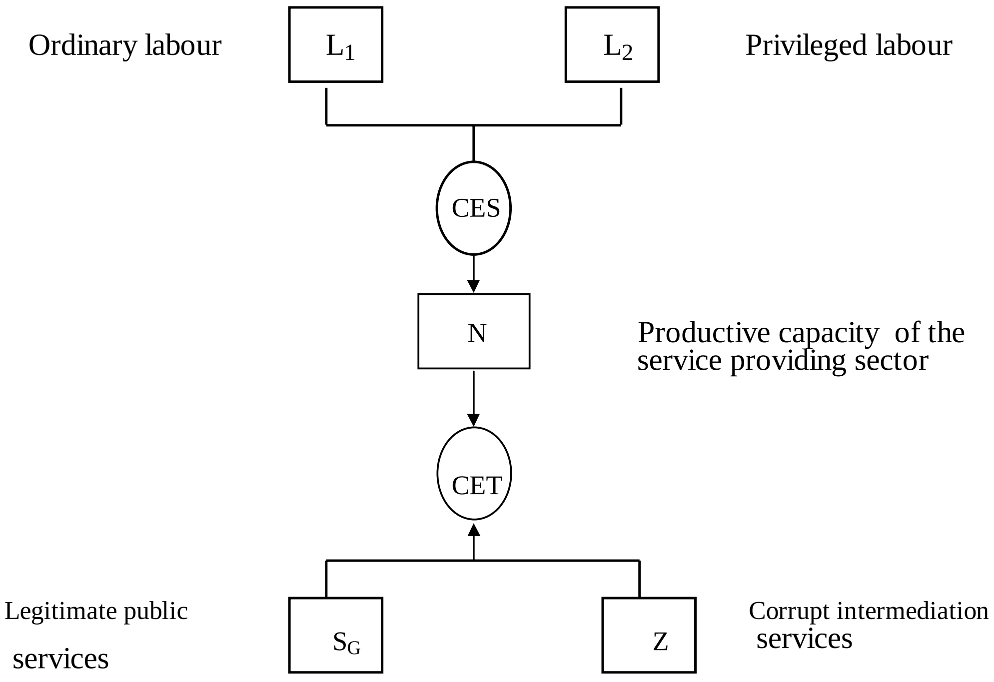

Figure 3 The structure of production of the services providing sector. ($N = N_T = N_P$).

4 The closure

The complete equations and variables of the CI model are collected in Tables 1 and 2. Because we have not introduced an industry dimension, the size of the model is still relatively small, involving 20 equations and 28 variables (see Tables 1 and 2). At this stage, in order to solve the model numerically, we need to set the value of eight (=28 - 20) variables exogenously. There is more than one way of selecting the variables on the exogenous list. In Table 4 we have shown one standard choice. The first variable in the list is P_H, which we set as the numeraire. The second variable is nominal gross profit (H). This is a natural choice because so far the CI model, which is to be a sub-model of a larger model, contains no equation describing how H is generated. This variable, therefore, cannot be endogenous. However, when this CI model is embedded within a larger economy-wide model which contains a mechanism on how H is generated, then it can be endogenous. Note that with P_H chosen as the numeraire, choosing H as exogenous is tantamount to setting real profits Q_H exogenously.

The choice of exogenous variables is also partly determined by what we use the model for. As has been stated earlier, our current objective is to analyse the impact of tax reform in the presence of CI activity. In this case it is, therefore, necessary to put some variables related to the instruments of tax reform on the exogenous list. The official tax rate (t) and the fine multiplier (g) are suitable candidates. The first will accommodate changes in the tax rate while the second will allow us to simulate changes in penalties, a major instrument in the government's tool kit for enforcing tax policy.

Earlier in section 3 we assumed that the government purchases legitimate public services from service providers and also sets both their price and quantity. This assumption implies that both the price (P_G) and the quantity (S_G) of legitimate public services are exogenous to the service providers.

In producing both S_G and P_G service providers use ordinary (L_1) and privileged labour (L_2) as inputs. In this model we do not have any equation describing the supply of either type of labour. We assume that the supply of privileged labour (L_2) is fixed exogenously, while its wage rate is determined endogenously. As regards to the ordinary labour, we assume its wage equals the economy-wide hourly wage rate, which is exogenous to the corruption intermediation model, and that the service providing industry is able to engage any amount of ordinary labour at this price.

Table 1 Equations of the corrupt intermediation model

Equations	Description
(a) Demand side	
(T.1) $Q_H = H/P_H$	Real profits
(T.2) $\Pi(0) = H - T$	After-tax profit with no CI
(T.3) $T = tH$	Tax liabilities
(T.4) $E(\Pi(Z_D)) = H - B(Z_D)\, T - M(Z_D) - J(R)\, G$	After-tax profit with CI
(T.5) $B = \theta_1 + \dfrac{(1-\theta_1)(1+\theta_1)}{1+\theta_1 e^{\gamma A}}$	Effective tax quotient
(T.6) $A = \varepsilon_B Z_D + (1-\varepsilon_B)(Z_D/Q_H)$	Normalised CI input
(T.7) $M = P_Z Z_D$	Value of CI services
(T.8) $J = \theta_2 + \dfrac{(1-\theta_2)(1+\theta_2)}{1+\theta_2 e^{\alpha S}}$	Probability of incurring fine
(T.9) $S = \varepsilon_J R + (1-\varepsilon_J)(R/Q_H)$	Normalised political influence
(T.10) $G = gT$	Nominal fine for tax evasion
(T.11) $R = Z_D/\delta$	Stock of political influence
(T.12) $P_Z = \dfrac{\gamma(B-\theta_1)^2\theta_1 e^{\gamma A}}{(1-\theta_1)(1+\theta_1)}\, T/Q_H + \dfrac{\alpha(J-\theta_2)^2\theta_2 e^{\alpha S}}{(1-\theta_2)(1+\theta_2)\,\delta}\, G/Q_H = 0$.	First-order condition
(b) Supply side	
(T.13) $Z_s = S_G\, [(\mu P_Z)/(\beta P_G)]^{-\tau}$	Supply of CI
(T.14) $N_T = \Lambda\, [\mu S_G^{-\rho} + \beta Z_S^{-\rho}]^{-1/\rho}$	Service providers' aggregate production capacity
(T.15) $P_N = 1/\Lambda[\mu^{\tau} P_G^{\rho\tau} + \beta^{\tau} P_Z^{\rho\tau}]^{1/\rho\tau}$	Unit revenue of from service provision
(T.16) $N_P = \Omega[\kappa L_1^{-\lambda} + \nu L_2^{-\lambda}]$	Aggregate input used by Service providers' capacity
(T.17) $C_P = 1/\Omega[\kappa^{\phi} P_1^{\lambda\phi} + \nu^{\phi} P_2^{\lambda\phi}]^{1/\lambda\phi}$	Unit cost of inputs to service provision
(T.18) $P_N = C_N$	Zero pure profits
(T.19) $N_P = N_T$	Input-Output identity
(c) Market clearing	
(T.20) $Z_D = Z_S$	Market clearing for CI

Number of equations = 20, Number of Variables = 28

Table 2 Variables of the corrupt intermediation model

Equations	Variables	Description
(a) Demand side		
	H	Nominal profit before-tax
	P_H	Price of profit
	$\Pi(0)$	After-tax nominal value of profit with no CI
	Q_H	Before-tax real profits
	T	Tax liability
	T	Official tax rate (proportion)
	$E(\Pi(Z_D))$	Expected after-tax nominal value of profit with CI
	Z_D	Quantity of CI demanded
	B	Effective tax quotient
	M	Value of CI services
	P_Z	Price of CI services
	J	Probability of incurring fine
	G	Nominal fine for tax evasion
	G	Fine multiplier – the multiple of the original tax liability that must be paid as a fine
	R	Stock of political influence
	A	Normalised CI input
	S	Normalised political influence
(b) Supply side		
	Z_S	Supply of CI
	N_T	Service providers' aggregate production capacity
	S_G	Supply of legitimate public services
	N_P	Aggregate input use by service providers
	P_N	Unit price of N
	P_G	Price of legitimate public services
	C_P	Unit cost of N
	L	Use of ordinary labour by the service providing industry
	L	Use of privileged labour by the service providing industry
	P_1	Hourly wage of ordinary labour
	P_2	Hourly wage of privileged labour

Number of variables = 28

Table 3 Parameters of the corrupt intermediation model

Equations	Parameter	Description
(a) Demand side		
(T.5,12)	γ	Technological coefficient in reducing tax quotient
(T.5,12)	θ_1	Minimum tax quotient (the floor for B)
(T.8,12)	α	Technological coefficient in reducing probability of being fined
(T.8,12)	θ_2	Minimum probability of being fined (the floor for J)
(T.11,12)	δ	Depreciation rate of the stock of political influence
(T.6)	ε_B	Parameter used to normalise CI input
(T.9)	ε_J	Parameter used to normalise political influence
(b) Supply side		
(T.13,14,15)	μ	CET distribution parameter for legitimate public services
(T.13,14,15)	β	CET distribution parameter for CI supplied
(T.13,15)	τ	Transformation elasticity between legitimate public services and CI
(T.14,15)	ρ	$\rho = -(1 - 1/\tau)$
(T.14,14)	Λ	General productivity (Hicks neutral) coefficient in production of aggregate capacity in service providing sector
(T.16,17)	κ	CES distribution parameter for ordinary labour input
(T.16,17)	ν	CES distribution parameter for privileged labour input
(T.17)	ϕ	Transformation elasticity between legitimate ordinary and privileged labour
(T.16,17)	λ	$\lambda = -(1 - 1/\phi)$
(T.16,17)	Ω	General productivity (Hicks neutral) coefficient in transformation frontier of service providing sector

Table 4 A standard closure of corrupt intermediation model – list of exogenous variables

Variable	Descriptions
P_H	Numeraire; price of profits
H	Nominal before-tax profit
T	Official tax rate
G	Fine multiplier
S_G	Supply of legitimate public services
P_G	Price of legitimate public services
L_2	Supply of privileged labour
P_1	Hourly wage of ordinary labour

Having specified the standard closure, we can now use the model to illustrate qualitatively the impact of a change in tax policy. Suppose the initial equilibrium is at point A (Figure 4) and then government introduces an income tax cut. We can establish that the fall in the tax rate must lead to a fall in the demand for CI services (Z) as follows. Assume, to the contrary, that $\Delta Z \geq 0$. From Table 1, equation (T.13) we can see that, with S_G and P_G exogenously fixed, $\Delta P_Z \geq 0$. The right-hand terms of the equation (T.12) of the same table measure the marginal benefits of a unit of CI; the schedules (T.5) and (T.8), however, imply that these benefits decrease with increasing Z. Hence $\Delta Z \geq 0$ implies that the right hand side of (T.12) declines. This contradicts the implication of (T.13) that P_Z increases. Hence the assumption that $\Delta Z \geq 0$ is fallacious, and the tax reduction must, in the standard closure of the model, lead to a fall in the demand for CI. The decrease in the demand for (hence the supply of) CI will reduce the quantity of resources used by the service providers from N_1 to N_2 in Figure 4.

To restore an equilibrium at the new frontier (B in Figure 4), the price of CI has to decrease relative to the price of legitimate public services. The reduction in N also induces a change into the composition of labour employed by the service providing sector (see Figure 5).

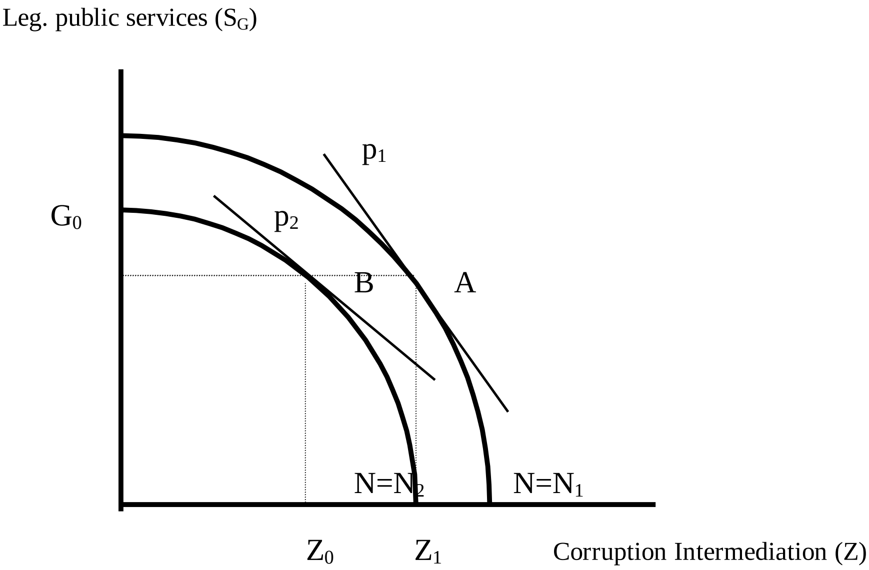

Figure 4 Resource impact of the tax policy change

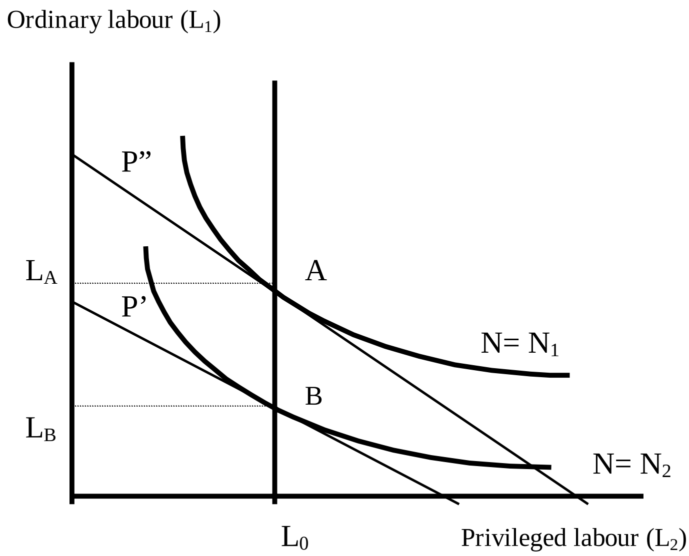

Figure 5 The direct employment impact of the changes in the tax policy.

With the supply of privileged labour exogenously determined (unchanged), the reduction in N is fully translated into a reduction in the use of ordinary labour. Since the wage of ordinary labour is also exogenously determined, naturally the wage of privileged labour has to decrease to accommodate a new equilibrium.

5 The relevance of the model to tax reform analysis

To illustrate how the model works numerically, we now need first to assign some values to the parameters (Table 5), and then some initial values to the exogenous variables (Table 6). A simple hypothetical set of values is chosen for illustrative purposes. The data reflects the behaviour of the service providing sector and two representative taxpayers (F1 and F2) with the same taxable incomes. The two taxpayers, however, have different productivity in their usage of corrupt intermediation activity. As shown by the values of γ, α and δ, in some sense F2 is twice as productive as F1.

The assumed values presented in Table 5 and 6 are sufficient to generate a base solution to the corrupt intermediation model (columns 2 and 3 of Table 7). From the initial solution for the demand side we can see that 50 units of (nominal and real) before tax-profit are available for both F1 and F2. Before the tax rate change, both representative taxpayers pay 25 units as income tax if they do not participate in CI activity.

Table 5 The values of the parameters

Equations	Parameter	Value F1	Value F2
(a) Demand side			
(5,12)	γ	25	50
	θ_1	0.20	0.20
(6)	ε_B	0	0
	α	25	50
	θ_2	0.10	0.10
(9)	ε_J	0	0
(11,12)	δ	0.40	0.20
(b) Supply side (Service providing sector)			
(13,14,15)	μ	0.35	
(13,14,15)	β	0.65	
(13,14)	τ	$1/(1+\rho)$	
(14,15)	ρ	- 1.1	
(13,14)	Λ	2	
(16,17)	κ	0.6	
(16,17)	ν	0.4	
(17)	ϕ	$1/(1 - 1/\lambda)$	
(16,17)	λ	1.4	
(16,17)	Ω	3	

Table 6 The initial values for exogenous variables

Variables	Initial value
P_H	1
H	30
t	**0.50**
g	2
S_G	10
P_G	1
L_2	2
P_1	1

Both F1 and F2, however, are assumed to engage in corrupt intermediation since they are able to increase their after-tax profits to 28.16 and 33.16 units, respectively. For F1, the increased after-tax profit, however, involves a spending of 8.23 monetary units to purchase 4.88 units of CI to reduce the effective tax quotient to only 0.328. This means that the average tax actually paid is reduced from the tax liability of 50 percent to just 16.40 (=50 x 0.328) percent of before-tax income. F2, more productive in its use of CI than F1, spends of only 5.12 monetary units to purchase 3.10 units of CI inputs Z, which reduces the effective tax quotient for F2 to a level lower than F1, namely 0.269. This means that the average tax F2 actually pays is reduced from 25 to 6.725 (=25 x 0.269) monetary units.

From the supply side we can see that the service providers require 17.38 units of production capacity (N) to provide 10 units of legitimate public services and 7.98 units of CI used by both F1 and F2. This level of production capacity is obtained by employing 4 and 8.92 units of privileged and ordinary labour, respectively.

5.1 A reduction in the tax rate

Now suppose the government introduces a shock to the system in the form of a reduction in the income tax rate from 50 to 35 percent. The new solution for F1 and F2 are shown in the last two columns of Table 7. The reduction of the tax rate increases after-tax profit with no corrupt intermediation from 25 to 32.5 monetary units, for now both taxpayers pay only 17.5 units as tax. For F2, however, CI activity still offers higher after-tax profit, namely 36.83 units. F2 therefore continues to engage in CI activity but to a slightly lesser extent. The firm purchases only 2.72 units of Z (previously 3.10) to reduce its effective tax quotient to 0.299. This means that the average tax actually paid after the reduction of the statutory tax rate is reduced from 35 to 10.47 percent. Unlike F2, the reduction in the tax rate makes it no longer profitable for F1 to engage in CI. The reduction in the tax rate increases F1's after-tax profit ($E\Pi(Z)$) with CI from 28.16 to 32.45 units. This, however, is smaller than $\Pi(0)$

(32.5 units), F1's profit if it does not engage in CI and hence does not satisfy the condition set out in inequality (6). It is therefore better for F1 to quit CI activity and pay the full tax at the rate of 35 percent.

Table 7 The initial and the tax cut solution for the corrupt intermediation model under standard closure

Variables	Base Case Solution F1	Base Case Solution F2	Tax cut F1	Tax cut F2
(a) Demand side				
H	50	50	50	50
T	25	25	17.5	17.5
Π(0)	25	25	32.5	32.5
E(Π (Z))	28.16	33.16	32.45	36.83
Z	4.88	3.10	4.26	2.72
B	0.328	0.269	0.370	0.299
M	8.23	5.12	7.27	4.43
J	0.104	0.100	0.108	0.100
G	50	50	35	35
R	12.19	15.49	10.66	13.58
P_Z	1.73	1.65	1.70	1.63
(b) Supply side				
N	17.38		10.75	
L_1	8.92		3.36	
P_2	3.64		3.62	

As regards the supply side, the reduction in the use of CI (2.72 units, all by F2), causes N to decrease form 17.38 to 10.75. This means that the service providers now need a lower level of production capacity to produce the new levels of public and corrupt intermediation services.

5.2 Revenue impact of the tax cut

One essential element of applied tax evasion analysis is to find the relationship between the tax rate and the degree of taxpayers' participation in tax evasion (Jung *et al* 1994). The reduction of the tax rate increases firms' willingness to pay tax, shown by the larger tax quotient B. Whether this will increase or reduce tax payments collected from the two representative taxpayers depends on how much B increases for both F1 and F2, which depends on the productivity of each firm in using CI. In the context of this model, at a given price of corrupt intermediation, the level of income reported to tax officials depends on taxpayers' productivity in CI as represented by the value of parameters γ and α in equations T.5 and T.8 of Table 1, respectively. Therefore, by varying the settings of these parameters we can find three different cases where representative taxpayers with the same level of taxable income (i) do not engage in CI in the first place (the values of γ, δ and α are very low, for example < 10); (ii) engage in CI when the tax rate is high but quit it when the tax rate is reduced (both γ and α have moderate values such as 25), and (iii) engage in CI irrespective of the tax rate (the values of both γ and α are ≥ 30).

Table 8 Revenue impact of tax rate reduction

Firm	*Tax rate in percent 100×t*	*Tax quotient (B)*	*Effective tax payments (E= T x B)*	*Tot. tax rev at each t (F1+F2)*
F1	***50***	0.328	8.2	
F2	***50***	0.269	6.73	14.93
F1	***35***	1	17.5	
F2	***35***	0.299	5.23	22.73

The representative taxpayers belonging to (i) report their full income whether the tax rate is low or high. The reduction of tax rate will, therefore, reduce government revenue collected from this group of taxpayers. The representative taxpayers in group (ii) report part of their income when the tax rate is high but declare it in full when the tax rate is reduced. If the increase in the reported income leads to additional tax collections which outweigh the reduction of tax revenue due to the reduction in the tax rate, it is possible to find that the reduction of the tax rate will increase government revenue collected from this group. This case is shown in Table 8, where tax reduction increases tax revenue collected by government from 14.93 to 22.73 units of income. In the third case, the reduction in the tax rate increases the effective tax quotient for both F1 and F2 but not sufficiently to increase government revenue. This is usually the case where both firms still find it profitable to engage in CI activity even after the reduction in the income tax rate.

Note however, that this stand-alone version of the CI model has ignored the impact that resources released from the service providing sector would have on the size of the rest of the economy (and therefore on the size of the tax base). In particular, the reduction of N from 17.38 to 10.75 (see Table 7) could result in higher total factor payments and hence in taxable incomes in a fully integrated economy-wide model that allows feedbacks from the service providing sector to the economy at large.

Arthur B. Laffer (1979) asserted that if a country is operating in the prohibitive range (the downward-sloping portion of the Laffer curve), a reduction of the tax rate will lead to an increase in government revenue. Whether a country is operating in the prohibitive range or not is an empirical question, for it depends on the magnitude of the supply elasticity of labour (capital) with respect to the net wage (rental rate).

Table 9
Government revenue schedule*

tax rate	***0.1***	***0.15***	***0.2***	***0.25***	***0.3***	***0.35***	***0.4***	***0.45***	***0.5***
tax rev	10	15	13.77	16.76	19.74	22.73	12.8	13.86	14.93

* Tax revenue is the total tax payment of F1 and F2 at each tax rate.

The majority of the empirical findings do not seem to support Laffer's assertion. Using a general equilibrium framework, Fullerton (1982) suggests that the US economy would be operating in the prohibitive range only if the labour supply elasticity were as high as four, which is much higher than almost any existing estimates.

Although motivated by corruption and tax evasion, the framework introduced in this paper can be applied in a straightforward way to (legal) tax avoidance. Our simulations indicate that the reduction in the tax rates broadens the tax base due to the inclusion of F1's full income (see Table 8). The broadened tax base is sufficient to cover the loss of tax revenue from the reduction of the tax rates and hence increases the revenue collected by the government. As shown by the contents of Table 9, it seems that before the tax cut, as far as these two representative taxpayers are concerned, the government is operating in the prohibitive range. At the tax rate of 50 percent, which is the base case for the tax reform example above, the government is operating well beyond the value that maximises tax collections.

The results presented above, therefore, seem consistent with Laffer's hypothesis. It is important to note, however, that we use a different mechanism in deriving our results. While Laffer's hypothesis depends on the magnitude of the supply elasticity of labour (capital) with respect to the net wage (rental rate), our finding is explained by the marginal benefit taxpayers obtain from CI (or tax avoidance) activity.

This marginal benefit determines the firm's decision as to whether to engage in or to quit CI, which in turn affects the effective tax base. The higher the benefit taxpayers obtain from attempts to reduce tax payments, the more likely it is that the government is operating in the prohibitive range. The reduction of the tax rate will reduce taxpayers' benefits from such attempts and hence induce some taxpayers to quit, which in turn extends the effective tax base.

6 Concluding remarks

In this paper we have constructed a simple model of the demand for and supply of corrupt intermediation in the context of tax avoidance/evasion. We are able to establish that a reduction in the tax rate on profits induces a reduction in the demand for and hence the supply of corrupt intermediation. This in turn could increase or reduce tax collected by the government depending on how much tax reduction firms are able to achieve per unit of real resources devoted to reducing tax payments. These arguments, however, are based on a very simple and stylized model using hypothetical data. As a consequence, further research is needed to assess its relevance.

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