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Paper presented to the Ph.D Conference in Economics and Business, University of Western Australia, November 1997

Can Tax Reform Work in an Economy Where Tax Avoidance and Evasion are Endemic ?

by

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Preliminary Working Paper No. IP-71 January 1998

ISSN 1 031 9034 ISBN 0 7326 0751 5

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Abstract

In this model firms seek to minimise their tax liabilities by purchasing rent-seeking services from a provider who also sells legitimate public services to the government. The provider enjoys economies of scope – its two outputs are produced jointly. Tax reform in this setting can increase both government revenue and the efficiency of the economy because a type of Laffer curve is operational and because such reform can lead to resources being moved out of rent-seeking activity. Later this partial equilibrium framework will be embedded within a conventional general equilibrium model.

JEL Classification: D72

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PREFACE

The concept of rent-seeking has been extensively applied to the analysis of various types of government regulation. Recently, the spirit of the concept has also been applied to the field of taxation (Tollison, 1987; Pederson 1995). Once the rent-seeker is in control of a certain rent, he will be prepared to spend resources to protect it from eroding. The introduction of an excise tax, for example, reduces producer's surplus. To prevent the surplus from eroding, the rent-seeker may engage in lobbying and in the limit spend as much as the potentially lost surplus. This rent-protection activity may exacerbate the allocative distortion due to the tax (Tollison 1987).

Pederson introduces rent-seeking into tax analysis by modelling the interaction between government and private agents. The government is assumed to serve the interests of those private agents who compete through rent-seeking activity. Private agents who succeed in rent-seeking activity obtain a return in the form of a tax reduction. Some resources are wasted in the process; rent-seeking activity, therefore, is good for the successful agent but not for the economy as a whole.

In this study we apply the rent-seeking concept to tax reform analysis. Like Pederson's, our framework implies that rent-seeking is socially wasteful because it absorbs resources without increasing social product. Unlike Pederson, we assume from the beginning that agents engaging in rent-seeking have different productivities. By this we mean that for the same monetary input different firms succeed to varying degrees in their efforts to avoid/evade tax payments.

In an economic environment with zero rent-seeking activity, we generally assume that firms simply maximise gross profit by choosing the most efficient combination of inputs at any given output level and with given input prices. The tax on profits is taken as given and does not enter into firms' input decision making as it simply reduces gross profit to after-tax profit. In an environment where rent-seeking activity is pervasive, this often is not the case. Rent-seeking activity presents a firm with two alternatives: (i) to pay tax in full; or (ii) to engage in certain activities to reduce its tax burden. This activity, therefore, introduces both additional cost and additional after-tax profit. If the firm takes maximising after-tax profits seriously, then after its production decisions have been taken, it needs to consider a second level of profit decision making in order to maximise profit net of taxes and rent-seeking costs. This creates demand for rent-seeking services.

As regard to the supply of rent-seeking services we assume that the service providing sector (bureaucrats) maximise profits by engaging in joint-production of legitimate public services and rent-seeking services. A change in the tax policy in a general equilibrium setting will affect the demand for rent-seeking services and in turn change the composition of output produced and also resources used by the service providing sector. Thus, a change in tax policy can bring about efficiency improvement to the economy either by substituting (presumably socially valuable) legitimate public services for wasteful rent-seeking activity, and/or by releasing resources from the service-providing sector for productive use elsewhere.

An interesting by-product of this exercise is that we are able to derive the government's tax revenue schedule which has elements in common with the Laffer curve proposed by Arthur B. Laffer (1979). However, unlike the Laffer curve whose existence depends on the magnitude of the supply elasticities of labor with respect to the net wage (Rosen 1988), the revenue schedule we derive here is determined by the taxpayers' marginal benefit in engaging in rent-seeking activity.

This paper is based on Chapters 2, 3, and 4 of my PhD thesis, which is being supervised by Professor Alan Powell[1]. The thesis has the following Chapter outline:

1 Introduction

2 The Demand for Rent-Seeking Services

3 The Supply of Rent-Seeking Services

4 A Standard Closure for the Rent-Seeking Model

5 The ORANI-RNT: An GE Model with Rent-Seeking Services

6 The Database for ORANI-RNT

7 Illustrative Application of ORANI-RNT

8 Conclusion.

E.G. Clayton, Vic., November 1997

[1] I am very grateful for Alan's excellent supervision.

Can Tax Reform Work in an Economy Where Tax Avoidance and Evasion are Endemic ?

by

Edimon GINTING

1. Introduction

The objective of this paper is to examine the reactions of representative taxpayers, whose productivity in use of rent-seeking activity differs, to a change in the tax policy. A model to describe taxpayers demand for rent-seeking services is developed in section 2. The supply side is outlined in section 3. It incorporates constant returns to scale. Section 4 describes a more flexible variant of the model, which can include both constant and non-constant returns to scale. The standard closure and a qualitative analysis of tax policy change are set out in section 5. Using a hypothetical data set, the relevance of the model to tax analysis is illustrated in section 6. Section 7 offers a brief concluding remarks.

2. The Demand for Rent-Seeking Services

The firms in this model are assumed to take rent-seeking activity (hereafter called RS) seriously. For simplicity it is assumed that the levels of output and of attainable pre-tax profit are independent of rent seeking activity. Hence firms to engage in two levels of profit decision making, the first with respect to ordinary inputs and the second with respect to the purchase of rent-seeking 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. In the following, therefore, we focus just on the firm's second level profit maximisation problem, taking the firm's pre-tax profit level as given.

Having maximised gross profit with respect to ordinary inputs, we assume that firms are also maximising net-profit by engaging in RS. 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 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

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

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 schedule.

Secondly, the firm may engage in RS and obtain expected net-profits as follows:

$$E(\Pi\,(Z)) = H - B(Z)\,T - M(Z) - J(R)\,G \quad , \tag{4}$$

where $0 \leq B \leq 1$ is the effective tax quotient after engaging in RS, Z is the real input used in RS and M(z) is nominal value of resources spent. R denotes the firm's stock of political influence. J is the probability of being fined for engaging in RS 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 that the firm is indifferent between the sure prospect $\Pi(0)$ = \$ 500 and the unsure prospect involved when $Z > 0$ and expected $\Pi(Z)$ = \$ 500. Note that this assumption can be relaxed without difficulty to accommodate risk-averse or risk-loving behaviour.

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

$$E(\Pi(Z)) > \Pi(0) \quad . \tag{5}$$

For the necessary condition (5) to be satisfied, the tax reduction obtained by the firm must be less than the amount of resources transferred to RS, taking into account 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 task , however, we need to discuss how each component of (4) 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 RS 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 (2.6) we define the dependence of B on Z ($0 \leq B \leq 1$). In the chosen functional form it can be expressed as:

$$B = \theta_1 + \frac{(1-\theta_1)(1+A)}{1+Ae^{\gamma z}} \quad , \qquad (6)$$

where A is a constant and γ is a 'technological' parameter related to the effectiveness of the rent-seeking input Z in reducing tax payments.

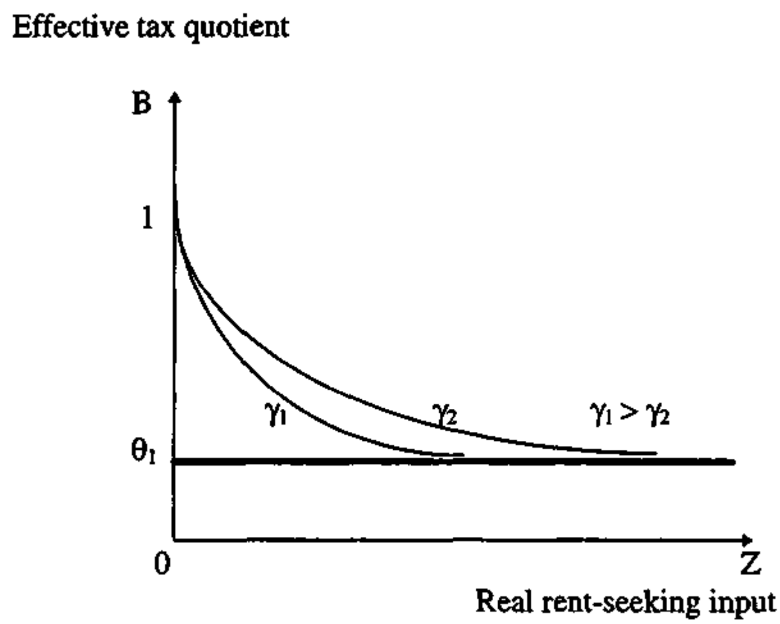

Figure 1: Two hypothetical schedules showing different productivity in rent-seeking activity. The firm whose parameter is γ_1, is more efficient than the firm with parameter γ_2.

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 constant A is for calibration purposes and does not have any economic interpretation. It is designed only to make the function produce the value of $B = 1$ when Z is zero, to represent the case where the firm does not engage in rent-seeking activity. The value of γ is positive. As Z gets indefinitely large, B tends towards θ_1. The higher the value of γ, the more efficient is the rent-seeking 'technology' of the firm, meaning that using the same quantity of input Z, the firm is able to obtain a higher benefits in terms of tax reduction. In addition, equation (6) implies B decreases at a decreasing rate as z increases, meaning that the first few rent-seeking inputs are much more productive in reducing B than the subsequent inputs (see Figure 1).

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 rent-seeking 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 (7), where P_Z is the price of Z.

$$M = P_Z Z \qquad (7)$$

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 (log R) 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 developing countries 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 J is determined by R, as shown in equation (8).

$$J = \theta_2 + \frac{(1-\theta_2)(1+Q)}{1+Qe^{\alpha R}} \quad . \tag{8}$$

The constant Q in (8) serves the same function as A in (6) so that it does not have an economic interpretation.

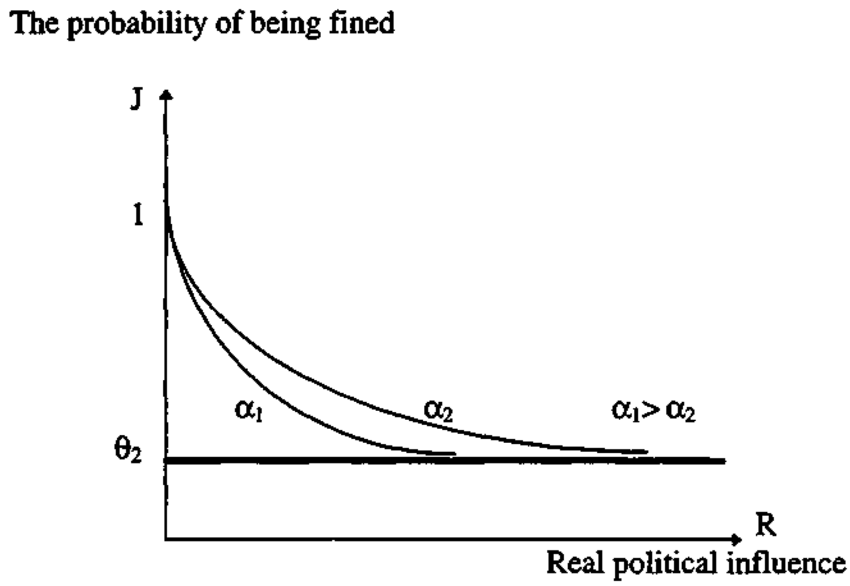

Figure 2: Two hypothetical schedules showing different productivity in reducing the probability of being fined. The firm whose parameter is α_1, is more efficient than the firm with parameter α_2.

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 ($R \rightarrow \infty$), they can only reduce J to θ_2. Parameter α has a positive value and measures the effectiveness of firms' 'technology' in reducing J. The higher 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. As shown in Figure 2, the higher the value of α, the faster the J schedule approaches the θ_2 line.

Further we assume that R is to be determined by z, the real amount of resources the firm spends in rent-seeking activity. 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 RS balances the natural attrition (or 'depreciation') of the stock of political influence. Thus

$$R(t+1) = R(t)(1-\delta) + Z(t) \quad . \tag{9}$$

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

$$R = Z/\delta \quad . \tag{10}$$

An important point to note about RS in this steady-state formulation is that real inputs 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 Rent-seeking Input.

Having defined all elements of (4) 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:

$$\frac{d\Pi}{dz} = -\frac{db}{dz}\,T - \frac{dB}{dz} - \frac{dJ}{dR}\,\frac{dR}{dz}\,G = 0 \quad . \tag{11}$$

By taking the first derivative of (6), (7), (10) with respect to Z and (9) with respect to R and then substituting them into (11) we get the following condition:

$$\frac{d\Pi}{dz} = -\frac{-\gamma(B-\theta_1)^2 Ae^{\gamma z}}{(1-\theta_1)(1+A)}\,T - \mu\,-\frac{-\alpha(J-\theta_2)^2 Qe^{\alpha R}}{(1-\theta_2)(1+Q)\,\delta}\,G = 0\ . \tag{12}$$

Equation (12) can be rearranged to obtain the following form:

$$P_Z = \frac{\gamma(B-\theta_1)^2 A e^{\gamma z}}{(1 - \theta_1)(1 + A)} T + \frac{\alpha(J-\theta_2)^2 Q e^{\alpha R}}{(1 - \theta_2)(1 + Q)\,\delta} G \,. \qquad (13)$$

Equation (13) implies that to optimise spending on rent-seeking, 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 reduction of 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 (13).

3 The Supply of Rent-Seeking Services

3.1 A Simple Model

We assume that rent-seeking services is supplied by the service providing sector. This sector engages in the joint production of (legitimate) services which are sold to government, and (possibly illegitimate) rent-seeking 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. 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 (possibly illegitimate) rent-seeking services (Z) to the private sector. The service providing sector's production frontier is assumed to take the following CET form:

$$N_T^{-\rho} = \Lambda^{-\rho}(\mu S_G^{-\rho} + \beta Z^{-\rho}) \quad (14)$$

where N_T is the sector's production capacity, S_G is the quantity of public services and Z is the real quantity of rent-seeking 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 3.

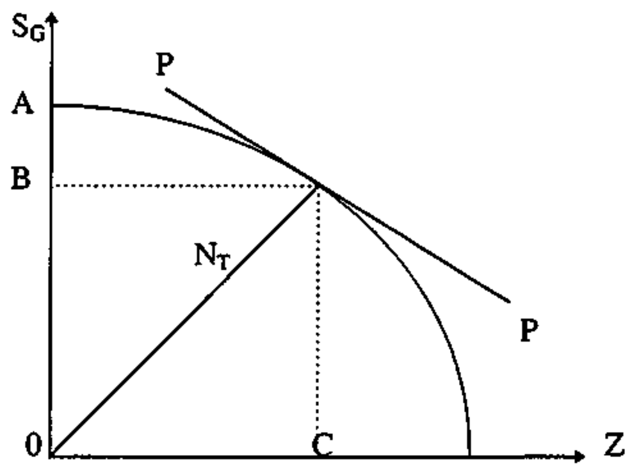

Figure 3 Production possibilities frontier for public and rent-seeking services.

Since the quantity of public service 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 both prices of S_G and Z as given, and the slope of the price line PP in Figure 3 therefore is given, then the service providers' net revenue maximisation decision can be formulated as follows:

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

(15)

subject to equation (14), where P_G, P_Z and S_G are all given. P_G and P_Z are the prices of public and rent-seeking services, respectively. N_TP_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 (14),

(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:

$$\left.\frac{\partial S_G}{\partial Z}\right|_{N_T \text{ is const}} = -\frac{P_Z}{P_G} \quad . \tag{16}$$

Taking the total differential of equation (14), we obtain:

$$d(N_T^{-\rho}) = \Lambda^{-\rho} \{\mu\, d(S_G^{-\rho}) + \beta\, d(Z^{-\rho})\} \quad . \tag{17}$$

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

$$0 = \mu(-\rho)\, S_G^{-(\rho+1)}\, dS_G + \beta(-\rho) Z^{-(\rho+1)}\, dZ\, , \tag{18}$$

which is a restatement of (17) when N_T held fixed. From equation (18) we can find the differential quotient dS_G/dZ and take the limit as $dZ \rightarrow 0$, obtaining:

$$\frac{\partial S_G}{\partial Z} = \frac{-\beta Z^{-(\rho+1)}}{\mu S_G^{-(\rho+1)}} \quad . \tag{19}$$

Equating (19) and (16), we can solve for the optimum output ratio as a function of the output price ratio:

$$S_G/Z = [(\mu P_Z)/(\beta P_G)]^{\tau} \quad . \tag{20}$$

This completes the first step. By rearranging (20) we can also derive the supply of rent-seeking service as follows:

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

Hence

$$d \ln Z = d \ln S_G - \tau (d \ln P_Z - d \ln P_G) \quad . \tag{22}$$

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

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 (14) into:

$$N_T = \Lambda (\mu S_G^{-\rho} + \beta Z^{-\rho})^{-1/\rho} \quad . \tag{23}$$

Then, by substituting the supply of rent-seeking services from (21) into equation (23), we get the desired solution for N_T as follows:

$$N_T = \Lambda(S_G^{-\rho} \{\mu + \beta([\mu P_Z]/[\beta P_G])^{\rho\tau}\})^{-1/\rho} \quad . \tag{24}$$

As regard to P_N, the price of N_T, dual to the CET transformation function set out in equation (14) is the following unit revenue function:

$$P_N = 1/\Lambda \, [\mu^{\tau} P_G^{\rho\tau} + \beta^{\tau} P_Z^{\rho\tau}]^{1/\rho\tau} \quad . \tag{25}$$

If we model the service provider as a price-taker who hence operates under zero pure profits, (25) also represents the service providers' unit cost in providing public and rent-seeking services. In terms of proportional changes (25) becomes:

$$d \log P_N = share_G \, d \log P_G + share_Z \, d \log P_Z \quad , \qquad (26)$$

where $share_G$ and $share_Z$ respectively are the shares in total revenue of S_G and Z.

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 rent-seeking services to the private sector. We have not discussed how the service providers obtain the capacity to produce both public and rent-seeking services. 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,

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

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:

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

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

$$P_N = C_N \quad , \qquad (29)$$

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

$$N_T = N_P . \qquad (30)$$

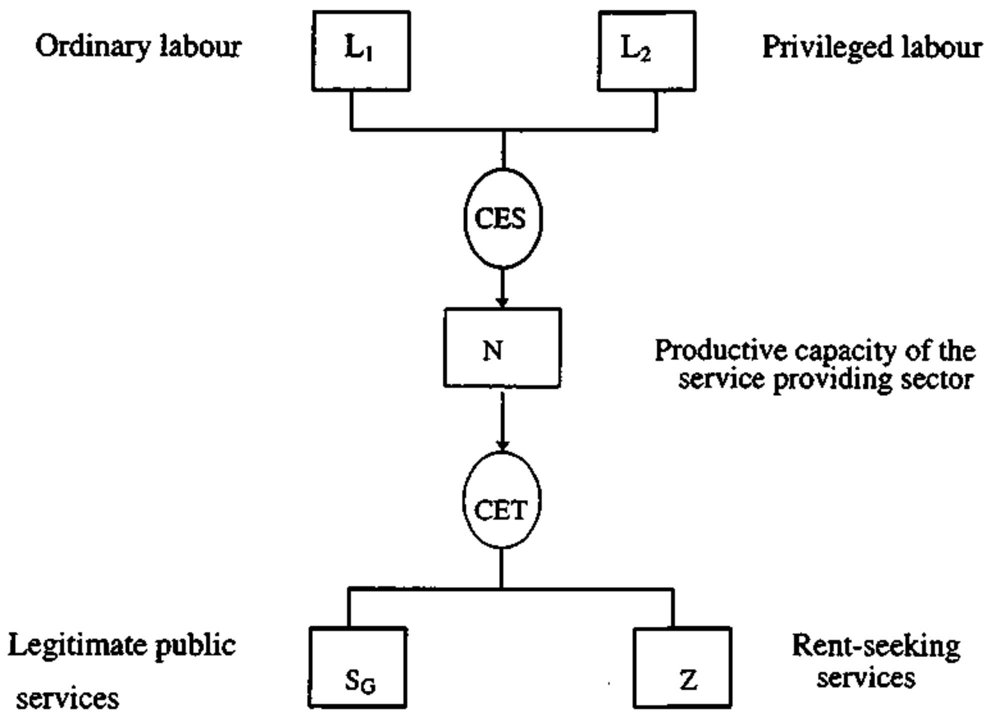

Figure 3.2 The Structure of Production of the Service Providing Sector. ($N = N_T = N_P$).

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, rent-seeking 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 rent-seeking services. A summary of the production structure is shown in Figure 4. Note that with N_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 ($P_1 > P_2$) does not lead to an increase in L_2 such as to equalise the returns to the two types of labour.

4 A More General Form of the Model

The majority of general equilibrium models, including the economy-wide model within which this rent-seeking model is to be embedded, use constant returns to scale (CRTS) in the production structure of the model. This is because the properties of the CRTS production function significantly reduce the burden of calibrating the model, and allow easier validation of the correct coding of the model (e.g., via homogeneity tests). Under CRTS properties, most coefficients required for the model can be derived from cost and sale shares, which can easily be obtained from input-output tables. The CRTS properties also simplify the task of interpreting the model.

The demand side of the rent-seeking model set out in the previous section does not have CRTS properties[2]. The presence of scale effects makes the rent-seeking model slightly at odds with the economy-wide model within which it is to be embedded. Some interpretation problems and unnecessary difficulties may occur during the development of the fully integrated model because the two component

[2] While the rent-seeking model is homogenous in prices – when all prices change by the same percentage, all the quantities stay constant – the model is not homogenous on the real side. When real profit Q_H is multiplied by two, the new optimum quantity of Z demanded is less than twice the old one. The model, therefore, exhibits increasing returns to rent-seeking. Moreover, at least over a range of values of Q_H the degree of the scale effect is higher as Q_H increases.

models do not share common CRTS properties. To avoid this problem we need to make the rent-seeking model more general; that is, to make the specification more flexible, so that it possible for the model to have either scale effects or CRTS properties. This task can be accomplished by redefining equations (6) and (8), the sources of the scale effect. We replace (6) by the following equation;

$$B^* = \theta_1 + \frac{(1-\theta_1)(1+A)}{1 + Ae^{\gamma L_B}} \qquad (6')$$

where

$$L_B = \varepsilon_B Z + (1 - \varepsilon_B)(Z/Q_H), \qquad (6'')$$

and $0 \leq \varepsilon_B \leq 1$. Equation (6') has CRTS properties when $\varepsilon_B = 0$ and returns to the initial specification when $\varepsilon_B = 1$.

In the same way we can redefine equation (2.8) as:

$$J = \theta_2 + \frac{(1-\theta_2)(1+Q)}{1 + Qe^{\alpha L_J}} \qquad (8')$$

where

$$L_J = \varepsilon_J R + (1 - \varepsilon_J)(R/Q_H) \quad , \qquad (8'')$$

and similarly (8') will have CRTS properties if ε_J is set to zero and increasing returns to scale when $\varepsilon_J > 1$. With this specification we can now incorporate CRTS as a special case into the model by simply setting values of both ε_B and ε_J to zero. The revision of the model introduces two new equations (6" and 8"), two variables (L_B, L_J) as well as two parameters (ε_B and ε_J). It also alters the first-order condition for optimal use of rent-seeking services.

5 The Closure

The complete equations and variables of the rent-seeking 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 rent-seeking 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 rent-seeking 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 rent-seeking 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.

Table 1 Equations of the Rent-Seeking 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 RS
(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 RS
(T.5) $B = \theta_1 + \dfrac{(1-\theta_1)(1+A)}{1 + Ae^{\gamma L_B}}$	Effective tax quotient
(T.6) $L_B = \varepsilon_B Z_D + (1-\varepsilon_B)(Z_D/Q_H)$	Normalised RS input
(T.7) $M = P_Z Z_D$	Value of RS services
(T.8) $J = \theta_2 + \dfrac{(1-\theta_2)(1+Q)}{1 + Qe^{\alpha L_J}}$	Probability of incurring fine
(T.9) $L_J = \varepsilon_J R + (1-\varepsilon_J)(R/Q_H)$	Normalised political influence
(T.10) $G = gT$	Nominal fine for tax evasion
(T.11) $R = Z_D/\delta$	Stock of political influence
(T.12) $P_Z = \dfrac{\gamma(1-\theta_1)B^2Ae^{\gamma L_B}}{1+A}(T/Q_H) + \dfrac{\alpha(1-\theta_2)J^2Qe^{\alpha L_J}}{(1+Q)\,\delta}(G/Q_H)$	First-order condition for optimal use of RS
(b) Supply side	
(T.13) $Z_s = S_G\,[(\mu\,P_Z)/(\beta P_G)]^{\tau}$	Supply of RS
(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 RS

Number of equations = 20, Number of Variables = 28

Table 2 Variables of the Rent-Seeking 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 RS
	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 RS
	Z_D	Rent-seeking services demanded
	B	Effective tax quotient
	M	Value of RS services
	P_Z	Price of rent-seeking 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
	L_B	Normalised RS input
	L_J	Normalised political influence
(b) Supply side		
	Z_S	Supply of RS
	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_1	Use of ordinary labour by the service providing industry
	L_2	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 Rent-Seeking Model

Equations	Parameter	Description
(a) Demand side		
(T.5,12)	A	Designed to be = 1
(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)	Q	Designed to be = 1
(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 RS 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 rent-seeking services supplied
(T.13,15)	τ	Transformation elasticity between legitimate public services and RS services
(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 Rent-Seeking Model – List of Exogenous Variables

Variables	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_l	Hourly wage of ordinary labour

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 to the economy-wide hourly wage rate, which is exogenous to the rent-seeking model, and that the service providing industry is able to engage any amount of ordinary labour at this price.

Having specified the standard closure, we can now use the model to illustrate qualitatively the impact of the change in tax policy. Suppose the initial equilibrium is at point A (Figure 4) and then government introduces a an income tax cut. We can establish that the fall in the tax rate must lead to a fall in the demand for rent-seeking 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, $\Delta P_Z \geq 0$. In (T.12) of the same Table, however, that $\Delta T < 0$ and $\Delta P_Z > 0$ both individually and jointly, require that ΔB and $\Delta J > 0$. But with $\Delta Z > 0$, this is impossible (see Figure 1 and 2). 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 rent-seeking services Z. The decrease in the demand for (hence the supply of) rent-seeking services will reduce the quantity of resources used by the service providers from N_1 to N_2.

To restore an equilibrium at the new frontier (B), the price of rent-seeking services has to decrease relative to the price of legitimate public services. The reduction in N also induces change into the composition of labour employed by the service providing sector (see Figure 5). With the supply of privileged labour exogenously determined (unchanged), the reduction in N is fully translated to the 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.

From the way it is structured, it can be seen that the model is recursive. The demand side determines the optimum demand for Z and then it is assumed that this optimum is met by the supply side. The reverse does not apply since the supply side of the model does not have any mechanism to determine the optimum Z from the viewpoint of the client firms using rent-seeking services. The supply side is mainly designed to assess the allocative impact of rent-seeking activity, which withdraws resources (L_1) from the rest of the economy.

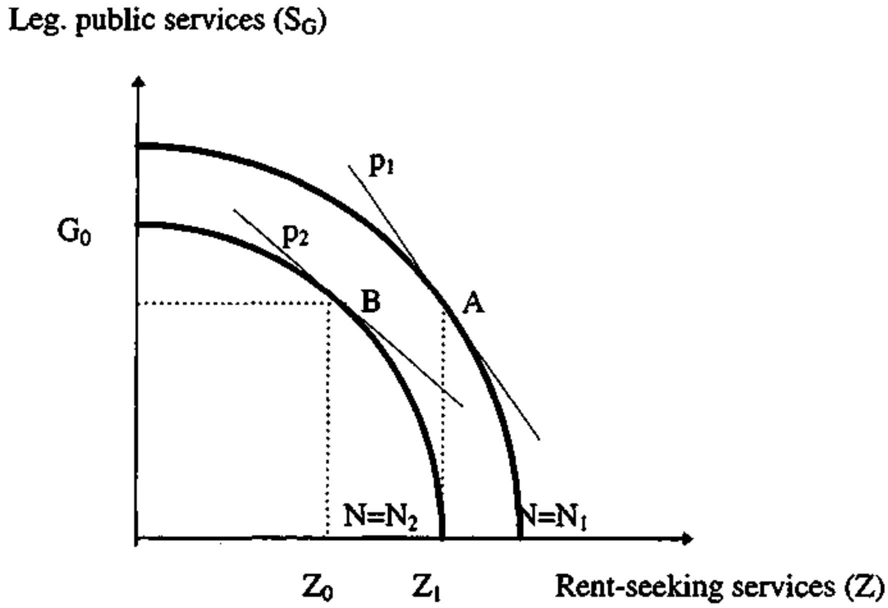

Figure 4 Resource impact of the tax policy change

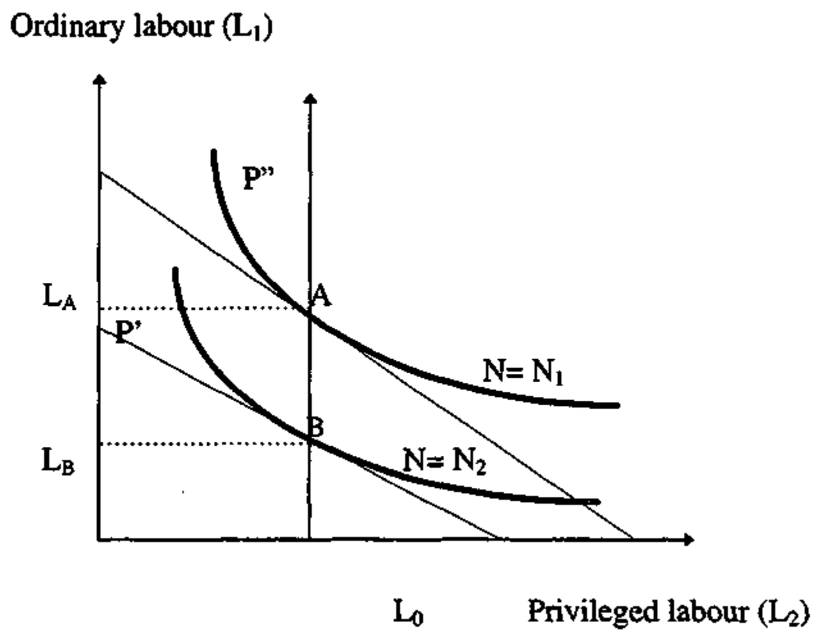

Figure 5 The employment impact of the changes in the tax policy.

6 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) to generate a base solution to the model. 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 rent-seeking activity. As shown by the value of γ, α and δ, in some sense F2 is twice as productive as F1.

Table 5 The Values of the Parameters

Equations	Parameter	Value F1	Value F2
(a) Demand side			
(5,12)	A	1	1
	γ	25	50
	θ_1	0.20	0.20
(6)	ε_B	0	0
(8,12)	Q	1	1
	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_I	1

6.1 A Reduction in the Tax Rate

Table 4.7 presents the base case and the shocked values of endogenous variables. From the base case 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 pays 25 units as income tax if they do not participate in rent-seeking activity. Both F1 and F2, however, are assumed to engage in rent-seeking 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 units to purchase rent-seeking inputs Z to reduce the effective tax quotient only to 0.328. This means that the average tax actually paid is reduced from 50 percent of tax liability to 16.40 (=50 x 0.328), percent. For F2, being more productive in rent-seeking activity than F1, to increase the after-tax profit involves a spending of only 5.12 units to purchase 3.10 units of rent-seeking inputs Z. This also reduces the effective tax quotient for F2 to a level lower than F2, 0.269, which means that the average tax F2 actually pays is reduced from 50 percent to 13.45 (=50 x 0.269) percent of its legal liability.

Table 7 The Initial and the Tax Cut Solution for the Rent-Seeking Model under Standard Closure

Variables	Base Case Solution		Tax cut	
	F1	F2	F1	F2
(a) Demand side				
H	50	50	50	50
T	25	25	17.5	17.5
$\Pi(0)$	25	25	32.5	32.5
$E(\Pi(Z))$	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	

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 rent-seeking services 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.

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 rent-seeking activity from 25 to 32.5 units, for now both taxpayers pay only 17.5 units as tax. For F2, however, rent-seeking activity, still offers higher after-tax profit, 36.83 units. F2 therefore continues to engage in rent-seeking 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 is no longer profitable for F1 to engage in RS. Tax reduction increases F1's after -tax profit with RS (EΠ(z)) from 28.16 to 34.45 units. It, however, is smaller than Π(0), the profit if F1 does not engage in RS (32.5 units) and hence does not satisfy the condition set out in inequality (5). It therefore better for F1 to quit rent-seeking activity and pay the full tax at the rate of 35 percent.

As regards to the supply side, the reduction in the use of rent-seeking services (2.72 by F2 and 0 by F1 since it quits RS), 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 rent-seeking services.

6.2 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). Clotfelter (1983) found that to what extent one evades tax is strongly correlated with the source of one's income. 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 RS. In the context of this model, at a given price of rent-seeking services, the level of income reported to tax officials depends on taxpayers' productivity in rent-seeking activity as represented by the value of parameters γ and α in equations 5 and 8, 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 rent-seeking activity in the first place (the values of both γ and α are very low, for example < 10); (ii) engage in rent-seeking when the tax rate is high but quit it when the tax rate is reduced (the values of both γ and α are moderate such as 25), and (iii) engage in rent-seeking 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 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) reporting 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 sufficient to increase government revenue. This is usually the case where both firms still find it profitable to engage in rent-seeking activity even after the reduction in the income tax rate.

Note however, that this stand-alone version of the rent-seeking 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 8) could result in higher total factor payments and hence their taxable incomes in a fully integrated 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).

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.

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 in each tax rate.

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 rent-seeking activity. This marginal benefit determines the firm's decision as to whether to engage in or to quit RS, which in turn affects the effective tax base. The higher the benefit taxpayers obtain from engaging in RS, 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 RS and hence induces some taxpayers to quit RS, which in turn extends the effective tax base.

7 Concluding Remarks

In this paper we have constructed a simple model of the demand for and supply of rent-seeking services in the context of tax avoidence/evasion. We are able to establish that a reduction in tax rate on profits induces a reduction in the demand for and hence the supply of rent-seeking services. 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 RS. These arguments, however, are based on a very simple and stylized model using hypothetical data. As a consequence, further empirical as well as theoretical research is needed to assess its validity and relevance.

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