Choosing the size of the public sector under rent seeking from state coffers

Hyun Park\textsuperscript{a}, Apostolis Philippopoulos\textsuperscript{b,c,*}, Vanghelis Vassilatos\textsuperscript{b}

\textsuperscript{a}Department of Economics, Kyunghee University, 1 Heoki-dong, Dongdaemoon-ku, Seoul, 130-701, South Korea
\textsuperscript{b}Department of Economics, Athens University of Economics and Business, 76 Patission Street, Athens 10434, Greece
\textsuperscript{c}CESifo, Munich, Germany

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Abstract

This paper incorporates rent seeking from state coffers into a general equilibrium model of economic growth and endogenous policy. Self-interested individuals try to extract, for personal benefit, part of tax revenues that could be used to finance public investment. We solve for a non-cooperative Nash equilibrium in individual agents’ behavior. The determinants of rent seeking in general equilibrium are identified and we consider the efficient size of public sector given the rent-seeking activity. Cross-country data from 108 rich and developing countries provide support for our predictions.

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1. Introduction

Anecdotal, case-study, and econometric evidence across countries indicates use of political influence or power to appropriate resources for private benefit from the rest of
society, particularly in countries where government policymakers or bureaucracies are corrupt, or institutions are weak. Theoretical models of rent-seeking behavior show how redistributive contests are inefficient in wasting resources. In this paper, we introduce rent seeking from state coffers into a general equilibrium model of economic growth where fiscal policy is endogenously chosen. The government collects tax revenues and self-interested individuals use private resources to seek to extract parts of the revenues for personal benefit. We study how rent-seeking behavior is related to the size of public sector and how endogenous economic policy affects rent seeking. The opening of the Pandora’s box of rent seeking from state coffers introduces a range of possibilities that depend on how corruption arises. We consider a large number of private agents competing for fiscal favors in a state with “weak” institutions that accommodate rent seeking. Given the possibility of rent seeking, we ask: “what is the expenditure-tax policy mix that maximizes the economy’s growth rate?”

Our reference point is Barro’s (1990) model of economic growth and endogenous fiscal policy in which government expenditures enhance the productivity of private firms. We add rent-seeking competition for tax revenue. In the general case, the economy-wide degree of rent extraction consists of exogenous and endogenous parts that depend on the total effort individuals expend in rent-seeking activities. The exogenous component

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1 Weak institutions are associated with poor legal systems, insecure property and contract rights, social polarization, ethnic conflicts, low education rates, and large and inefficient administrations (see Knack and Keefer, 1995; Rose-Ackerman, 1999; Rodrik, 1999; Easterly, 2001; and Tanzi, 2002). In democracies, interest groups can benefit at the expense of the unorganized general public: for surveys, see Persson and Tabellini (2000), Mueller (2003), and Hillman (2003).

2 The term “rent seeking” refers to the socially costly pursuit of winning a contestable prize. We shall use the terms “rent seeking”, “appropriation” and “extraction” interchangeably. The concept of rent seeking (if not the term) was introduced by Tullock (1967). See also, for example, Buchanan et al. (1980) and Tullock (1991). Drazen (2000, chapter 8), Mueller (2003, chapter 15) and Hillman (2003, chapter 6) provide surveys of the rent-seeking literature. Murphy et al. (1991), Tornell and Velasco (1992), Benhabib and Rustichini (1996), Lane and Tornell (1996), Mohtadi and Roe (1998, 2003), Tornell and Lane (1999), Mauro (2002) and Grossman and Mendoza (2003) also model non-cooperative redistributive games (see Drazen, 2000, chapters 10 and 11, for a survey).

3 Favors from the state can include direct transfers in cash (e.g. subsidies) and non-cash (e.g. private use of public assets). Other forms of favors include indirect transfers (e.g. measures that increase the demand for an interest group’s services, government-created barriers to entry and price controls that restrict competition, policies that discourage trade and foreign direct investment from abroad), disguised transfers (for example a road may be planned to increase the value of certain pieces of real estate), or tax exemptions and avoidance. See Mueller (2003, chapter 15) and Hillman (2003, chapter 6) for forms of fiscal favors.

4 In our paper, as in Mohtadi and Roe (1998, 2003) and Mauro (2002), the contestable prize is the rent from coercive taxation and individuals use private resources to influence transfer policies. This is a common-pool problem where the common pool is the collected tax revenue.

5 For instance, Rose-Ackerman (1999, chapter 7) distinguishes four polar cases of corruption: first, the case in which powerful corrupt private agents facing a weak state can extract high private benefits without paying high bribes; second, the opposite extreme case in which a powerful head of government organizes the political system to maximize rent-extraction possibilities facing a large number of weak private agents; third, a bilateral monopoly case in which powerful private interests face a corrupt ruler; and fourth, a case of competitive corruption in which a large number of private agents deal with a large number of corrupt low-level government officials.

6 Knack and Keefer (1995, p.1256) assess the strength of institutions from responses to questions about "claiming government benefits which you are not entitled to" or "cheating on taxes if you have the chance".
reflects government programs independent of interest groups’ pressure and lobbying.\(^7\) The endogenous component reflects the transfers that are targeted to more narrow groups and are provided only if the beneficiaries of the transfers apply pressure.\(^8\)

We obtain three main results. First, the possibility of rent extraction reduces economic growth both directly (resources available for social infrastructure are reduced) and indirectly (the incentives of self-interested individuals are distorted by pushing them away from productive effort). Second, a higher tax rate provides stronger incentives for rent seeking. Atomistic individuals do not internalize the adverse effect of their rent seeking activities on aggregate output; hence, whenever the tax rate increases, they have the impression that the contestable prize (here, government tax revenue) also increases, and so they attempt to extract more (see also Mauro, 2002). The total effect of the tax rate on growth consists of a direct Laffer-curve effect and an indirect negative effect through smaller effort allocated to productive work. Third, with the objective of economic policy being to maximize growth, and with a seemingly larger public sector triggering more aggressive rent seeking, there are social benefits from a lower tax rate (specifically, a tax rate that is less than that established by Barro, 1990). The lower tax rate corrects for individuals’ incentives to engage in socially inefficient rent seeking.

A special case is when the economy-wide degree of rent extraction is determined entirely by the total effort individuals spend in rent seeking activities. In this case, and if the size of public sector is small enough, there is a single decentralized competitive equilibrium without rent seeking. By contrast, if the size of public sector is large enough, there can be two decentralized competitive equilibria: a “good” one without rent seeking and a “bad” one with rent seeking.\(^9\) Intuitively, in the absence of institutionally given transfers that unambiguously make rent seeking dominant behavior, and if the pie or total rent looks large enough, there can be an expectations coordination problem: atomistic individuals can coordinate their actions to an outcome without rent seeking but it is equally possible that rent seeking becomes the self-fulfilling outcome. A government that chooses tax policy to maximize the growth rate but confronts the possibility of rent seeking from state coffers has the means to resolve the expectations coordination failure and select the

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\(^7\) This is mainly related to social and political conventions or norms (see e.g. Drazen, 2000, p. 137). Examples include pre-election transfers and general-interest welfare state programs, such as pensions, unemployment insurance, assistance to the poor, etc. These programs affect private incentives (see also Persson and Tabellini, 2000, chapter 6). Another cause is government bureaucracy itself. As Mueller (2003, p. 523) points out, government programs “may grow not only because increasing expenditures are demanded by citizens, interest groups or legislators, but also because they are demanded by the bureaucracy supplying government programs”. These programs again affect private incentives.

\(^8\) See Mueller (2003, chapter 21) for a survey of the earlier literature on interest groups, transfers and the size of the government. See also Persson and Tabellini (2000, chapter 7) for special-interest politics. Alesina (1999) provides examples of pressure applied by interest groups to increase the transfers.

\(^9\) Multiplicity can arise if the tax rate is high relative to the productivity of public services. Thus, a high tax rate cannot in itself lead to multiple equilibria and to rent seeking activity. This is consistent with reality. Scandinavian countries may have large public sectors and high tax burdens but do not seem to have rent-seeking problems. Crucial is the relation between size and productivity of the public sector, and not the size per se. See Afonso et al. (2003) who rank OECD countries according to public spending efficiency.
“good” equilibrium. Cross-country data from 108 rich and developing countries provide support for our predictions. Measuring rent seeking by the IRIS database, we find that the size of public sector measured as the share of government in GDP is positively correlated with rent seeking.

Our policy conclusion is that tax rates should be lower and the size of public sector should be smaller when economic agents (private agents, low-level government bureaucrats, top-level government officials) are self-interested and attempt to extract rents from the pool of tax revenues. We describe the model in Section 2. Section 3 solves for a decentralized competitive equilibrium. Section 4 considers policy decisions. Section 5 reports our empirical results. Section 6 is a brief conclusion.

2. Informal description of the model

The key features of the model are as follows: We extend Barro’s (1990) model by individuals competing in a non-cooperative (Nash) rent-seeking game to extract parts of tax revenue for personal benefit. Rent seeking comes at a private cost that we here assume entails personal time and effort. Each individual chooses, in addition to consumption and saving, the allocation of time and effort between productive work and rent-seeking activity. The amount of public sector income appropriated by each individual is proportional to the effort that he or she allocates to rent seeking relative to the total effort allocated to rent seeking competition by all individuals. The economy-wide, or aggregate, degree of rent seeking as determined by the sum of individual rent seeking efforts depletes resources available for government productive services. Against the background of the rent-seeking activity, the government chooses economic policy to maximize the economy’s growth rate. The sequence of events is that economic policy is chosen first, and then private agents make decisions. The government acts as a Stackelberg leader vis-à-vis the decentralized private agents. The general equilibrium is a subgame-perfect Nash equilibrium.

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10 This database was constructed by Stephen Knack and the IRIS Center, University of Maryland, from monthly International Country Risk Guide data provided by the consulting company Political Risk Services.

11 This outcome is also consistent with the empirical results of Baldacci et al. (2004), who find that lower government spending increases growth of per capita income in countries with poor governance. Also, the endogeneity of tax policy contributes to explaining the mixed empirical evidence on the relationship between growth and taxes, and in particular the non-decreasing relationship observed in the data (see Stokey and Rebelo, 1995).

12 Reducing the tax rate does not necessarily imply lower levels of government spending because, with a Laffer curve in the background, a lower tax rate can increase tax revenue.

13 A benefit of a small public sector is therefore discouragement of rent seeking. Public sectors in low-income countries tend to be small (see for example Alesina, 1999) but administrative limitations and corruption (see the papers in Abed and Gupta, 2003) affect fiscal capabilities rather than necessarily policy behavior that follows from our model.

14 Extracting favors from the state through lobbying efforts, campaign contributions, participation in strikes and demonstrations, bribing, paying lawyers, etc., is of course a privately costly activity.

15 See also Baumol (1990), Murphy et al. (1991), Grossman and Kim (1996) (among many others) on individuals choosing between productive (work, innovation, entrepreneurship) and unproductive (rent seeking, poaching, breaking the law) activities.
equilibrium in private decisions and the chosen policy. We assume infinite-time horizons, continuous time, and certainty.

3. Decentralized competitive equilibrium

We use backward induction to solve for a decentralized competitive equilibrium for any feasible economic policy. Economic policy will be chosen in the next section.

3.1. Firms’ behavior

Firms are indexed by \( i \in I \). Each firm \( i \) maximizes profits, \( \pi^i \):

\[
\pi^i = (1 - \tau)y^i - rk^i - wl^i
\]

where \( 0 < \tau < 1 \) is the output tax rate; \( y^i \) is output produced by firm \( i \); \( k^i \) and \( l^i \) are capital and labor inputs used by firm \( i \); and \( r \) and \( w \) are the market interest rate and wage rate.

At the firm’s level, the production function is:

\[
y^i = A(k^i)^{a}(l^i)^{1-a}\left(\frac{G}{I}\right)^{1-x}
\]

where \( G \) is total public production services, while \( A > 0 \) and \( 0 < x < 1 \) are parameters.

Each firm \( i \) acts competitively by taking prices \((r, w)\) and policy \((\tau, G)\) as given. The familiar first-order conditions for \( k^i \) and \( l^i \) are:

\[
r = (1 - \tau)x\frac{y^i}{k^i}
\]

\[
w = (1 - \tau)(1 - x)\frac{y^i}{l^i}
\]

so that profits are zero in equilibrium.

3.2. Households’ behavior

Households are also indexed by \( i \in I \). Each household \( i \) maximizes intertemporal utility:

\[
\int_0^\infty \log(c^i)e^{-\rho t}dt
\]

where \( c^i \) is private consumption and \( \rho > 0 \) is a discount factor.

\[\text{\[16\]} \quad \text{We could have a single firm. We could also assume that firms, like households, also extract public revenue. These features are not important.}\]

\[\text{\[17\]} \quad \text{Since the model is } AK \text{ at the social level (see below), the type of distortionary taxation assumed is not important.}\]

\[\text{\[18\]} \quad \text{We assume that the average amount of public services provides externalities to each firm so as to avoid scale effects in equilibrium. This is not important.}\]
Each household $i$ consumes $c^i$ and saves $a^i$ in the form of an asset. It is also endowed with one unit of effort time at each instant and allocates $0<\eta^i \leq 1$ of that unit to productive work and $0 \leq (1-\eta^i)$ to rent-seeking competition. Thus, household $i$’s budget constraint is:

$$\dot{a}^i + c^i = ra^i + \eta^i w + \frac{(1-\eta^i)}{\sum_{j=1}^{I} (1-\eta^j)} \delta T$$

where $T$ is total government income (see below) and $0 \leq \delta < 1$ is the aggregate degree of extraction (see below). That is, a total amount $\delta T$ is taken away from the government, and then each agent $i$ attempts to extract a fraction or share of $\delta T$, where this fraction depends on the amount of effort that $i$ allocates to the appropriative competition relative to all agents.20

Each household $i$ acts competitively by taking prices $(r,w)$, policy $(T)$ and aggregate activity $(\delta, \sum_{j=1}^{I} (1-\eta^j))$ as given.21 The first-order conditions for consumption, saving and extraction, $c^i, a^i, \eta^i$, imply:

$$\dot{c}^i = c^i (r - \rho)$$

$$w = \frac{\delta T}{\sum_{i=1}^{I} (1-\eta^i)}$$

where (6a) is a standard Euler equation and (6b) implies that net returns from work and rent-seeking competition are equal in equilibrium.

3.3. Government budget constraint

Assuming a balanced budget at each instant, the government’s budget constraint is:

$$G = (1-\delta) T$$

where $T = \tau \sum_{i=1}^{I} y^i$ is total tax revenue. Thus, only a part $0<(1-\delta)\leq 1$ of public sector income is used for public services because rent-seeking individuals capture the rest.22

3.4. Decentralized competitive equilibrium

We now solve for a decentralized competitive equilibrium (DCE). This is defined to be a Nash equilibrium in individuals’ decisions in which: (i) each individual firm maximizes

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19 Since the total effort time is exogenous, leisure is not included in the instantaneous utility function in (4). This is for simplicity.

20 For similar modeling, see Murphy et al. (1991), Grossman and Mendoza (2003), Mueller (2003, chapter 15) and many others. On contest success functions, see Skaperdas (1996).

21 We could assume that each individual $i$ internalizes the effects of his/her own actions on aggregate outcomes. This is not important. What is important is that each individual $i$ takes the actions of other agents $j \neq i$ as given.

22 See also Mohtadi and Roe (2003) for leakages due to rent seeking. See also the examples in Mauro (2002, p. 7).
its own profits; (ii) each individual household maximizes its own utility; (iii) all constraints are satisfied; (iv) and all markets clear. A DCE holds for any feasible economic policy. Obviously, a DCE is inefficient because private agents have ignored externalities. For simplicity, we will focus on symmetric DCE, i.e. all firms and all households are alike ex post.

To close the model, we have to specify the aggregate degree of extraction (δ). We assume that, in equilibrium, δ is a positive function of the total time spent in extraction activities, \( \sum_{i=1}^{l} \omega^i (1 - \eta^i) \), where \( \omega^i \) is the weight of agent \( i \) and \( \sum_{i=1}^{l} \omega^i = 1 \). Further, to keep in line with the simple AK structure of the model, we assume a linear function of the form:

\[
\delta = \delta_0 + \delta_1 \left( \sum_{i=1}^{l} \omega^i (1 - \eta^i) \right)
\]  

(8)

where \( 0 \leq (\delta_0 + \delta_1) < 1 \). The constant term, \( \delta_0 \geq 0 \), captures the possibility of transfers independently of rent seekers’ pressure, while \( \delta_1 \geq 0 \) translates lobbies’ effort into actual extraction from state coffers. Since \( 0 < \eta^i \leq 1 \), Eq. (8) gives a well-defined value \( 0 \leq \delta < 1 \).

We are now ready to solve for a DCE as defined above. It is easy to show that (1) (2) (3a) (3b) (4) (5) (6a) (6b) (7) (8) give (from now on, the superscript \( i \) is not needed):

\[
\dot{c} = c \left( 1 - \tau \right) x d^* \left[ (1 - [\delta_0 + \delta_1 (1 - \eta)] \tau \eta]^{-\lambda} - \rho \right)
\]  

(9a)

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23 The market clearing conditions in the capital and labor markets are respectively \( \sum_i k_i = \sum_i d_i \) and \( \sum_i l_i = \sum_i \eta^i \). See Cooper and John (1988) for the properties of symmetric equilibria. Note that solving for symmetric equilibria is not restrictive for what we do here. That is, we can still capture effects on incentives and therefore show how non-cooperative (Nash) and cooperative equilibria differ. A simple way to obtain a cooperative equilibrium is to assume ex ante symmetry in the optimization problem (4)–(5) so as to have a representative individual. Then, it is optimal to set \( \eta \) at its highest possible value of \( \eta = 1 \). Thus, when economic agents do not compete for transfers, all effort goes to productive work and we are back to Barro’s (1990) model.

24 While each individual \( i \) takes the aggregate degree of extraction \( \delta \) as given, in equilibrium \( \delta \) is a function of the sum of rent-seeking activities. This is standard modeling. See also Zak and Knack (2001) and Mauro (2002).

25 We have experimented with non-linear specifications, such as \( \delta = \delta_0 \left( \sum_{i=1}^{l} \omega^i (1 - \eta^i) \right) \), where \( 0 \leq \sigma \leq 1 \), and the main results do not change.

26 To obtain (9c), we equalize (3b) and (6b), and then use the solution for total tax revenues, \( T^* = ty \), the market-clearing condition, \( l = \eta \), and the economy-wide extraction, \( \delta = \delta_0 + \delta_1 (1 - \eta) \); these conditions are written in a symmetric equilibrium (for further details and the asymmetric case, see Appendix A3). To obtain (9a), we use the solution for \( r \) in (3a) into (6a). (9b) is the economy’s resource constraint and follows from (5) and (7), where the solution for output is \( y = A^* \left[ (1 - [\delta_0 + \delta_1 (1 - \eta)] \tau \eta]^{-\lambda} - k \right] \).
\[ \dot{k} = [1 - \tau(1 - [\delta_0 + \delta_1(1 - \eta)])]A^2[(1 - [\delta_0 + \delta_1(1 - \eta)])\tau]^{1/\tau}k - c \quad (9b) \]

\[ \eta = \frac{(1 - z)(1 - \tau)}{(1 - z)(1 - \tau) + [\delta_0 + \delta_1(1 - \eta)]\tau} \quad (9c) \]

Eqs. (9a)–(9c) give the paths of \((c, k, \eta)\). This is for any feasible economic policy, \(0 < \tau < 1\). An advantage of the model is its simplicity. Eq. (9c) is a quadratic equation in \(\eta\). This is the crucial equation. Once we get a solution for \(\eta\), (9a) can give the so-called balanced growth rate, defined as \((\dot{c}/c) = (\dot{k}/k) = \gamma\), and then (9b) can give the consumption-to-capital ratio, \(c/k\).\(^{30}\)

Appendix A1 shows:

**Proposition 1.** Given economic policy \(0 < \tau < 1\), there is a unique Decentralized Competitive Equilibrium (DCE), which is described by Eqs. (9a)–(9c). In this equilibrium, there is rent-seeking behavior, \(0 < \eta < 1\).\(^{31}\)

To understand the logic of the model, we present comparative static results in a DCE. Since analytical results are not possible in general,\(^{32}\) we resort to numerical simulations. We start with the effects of a changing tax rate \(\tau\) on the fraction of effort that individuals allocate to work relative to rent seeking \(\eta\), the aggregate degree of extraction \(\delta\), the balanced growth rate \(\gamma\), and the consumption-to-capital ratio \(c/k\). Numerical results are reported in Table 1.\(^{33}\)

The main result is \((\partial \eta / \partial \tau) < 0\). That is, a higher tax rate leads to a lower fraction of labor effort allocated to work relative to rent seeking activities. This happens because atomistic agents do not internalize the adverse effect of their rent seeking actions on

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\(^{29}\) The way we have modeled rent-seeking competition in (4) (5) implies that the decision whether to engage in rent seeking is only intra-temporal (see the optimality condition (6b)). This, together with the way we model transfers, makes rent-seeking behavior independent of the capital stock in equilibrium (see Eq. (9c)). See Drazen (2000, chapter 11) for a survey of state-independent and state-dependent behavior in models with extraction. Also note that if equilibrium rent-seeking behavior were state-dependent, we might have a time inconsistency problem when policy is chosen optimally (see below).

\(^{30}\) If \(\delta_0 = \delta_1 = 1\), we have Barro’s (1990) reference model.

\(^{31}\) We have solved for a symmetric competitive equilibrium so that in the end all agents (or equivalently the single agent) devote some of their resources to rent seeking and some of their resources to productive work. We could alternatively assume from the start that there is an income stream from rent seeking and from productive work, and an agent could choose one or the other activity but not both. In this case, the two incomes should be equalized in equilibrium, and the resulting income-equalization equation would determine the number of rent seekers relative to productive workers. This is the approach in Mohtadi and Roe (2003). Here, we have chosen the first approach because it is simpler. However, the key assumption in all these models is the possibility of rent seeking in the first place (see also Section 6). Whether we assume that some agents are rent seekers and some others are producers, or whether all agents devote some of their resources to rent seeking and some to work, is less important.

\(^{32}\) Only if we set \(\delta_1 = 0\), the sign of \((\partial \eta / \partial \tau)\) is unambiguously negative. Actually, this special case \((\delta_1 = 0)\) gives analytical results throughout the paper.

\(^{33}\) The growth rate, \(\gamma\), can easily become positive if we set the productivity parameter \(A > 1\). Since this is not important, we just set \(A = 1\) in all numerical examples.
aggregate output and the tax base, $y$. Hence, whenever the tax rate, $\tau$, increases, they get
the impression that the contestable prize, $\delta T = \delta y$, also increases and so attempt to extract
a greater share of it by demanding more transfers. They therefore devote less time to work
and more time to rent seeking (see also Mauro, 2002). This prediction is supported by
empirical evidence provided in Section 5.

In turn, as Eq. (9a) implies, rent seeking is at the society’s expense: a lower $\eta$ leads
ceteris paribus to lower growth, $\gamma$. Specifically, (9a) implies
$$\frac{\partial \gamma}{\partial \tau} \text{ total} = \frac{\partial \gamma}{\partial \tau} \text{ Laffer} + \frac{\partial \gamma}{\partial \eta} \frac{\partial \gamma}{\partial \tau}.$$ That is, an increase in $\tau$ exerts two effects on $\gamma$: (i) A direct Laffer-curve type effect,
denoted as $\frac{\partial \gamma}{\partial \tau} \text{ Laffer}$. This is Barro’s (1990) well-known effect arising from a tradeoff

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Table 1
Effects of $\tau$ in DCE

<table>
<thead>
<tr>
<th>$\tau$</th>
<th>$\eta$</th>
<th>$\delta$</th>
<th>$\gamma$</th>
<th>$c/k$</th>
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</table>

$\sigma=0.4$, $A=1$, $\rho=0.04$, $d_0=0.20$, $d_1=0.20$.

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Fig. 1. Laffer curves with and without rent seeking.
between higher productive government services and higher taxes required to finance these services. (ii) An indirect negative effect through smaller effort allocated to work, \( \eta \); this is captured by \( \frac{\partial \gamma}{\partial \eta} < 0 \). This indirect negative effect arises because the possibility of extraction distorts individuals’ incentives and pushes them to appropriative activities, and this is socially harmful. Our numerical simulations in Table 1 show that these two effects combined give a Laffer-curve type effect from \( \tau \) to \( \gamma \). Specifically, rent-seeking competition shifts Barro’s Laffer curve downwards. This is shown in Fig. 1.

Consider some other comparative static results. Table 2 reports the effects of a changing \( \delta_0 \) (see (8) above). A higher \( \delta_0 \) leads monotonically to lower \( \eta \), higher \( \delta \), and lower \( \gamma \) and \( c/k \). Table 3 reports similar effects of a changing \( \delta_1 \) (again see (8) above). In other words, higher \( \delta_0 \) and \( \delta_1 \) (and hence higher \( \delta \)) reduce economic growth both directly (see (9a)) and indirectly (via a decrease in \( \eta \); see (9c)). The direct effect arises simply because there are less social resources available to finance public infrastructure. The indirect effect arises because the possibility of extraction distorts individuals’ incentives by pushing them away from productive activities.

### Table 2
Effects of \( \delta_0 \) in DCE

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<th>( \gamma )</th>
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<td>0.9824</td>
<td>0.5879</td>
<td>-0.0200</td>
<td>0.0201</td>
</tr>
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</table>

\( \gamma = 0.4, \lambda = 1, \rho = 0.04, \tau = 0.30, \delta_0 = 0.20 \).

### Table 3
Effects of \( \delta_1 \) in DCE

<table>
<thead>
<tr>
<th>( \delta_1 )</th>
<th>( \delta )</th>
<th>( \eta )</th>
<th>( \gamma )</th>
<th>( c/k )</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.0527</td>
</tr>
<tr>
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<td>0.0422</td>
</tr>
</tbody>
</table>

\( \gamma = 0.4, \lambda = 1, \rho = 0.04, \tau = 0.30, \delta_0 = 0.20 \).
3.5. An interesting special case, $\delta_0 = 0$

We will close the study of Decentralized Competitive Equilibria (DCE) by focusing on the special case in which $\delta_0 = 0$ in (8) above. That is, now the degree of aggregate extraction is determined entirely by the total time and effort spent in extraction activities. Then, Appendix A2 shows:

**Corollary 1.** Assume $\delta_0 = 0$ in (8). Then, we distinguish two cases: (i) If $\tau > ((1 - \alpha) / (1 - \alpha + \delta_1))$, there are two DCE; one without rent seeking, $\eta_1 = 1$, and one with rent seeking, $0 < \eta_2 < 1$. (ii) If $\tau \leq ((1 - \alpha) / (1 - \alpha + \delta_1))$, there is a unique DCE without rent seeking, $\eta = 1$.

In case (i), there are multiple (two) self-fulfilling equilibria, in the sense that the rational expectations competitive equilibrium outcome is not unique but depends on what agents expect is going to happen. Notice that the necessary condition for rent seeking, $\tau > ((1 - \alpha) / (1 - \alpha + \delta_1)) = \bar{\tau}$, reveals that the possibility of ending up in a bad equilibrium increases with the tax rate ($\tau$) and the effectiveness of illegal effort ($\delta_1$), while it decreases with the productivity of public services ($1 - \alpha$). This is an intuitive condition.

We therefore have multiplicity when $\tau > \bar{\tau}$ and $\delta = \delta_1(1 - \eta)$. The first condition, $\tau > \bar{\tau}$, means the perceived pie is large enough. The second condition, $\delta = \delta_1(1 - \eta)$, means the private return to rent seeking depends on aggregate rent seeking, where aggregate rent seeking is determined entirely by the sum of individuals’ rent seeking activities. It is this type of externality that can lead to expectational indeterminacy. By contrast, in Section 3.4, where there was also an exogenous component in the determination of $\delta$ (i.e. $\delta = \delta_0 + \delta_1(1 - \eta)$, or simply $\delta = \delta_0$), we got a unique DCE with rent seeking.

The interpretation of this result is as follows. The presence of institutionally given transfers ($\delta_0 > 0$) unambiguously makes rent seeking the dominant behavior (see Proposition 1); hence, in this case, there is a unique DCE with rent seeking. By contrast, in the absence of institutionally given transfers ($\delta_0 = 0$), there can be an expectations coordination problem depending on the perceived size of the pie (as captured by the tax rate, which is also the government expenditure-to-GDP ratio and so the size of public sector). A low enough tax rate ($\tau \leq \bar{\tau}$) signals a small pie and this ties down individuals’ expectations to a unique, good equilibrium without rent seeking. By contrast, when the perceived pie is large enough ($\tau > \bar{\tau}$), individuals have an incentive to devote some private resources to rent seeking, but what they expect to grab depends on economy-wide rent seeking activities. This is because the contestable pie depends entirely on what everybody does.

Technically, multiplicity arises because of strategic complementarities ($\eta^j$ is an increasing function of $\eta^j$, where $j \neq i$). When an individual expects other individuals to behave aggressively so that the pie is expected to get larger, we end up in a bad equilibrium where rent seeking is the equilibrium strategy. But it is equally possible to end

---

34 Multiplicity is here independent of initial conditions. As Eq. (9c) shows, the initial condition for the capital stock is irrelevant. Thus, only beliefs matter here. In more general models, history can also matter for multiplicity (for surveys, see Azariadis, 1996; Benhabib and Farmer, 1999).
up in a good equilibrium without rent seeking depending on expectations about other individuals’ behavior. Appendix A3 confirms the presence of strategic complementarities in the model.\textsuperscript{35}

4. Endogenously chosen policy and general equilibrium

We now endogenize the choice of economic policy, as summarized by the income tax rate, $0<\tau<1$. Following Barro (1990) and most of the related endogenous growth literature, we assume that $\tau$ is chosen by a growth-maximizing government. In doing so, the government solves a second-best policy problem. Notice that, since here the policymaker does not also attempt to maximize rents or to choose winners in the rent-seeking contest, we address the question of the efficient size of public sector from the society’s viewpoint.\textsuperscript{36}

4.1. Socially efficient tax policy

The government chooses the tax rate, $\tau$, to maximize the consumption growth rate in (9a).\textsuperscript{37} As Appendix A4 explains, the solution to this optimization problem gives:

**Proposition 2.** There is a socially efficient tax rate, $\tau^*$, that maximizes the balanced growth rate. This tax rate is a solution to:

$$0<\tau^* = \frac{(1 - \alpha)(1 + \varepsilon)}{(1 - \alpha)(1 + \varepsilon) + \alpha} < 1 - \alpha < 1$$

where $\varepsilon = \frac{\partial \eta}{\partial \tau} (1 + \frac{\delta_1 \eta}{1 - \delta})$, $\frac{\partial \eta}{\partial \tau} = \frac{-[(1 - \phi)(1 - \nu\phi) + \phi\delta]}{[1 - \phi(1 - \tau) + \phi(1 - \nu\phi)]}$ and $0 \leq \delta = \delta_0 + \delta_1 (1 - \eta) < 1$.

\textsuperscript{35} Our multiplicity result is consistent with Cooper and John (1988), who have shown that strategic complementarities are a necessary condition for multiple symmetric Nash equilibria. Our result is also consistent with the macroeconomic literature on indeterminacy, which has emphasized the role of market imperfections in generating multiple equilibria. Emphasis has been given to imperfections such as external effects, monopolistic competition, increasing returns to scale, strategic complementarities, or combinations thereof (for the various routes that can lead to indeterminacy, see Azariadis, 1996 and Benhabib and Farmer, 1999). In models close to ours, Tirole (1996), Mauro (2002) and Bottaglini and Benabou (2003) also obtain multiplicity because of strategic interactions among atomistic individuals. Specifically, in Tirole’s model of corruption, multiplicity is due to dynamic complementarities between past and future reputations. In Mauro’s model, as in ours, multiplicity is due to strategic complementarities in the rent-seeking technology. In Battaglini and Benabou, multiplicity arises for an intermediate range of policy disagreement between lobbyists and the policymaker. Ellis and Fender (2003) obtain multiplicity in a model of endogenous government corruption because of the presence of the stock of public capital.

\textsuperscript{36} Laffont and Tirole (1998), Acemoglu and Verdier (2000) and Sarte (2000) model central governments in a similar way in problems with private interest groups and corrupt low-level bureaucrats. This can be thought as a principal-agent problem, where the principal (central government) cannot control the behavior of its agents (bureaucrats and civil servants) who interact with interest groups for personal benefits (see Hillman, 2003, chapters 3.3 and 6.3).

\textsuperscript{37} This problem is static so there are no time inconsistency problems.
A general equilibrium is therefore summarized by (9a)–(9c) and (10). We first solve (9c) and (10) simultaneously for $g$ and $s$. In turn, (9a) gives the balanced growth rate, $c$. Finally, (9b) gives $c/k$. Numerical solutions will be presented below.

Proposition 2 shows that $s^\ast$ lies in the region $0 < s < 1/C_0 a$. That is, the chosen tax rate (and the associated size of public sector) are smaller than the productivity of government expenditures, $(1/C_0 a)$, which is Barro’s popular result. Intuitively, since a higher tax rate signals a larger pie and so pushes atomistic individuals to rent seeking competition, the government finds it optimal to impose a relatively low tax rate to correct individuals’ disincentives. By doing so, the government aims to discourage individuals from going for rent seeking and thereby push them to use their private resources more efficiently.

Table 4 and 5 report numerical results in general equilibrium. Table 4 shows the effects of the autonomous part of extraction, $\delta_0$, on all endogenous variables including now the optimally chosen tax rate, $\tau^\ast$. As $\delta_0$ increases, $\tau^\ast$ falls monotonically while the total degree of extraction, $\delta$, increases monotonically. The idea is that the government chooses a smaller and smaller tax rate in order to counterbalance the adverse effects of a rising $\delta_0$. Nevertheless, the policy control is less than perfect because, although $\tau^\ast$ falls to correct individuals’ disincentives, the direct effect dominates so that the overall degree of extraction, $\delta$, increases. As a result, $\gamma$ and $c/k$ fall monotonically as $\delta_0$ increases. This less-than-perfect control is also shown by the fact that, although policy is optimally chosen, the growth rate ($\gamma$) is always lower than in the benchmark case in which $\delta=0$ (in this Barro-case, as the first row of Table 4 reports, we get $\tau=0.6$, $\gamma=0.0544$ and $c/k=0.0632$). It is also worth pointing out that the growth rate ($\gamma$) and the tax rate ($\tau$) move in the same direction, as $\delta_0$ decreases. The positive correlation between $\gamma$ and $\tau$ is consistent with empirical evidence (see Section 5 below). Finally, notice that the effect of $\delta_0$ upon $\eta$ is U-shaped (we are still at Table 4). Intuitively, as the opportunities of

Table 4

<table>
<thead>
<tr>
<th>$\delta_0$</th>
<th>$\delta$</th>
<th>$\eta$</th>
<th>$\tau$</th>
<th>$\gamma$</th>
<th>$c/k$</th>
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<td>0.0204</td>
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</table>

$x=0.4$, $A=1$, $\rho=0.04$, $\delta_1=0.20$.

As in Barro (1990), it is optimal to keep the tax rate, $\tau$, and hence the allocation of work effort, $\eta$, flat over time.

In all solutions, $\tau^\ast$ is less than $(1-x)=0.6$, which is Barro’s (1990) optimal tax rate.

Thus, in general equilibrium, where tax policy is optimally chosen, the income tax rate should fall as rent seeking activities become more intensive.
extraction increase, the fraction of effort that each individual allocates to work relative to rent seeking falls initially, but then it starts increasing as the size of the pie gets smaller. Notice that this general equilibrium effect of $d_0$ upon $g$ differs from the effect of $d_0$ upon $g$ in a DCE (see the previous section). Specifically, in Table 2 above, a higher $d_0$ led monotonically to lower $g$; this was for given policy. Now, where policy is endogenously chosen, the government can stop the fall in $g$ by choosing a small enough public sector (and so mitigate the adverse effects of a rising $d_0$). Table 5 reports that the effects of $d_1$ are qualitatively similar to those of $d_0$.

The main results are: (a) From a social welfare point of view, weaker institutions imply a need for a smaller public sector. (b) The government cannot fully correct the distortion arising from rent extraction because it does not have enough policy instruments at its disposal. (c) When policy is chosen to maximize the economy’s growth rate, the growth rate and the tax rate move in the same direction, while the co-movement between rent seeking and the tax rate is not monotonic.

4.2. The case in which $d_0=0$

As shown in Section 3.5 above, in this special case, and if the tax rate is high enough, there can be two DCE: a good equilibrium without rent seeking ($\eta_1=1$) and a bad equilibrium with rent seeking ($\eta_2<1$). As Appendix A4 shows, when the government chooses its tax policy, it sets $\tau^*=1-\alpha$ so that $\eta=1$. In other words, the government has the ability to use its policy instrument so as to select the good equilibrium and lead the economy to Barro’s second-best solution.\(^{41}\)

\(^{41}\) This is consistent with the literature: when there is a coordination problem at the level of a competitive equilibrium, economic policy may help agents to coordinate their expectations, preferably on a good equilibrium. We have to point out, however, that this is not a general result. For instance, in Park and Philippopoulos (2004), it is a benevolent Ramsey government itself that causes indeterminacy.
5. Some empirical evidence

This section presents cross-country statistics that motivate our study and provide some empirical support. We will first study the link between rent seeking and the size of public sector. We will then study the link between economic growth and the size of public sector.

The data are for a group of 108 countries, including developed and developing, over the period 1990–2000 (our results are robust to the time period chosen). The data and their sources are described in Appendix A5. Here, we mention the following. Our primary measure of the size of public sector is the government share in GDP (see also Rodrik, 1998). This is the government’s consumption as a share of GDP. But we will also use other measures, such as tax revenues as a share of GDP and effective tax rates. To measure rent-seeking activities, we use the IRIS dataset (see footnote 10). The dataset contains five subjective sub-indexes: “corruption in government”, “rule of law”, “risk of repudiation of government contracts”, “risk of expropriation” and “quality of bureaucracy”. Our proxies for rent seeking will be the “corruption in government” sub-index, as well as the aggregate ICRG measure, which is the sum of the five sub-indexes (our results do not change if we instead use any of the other sub-indexes; this should not come as a surprise since they are all highly correlated). Notice that higher scores indicate better incentives or equivalently less rent seeking; we will therefore call these indexes “productive vs. rent-seeking measures”. The key correlations are included in Table 6 below.

The correlation between the government share in GDP and the productive vs. rent-seeking measure (when we use the “corruption in government” sub-index) is –0.306. When we use the aggregate ICRG index as a measure for productive incentives, its correlation with the government share in GDP is –0.4251. Therefore, as is the main idea in the paper (see for instance Section 3), larger public sectors are on average associated with more rent seeking. When, however, we use the tax revenue-to-GDP ratio as a measure of the size of public sector, its correlation with the productive vs. rent-seeking measure is 0.684 when we use the corruption in government sub-index, and 0.5946 when we use the aggregate ICRG index. This differs from the negative correlation found when we used the government share in GDP as a measure of the size of public sector. However, recall that our model predicts a negative link between the ex ante tax rate (the perceived pie) and private productive incentives, not between collected ex post tax revenues and private productive incentives. If there are problems of tax evasion and poor reporting, the correlation captures the latter. Thus, the positive link between the tax revenue-to-GDP ratio and the productive vs. rent seeking measures is probably a consequence of better reporting and less tax evasion (i.e. actual collection of taxes) as the quality of institutions improves, rather than an indication that higher tax rates lead to a less intense rent-seeking behavior. This interpretation seems to be confirmed when we restrict our sample to 21 OECD economies for which effective tax rates can be constructed. In these economies,

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42 The dataset has been used in a series of related papers (see, among many others, Knack and Keefer, 1995; Mauro, 1998; Rodrik, 1999; Hall and Jones, 1999; Barro and Sala-i-Martin, 2004, chapter 12).

43 See Mohtadi and Roe (2003) for a similar interpretation of the observed positive link between democracy and corruption. See also Folster and Henrekson (2001), where tax compliance issues are the reason why in rich countries there is a negative effect from taxes to growth. In general, it is recognized that “tax payments offer a poor measure of incentive effects” (see Auerbach, 2003, p. 118).
where problems of tax evasion are less acute than in the world-wide sample, the correlation between the average effective tax rate and the productive vs. rent seeking index turns to be small and negative. In particular, we report that in 21 OECD economies, the correlation is \(0.145\) when we use the corruption in government sub-index, and \(0.093\) when we use the aggregate ICRG index.

Finally, we study the link between economic growth and the size of public sector. The correlation between the government share in GDP and the growth rate is \(0.1975\). This is consistent with econometric findings by many authors (see e.g. Barro and Sala-i-Martin, 2004, chapter 12, where a reduction in the ratio of government consumption-to-GDP increases economic growth in a robust way). When we use the tax revenue-to-GDP ratio as a measure of the size of public sector, its correlation with the growth rate is only \(0.0724\). Lack of correlation is consistent with the empirical literature, which has shown that the evidence on the relationship between growth and taxes is mixed (see e.g. Stokey and Rebelo, 1995, who show that the growth effects of taxes are rather small, and in any case smaller than those on the expenditure side; see also Mohtadi and Roe, 2003, p. 447, for a brief survey of the empirical literature). More importantly, the evidence that growth is basically unrelated to the tax revenue-to-GDP ratio can be due to the fact that the government uses its tax policy to also correct for market imperfections, and this effect works in opposite direction from the direct adverse effect that higher taxes typically have on incentives and growth. Indeed, our simulations in Tables 4 and 5 predict that the tax rate \((\tau)\) and the growth rate \((\gamma)\) can move in the same direction in general equilibrium. Therefore, the endogeneity of tax policy may help to explain the mixed empirical evidence on the relationship between growth and taxes, and in particular their non-decreasing relationship observed in the data.

### 6. Conclusions, limitations and extensions

We have studied an economy where rent seeking occurs within Barro’s (1990) model in which, on the one hand, public services enhance the productivity of private

\[44\] The average effective tax rate is defined as the average of the effective tax rates on labor, capital and corporate income. These effective tax rates are constructed as in Mendoza et al. (1994).
firms and, on the other hand, the provision of public services requires distorting taxes. To Barro’s tradeoff, we have added rent-seeking competition for shares of collected tax revenues.45

We have taken the existence of “weak” institutions as given so that extraction from state coffers is possible. Explaining how the possibility of extraction arises in the first place would bring us to the role of government officials in rent seeking and their interaction with private agents. Also, while our model predicts that a large public sector, in combination with low productivity in this sector, can lead to rent-seeking behavior, is this so? Addressing this question simultaneously with economic growth may explain the stylized facts reported by Tanzi and Schuknecht (2000) and Afonso et al. (2003).46

Acknowledgements

We are grateful to two anonymous referees and the editor for many constructive and detailed comments. We are also grateful to Konstantinos Angelopoulos for help with the data and useful comments. We thank Harris Dellas, George Economides, Pantelis Kammas, Christos Kotsogiannis, Miltos Makris, Jim Malley, Theodore Palivos, Evi Pappa, Stergios Skaperdas, as well as seminar participants at the University of Bern, for helpful discussions and comments. Hyun Park also thanks “the 55th Kyung Hee University Anniversary Research Promotion Fund in 2003”. Any remaining errors are ours.

45 The general equilibrium growth models closest to ours are Lane and Tornell (1996), Mohtadi and Roe (1998, 2003), Tornell and Lane (1999) and Mauro (2002). The key difference in our analysis is our focus on the effects of the size of the public sector on rent seeking. Lane and Tornell (1996) and Tornell and Lane (1999) use a common-pool model that does not involve direct private costs. In our model, there is a private opportunity cost of rent seeking in the form of forgone labor income. Also, in the former papers, the common pool is the economy’s capital stock rather than government tax revenue and there is a focus on issues involving demand for transfers, reflected in higher tax rates that may outweigh the direct effect of increased productivity, and eventually reduce economic growth. In Mohtadi and Roe (1998) there is a tradeoff in lobbying: on the one hand, lobbying for public investment leads to higher taxes; on the other hand, lobbying (even if it is pursued for pure private self-interest) can provide positive spillovers to other groups in society. This type of lobbying reduces to pure rent seeking as a special case when the spillover effects vanish. Their focus is on the optimal level of private lobbying aimed at government spending rather than on the optimal economic policy. In Mauro (2002), as in our paper, the common pool is government tax revenue so that redistribution takes place explicitly via government policy. Mauro models rent seeking in a different way so as to focus on the role of strategic complementarities in generating multiple equilibria (see also the discussion in Section 3.5). Mohtadi and Roe (2003) model the interaction between rent-seeking individuals and public officials. As in our paper, agents extract rents from public funds at a private cost. The emphasis is on the effects of a democracy index on rent-seeking behavior, the allocation of public assets and economic growth rather than on the effects of economic policy on rent seeking. In their model, rent seeking is independent of the tax rate in equilibrium.

46 A recent econometric attempt along these lines, although in a model that does not consider the role of public sector productivity, is in Angelopoulos and Economides (2004).
Appendix A

A.1. Proposition 1

Eq. (9c) gives a quadratic equation in $g$:

$$g^2/C_0 + (1+\alpha)/(1-\tau)/C_0 s + d_1 s/C_0 g + 1 + a/(1-C_0 s) + d_0/C_0 s = 0.$$ 

Say that there are two real and distinct roots, denoted as $g_1$ and $g_2$. Since $0<\alpha<1$ and $0<\tau<1$, both roots are positive. Also, $(\eta_1 - 1)(\eta_2 - 1) = -\delta_0/\delta_1 < 0$. Hence, one root is higher than one, while the other root is positive but less than one. Only the latter is admissible, so there is a unique solution, denoted as $0<\eta<1$. In turn, (9a) and (9b) give unique solutions for $\gamma$ and $c/k$.

A.2. Corollary 1

We go back to Appendix A1 and set $d_0 = 0$. Then, $(g_1/C_0 + (1-\alpha)/(1-\tau)/C_0 s + d_1 s/C_0 g + 1 + a/(1-C_0 s) + d_0/C_0 s = 0$. Hence, one root is necessarily equal to one, say $g_1 = 1$, while the other root is $g_2 = ((1-\alpha)/(1-\alpha + d_1)) - s$. Therefore, if $s > \bar{s}$, there are two admissible solutions: one without rent seeking, $g_1 = 1$, and one with rent seeking, $g_2 < 1$. If $s < \bar{s}$, only $g_1 = 1$ can be a solution.

A.3. Strategic complementarities and multiplicity

If we combine Eqs. (3b) and (6b), and since $T = \sum_i y^i$, we have:

$$\frac{\delta \tau \sum_i y^i}{\sum_i (1-\eta^i)} = \frac{(1-\alpha)(1-\tau)y^i}{l^i}. \quad (A3.1)$$

If we use the market-clearing condition $\sum_i l^i = \sum_i \eta^i$, Eq. (8) for $\delta$, and assume that firms are identical so that $\sum_i l^i = II$ and $\sum_i y^i = Iy$, then (A3.1) gives a quadratic in $\eta$:

$$\eta^2 - M\eta + N = 0 \quad (A3.2)$$

where

$$M = \frac{\delta_0 \tau + (1-\alpha)(1-\tau) + \delta_1 \omega \tau [1 - (I - 1)\bar{\eta}] + \delta_1 (1-\omega)(1-\bar{\eta})\tau}{\delta_1 \omega \tau}$$

and

$$N = -\frac{-\delta_0 \tau (I-1)\bar{\eta} + (1-\alpha)(1-\tau)[I-(I-1)\bar{\eta}] - \delta_1 \tau (I-1)\bar{\eta}[\omega + (1-\omega)(1-\bar{\eta})]}{\delta_1 \omega \tau}.$$

This is the reaction function of rent seeker $i$. It gives the action $\eta$ of player $i$ as a function of symmetric changes in the action of all other players, where the action of each other player $j \neq i$ is denoted as $\bar{\eta}$. Thus, $\sum_{i=1}^I \eta^i = \eta + (I-1)\bar{\eta}$. Eq. (A3.2) is solved numerically. For instance, let set $\delta_0 = 0$, $\delta_1 = 0.4$, $\alpha = 0.4$, $I = 100$, $\omega = 0.1$, $\tau = 0.65$. We then study the effects of a changing $0 < \bar{\eta} < 1$ on the choice of $\eta$, where $\eta$ should also lie between 0 and 1. The numerical simulations imply that, in the range $0.685 \leq \bar{\eta} \leq 1$, (A3.2) is a continuous, upward-sloping and concave reaction function, which intersects the 45 degree line at two points, $\eta = 0.81$ and $\eta = 1$. This is shown in Fig. 2 below.
Recall that an upward slope implies strategic complementarities and is a necessary condition for multiplicity in symmetric Nash games (see Cooper and John, 1988). Finally, we report that there are many different combinations of parameter values that can lead to multiplicity. In all these cases, we get at least two admissible intersections (i.e. $0 < \eta, \eta \leq 1$) with the 45 degree line.

A.4. Proposition 2

Maximizing $(\dot{c}/c)$ in (9a) with respect to $(1 - \alpha)(1 - \tau)(1 + \varepsilon) = x\tau$, or $\tau^* = \frac{(1-\varepsilon)(1+\varepsilon)}{(1-\varepsilon)(1+\varepsilon)+\alpha x}$, where $\varepsilon$ is defined in the text. For this condition to hold, $(1 + \varepsilon) > 0$ so that $0 < \tau^* < 1$. Also, if $(\partial \eta / \partial \tau) < 0$ (which is what Table 1 shows) and hence $-1 < \varepsilon < 0$, we have $\tau^* < 1 - \alpha$. Note that in the special case in which $\delta_0 = 0$, it is straightforward to show that $\varepsilon = 0$, so that $\tau^* = 1 - \alpha$ and $\eta = 1$.

A.5. Data sources and description

The data are for a group of 108 countries (except otherwise defined) over the period 1990–2000. We take the average of these years. The data come from four sources: the Penn World Tables (version 6.1); the World Bank Development Indicators (2002 CD-ROM); the OECD Statistics; and the IRIS-3 dataset (countrydata.com). Some details about the data are as follows. We use the GDP per capita in constant prices from the Penn World Tables to

![Fig. 2. Reaction function and multiplicity.](image-url)
obtain the average growth rate over the 10-year period. The government share in GDP in constant prices is also available from the Penn World Tables; this is the general government consumption-to-GDP ratio. The size of government can be alternatively measured as the average ratio of tax revenues to GDP, or the average ratio of central government total expenditures to GDP (these variables are available from the World Bank Development Indicators). Concerning effective tax rates (this is for OECD countries only), they are constructed by following Mendoza et al. (1994) and by using data from OECD, Revenue Statistics and National Accounts. Finally, the proxy for rent seeking is defined in the text.

References


