The social cost of rent seeking in Europe

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Abstract

Direct measurement of the social cost of rent seeking is impeded by non-observable and non-reported activities. We use a dynamic stochastic general equilibrium model to compute the social cost of rent seeking in Europe. Our estimate is based on competition among interest groups for privileges provided by governments, including income transfers, subsidies, and preferential tax treatment. The model, which is calibrated to the euro area as a whole and also to individual euro member countries for 1980–2003, performs well vis-à-vis the data. We find that significant proportions of GDP are extracted as rents available to be sought by rent seekers.

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E32
O17

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Privilege
Taxation
Public spending

1. Introduction

The social costs of rent seeking are incurred when resources are unproductively used in quest of privileges from government. The privileges sought involve preferential tax treatment and benefit from public spending, which offer private gain from common-pool state coffers (Park et al., 2005). The non-observed and non-reported activities involved in creating, extracting, and contesting rents are impediments to direct empirical estimation of the social cost of rent seeking. We therefore apply computational methods to suggest values of social loss from rent seeking in Europe. We use a dynamic stochastic general equilibrium model calibrated to the euro area and to individual EU-12 countries (the initial group of twelve European countries that adopted the euro by 2001) over the period 1980–2003. The model also suggests macroeconomic implications; we are not aware of a previous calibration or estimation that explores the link between rent seeking and the macro-economy in a micro-founded dynamic general equilibrium model. The model performs well vis-à-vis the data by matching key statistical properties (volatility, persistence and co-movement) of the business cycle in the euro area. The model also fares better than the same model without rent seeking in terms of volatility in hours worked.

For the euro area as a whole, our model suggests that some 18% of collected tax revenues are extracted as rents, which corresponds to public spending and tax privileges equal to 7% of output produced. If we assume complete rent dissipation, these values are also social costs of rent seeking. At the individual country level, Ireland and the Netherlands exhibit essentially zero rent extraction and rent seeking, followed by Finland. Greece, Portugal and Italy exhibit the highest rent extraction and rent seeking, followed by post-reunification Germany.
We also investigate the relationship between the size of the government and rent seeking activities. The latter activities depend on most exogenous variables and calibrated parameters, of which the size of the government is one. For instance, despite high tax rates and large public sectors, Finland and the Netherlands exhibit low rent seeking due to their good “institutional quality”, as measured by a calibrated technology parameter that converts individual rent-seeking effort into rent extraction. Greece and Portugal have small government spending but exhibit high rent extraction and rent seeking because of poor institutional quality. Rent seeking in Germany is driven mainly by a large government size: its institutions are around the EU quality average.

We also quantify the potential welfare gains from improvements in institutional quality whereby the same rent-seeking effort results in less actual rent extraction because of better and more strictly enforced laws. Our results suggest that small improvements in institutional quality can result in substantial welfare gains.

Section 2 presents the model. Section 3 discusses the methodology and data problems. The quantitative study is described in Sections 4, 5 and 6. Welfare exercises are reported in Section 7. Extensions are discussed in Section 8. Section 9 briefly summarizes the conclusions.

2. Theoretical model

2.1. Description of the model

We build upon Park et al. (2005). There is a large number of identical households and (for simplicity) an equal number of identical firms. Households own capital and labour, which they supply to firms, and engage in rent-seeking competition for fiscal privileges.\(^4\) A household chooses consumption, leisure and saving, and the allocation of non-leisure time between productive work and rent-seeking activity. Firms produce a homogenous product using capital, labour, and public infrastructure. The government uses tax revenues and issues bonds to finance: (1) public consumption (which provides direct utility to households), (2) public investment (which augments the stock of public infrastructure providing production externalities to firms), (3) a uniform lump-sum transfer to each household, and (4) fiscal privileges to rent seekers.

2.2. Examples of rent seeking from state coffers

We distinguish between two categories of rent seeking that need not be mutually exclusive.

The first category consists of privileged transfers, subsidies and tax treatments: these are direct transfers either in cash (targeted subsidies and other benefits) or in-kind (private use of public assets such as state cars, extra health services and child benefits, etc.) as well as indirect transfers (policies that increase the demand for an interest group’s services, etc). There are also policies that reduce tax burdens (tax exemptions and loopholes favoring special interests) combined with an increase in the average tax rate to compensate for the lost revenue. There are also illegal forms of rent seeking (such as tax evasion, theft of funds for public programs, use of fake documents to obtain privileged treatment, etc.).

The second category of rent seeking consists of privileged regulation and legislation that reduce competition (government-created barriers to entry, trade restrictions and agricultural price supports), disguised transfers (a public road may increase the value of real estate, etc), and privileged avoidance of regulation. Again, there are legal and illegal forms.

Our model is conceptually consistent with both categories of rent seeking. The formal model however focuses on the first type.\(^5\)

2.3. Households

In each period \(t\) there are \(N_t\) identical households indexed by the superscript \(h\), where \(h = 1,2,..., N_t\). The population size \(N_t\) evolves at a constant rate \(\gamma_n \geq 1\) so that \(N_{t+1} = \gamma_n N_t\), where \(N_0 > 0\) is given. The expected lifetime utility of household \(h\) is:

\[
E_0 \sum_{t=0}^{\infty} \beta^t u \left( C_t^h + \psi G_t, L_t^h \right) \tag{1}
\]

where \(E_0\) denotes rational expectations conditional on the information set available at time zero, \(0 < \beta < 1\) is a time discount factor, \(C_t^h\) is \(h\)'s private consumption at time \(t\), \(G_t\) is average (per household) public consumption goods and services provided by the government at \(t\), and \(L_t^h\) is \(h\)'s leisure time at \(t\). Thus, public consumption of goods and services influences private utility through the value of the parameter \(\psi\).

\(^4\) We focus on the demand side of rent seeking. The supply side of fiscal favors (why and how government officials and voters decide to offer these favors, and at what price) is not modeled. See Section 8 below.

\(^5\) Our list of privileged rents is not exhaustive: for other examples, see for example Tanzi (1998) and Hillman (2009, chapter 2).
For the instant utility function, we use the form:

\[
u(C_t^b + \psi C_t^g, L_t^i) = \frac{\left( (C_t^b + \psi C_t^g)^{\mu} \right)^{1-\mu} \gamma_t^h}{1-\mu}
\]

where \(0<\mu<1\) and \(\gamma_t^h \geq 0\) are parameters.

Each household saves in the form of capital \(B_t^h\) and government bonds \(D_t^h\). It receives interest income from capital \(r_t^h K_t^h\) and government bonds \(r_t^h B_t^h\), where \(r_t^h\) and \(r_t^g\) are the gross returns to capital and bonds, \(K_t^h\) and \(B_t^h\). The household has one unit of time in each period divided between leisure \(L_t^h\) and effort \(H_t^h\), thus, \(L_t^h + H_t^h = 1\) in each period. It further divides its effort time \(H_t^h\) between productive work \(t_{h}^t H_t^h\) and rent-extracting or seeking activities \((1 - t_{h}^t) H_t^h\), where \(0 < t_{h}^t \leq 1\) and \(0 \leq (1 - t_{h}^t) < 1\) denote the fractions of non-leisure time that the household allocates to productive work and rent extraction and rent seeking; thus, \(H_t^h = t_{h}^t H_t^h + (1 - t_{h}^t) H_t^h\) in each period. Finally, each household receives a share of profits \(\Pi_t^h\), and a share of lump-sum government transfers \(G_t\). Thus, the household’s budget constraint is:

\[
(1 + \tau_t^h) C_t^h + l_{t+1}^h + D_t^h = (1 - \tau_t^h) \left( r_t^h K_t^h + w_t Z_t^h H_t^h + H_t^h \right) + r_t^h B_t^h + C_t^h + \frac{(1 - t_{h}^t) H_t^h}{\sum_{h=1}^{N_h} (1 - t_{h}^t) H_t^h} \Theta_t R_t
\]

where \(0 \leq \tau_t^h \leq 1\) and \(0 \leq \tau_t^h \leq 1\) are consumption and income tax rates common to all agents, \(w_t\) is the wage rate, \(z_t\) is labour-augmenting technology common to all households that evolves at a constant rate \(\gamma_z \geq 1\) so that \(Z_{t+1} = \gamma_z Z_t\) where \(Z_0 > 0\) is given, \(R_t\) denotes government tax revenue (specified below) and \(0 \leq \Theta_t \leq 1\) is the economy-wide degree of rent extraction (also specified below). The budget constraint in Eq. (3) is standard except for the last term on the right-hand side, which indicates that, given a total contestable prize denoted as \(\Theta_t R_t\), a self-interested agent attempts to obtain a share of that prize.  

Private holding of government bonds evolves according to:

\[
l_{t+1}^h = l_t^h + D_t^h
\]

where the initial \(l_0^h\) is given.

Private holding of capital evolves according to:

\[
k_{t+1}^h = (1 - \delta_t^h) k_t^h + l_t^h
\]

where the parameter \(0 < \delta_t^h < 1\) is a depreciation rate and the initial \(k_0^h\) is given.

Each household acts competitively by taking prices, policy and economy-wide variables as given. Thus, each \(h\) chooses \(\{C_t^h, H_t^h, t_{h}^t, k_{t+1}^h, B_{t+1}^h\}_{t=0}^{\infty}\) to maximize Eqs. (1) and (2) subject to Eqs. (3)-(5), \(L_0^h + H_0^h = 1, H_0^h = t_{h}^t H_0^h + (1 - t_{h}^t) H_0^h\) and \(k_0^h, B_0^h\) given. The first-order conditions include the constraints and also:

\[
\frac{\partial u(.)}{\partial L_t^i} = \frac{1}{(1 + \tau_t^h)} \frac{\partial u(.)}{\partial C_t^h} \left[ (1 - \tau_t^h) w_t Z_t^h H_t^h + \frac{(1 - t_{h}^t) H_t^h}{\sum_{h=1}^{N_h} (1 - t_{h}^t) H_t^h} \Theta_t R_t \right]
\]

\[
(1 - \tau_t^h) w_t Z_t^h H_t^h = \frac{H_t^h}{\sum_{h=1}^{N_h} (1 - t_{h}^t) H_t^h} \Theta_t R_t
\]

\[
\frac{1}{(1 + \tau_t^h)} \frac{\partial u(.)}{\partial C_t^h} = \beta \mu \frac{1}{(1 + \tau_t^h + 1)} \frac{\partial u(.)}{\partial C_t^h} \left[ (1 - \tau_t^h) r_t^h k_{t+1}^h + 1 - \delta_t^h \right]
\]

\[
\frac{1}{(1 + \tau_t^h)} \frac{\partial u(.)}{\partial C_t^h} = \beta \mu \frac{1}{(1 + \tau_t^h + 1)} \frac{\partial u(.)}{\partial C_t^h} \left[ 1 + r_t^h k_{t+1}^h \right]
\]

---

6 Since both \(t_{h}^t\) and \(H_t^h\) are optimally chosen, this is equivalent to choosing how to allocate one’s time to the three activities (leisure, productive work and rent seeking).

7 We assume that returns on government bonds are not taxed.

8 On rent seeking with shared rents, see Long and Vousden (1987).

9 Each individual \(h\) is small by taking economy-wide variables \(\Theta_t, R_t, \sum_{h=1}^{N_h} (1 - t_{h}^t) H_t^h\) as given. We could alternatively assume that each \(h\) internalizes the effects of his/her own actions on aggregate outcomes by taking only the actions of other agents \(j \neq h\) as given. This is not important regarding the features of a decentralized equilibrium. What is important is that there are (social) external effects.
Condition (6a) is the optimality condition with respect to effort time $H_t^f$, and equates the marginal value of leisure to the after-tax return to effort. Condition (6b) is the optimality condition with respect to the fraction of non-leisure time allocated to work vis-à-vis rent extraction and rent seeking $\tau_t^f$; in equilibrium, the return to work and the return to rent extraction and rent seeking are equal. Eqs. (6c) and (6d), are standard Euler equations for $K_{t+1}^f$ and $B_{t+1}^f$. The optimality conditions are completed by the transversality conditions for the two assets, namely $\lim_{t \to \infty} \beta^t E_0 \frac{\partial U_t(\cdot)}{\partial C_t} K_t^f + 1 = 0$ and $\lim_{t \to \infty} \beta^t E_0 \frac{\partial U_t(\cdot)}{\partial C_t} B_t^f + 1 = 0$.

### 2.4. Firms

There are as many firms as households. Identical firms are indexed by the superscript $f$, where $f = 1, 2, \ldots, N$. Each firm produces a homogeneous product $Y_t^f$ by choosing private capital $K_t^f$ and private labor $Q_t^f$ and by using average (per firm) public capital $K_t^G$. Its production function is:

$$Y_t^f = A_t \left( K_t^f \right)^{\alpha} \left( Q_t^f \right)^{1-\alpha - \varepsilon}$$

where $A_t > 0$ is stochastic total productivity (see below for its law of motion) and $0, \alpha,$ and $\varepsilon < 1$ are parameters (see Lansing, 1998, for a similar production function).

Each firm $f$ acts competitively by taking prices, policy and economy-wide variables as given. Thus, each $f$ chooses $K_t^f$ and $Q_t^f$ to maximize a series of static profit problems:

$$\Pi_t^f = Y_t^f - r_t^f K_t^f - w_t Q_t^f$$

subject to Eq. (7). The first-order conditions are:

$$\frac{\alpha Y_t^f}{K_t^f} = r_t^f$$

(9a)

$$\frac{Y_t^f}{Q_t^f} = w_t.$$  

(9b)

### 2.5. Government

The government collects tax revenue $R_t$ by taxing consumption and income at the rates $0 \leq \tau_t^c < 1$ and $0 \leq \tau_t^y < 1$. Rent seekers extract $\Theta_t R_t$, where the economy-wide fraction of rent seeking $0 \leq \Theta_t < 1$ is modelled below. Then the government uses the remaining tax revenue $(1 - \Theta_t) R_t$ and issues new bonds, $B_{t+1}$ to finance public consumption $C_t$, public investment $G_t$, and lump-sum transfers $G_t^i$. Thus, the government budget constraint at $t$ is:

$$C_t + G_t + G_t^i + \left( 1 + r_t^b \right) B_t = B_{t+1} + (1 - \Theta_t) R_t$$

(10)

where $R_t = \tau_t^c \sum_{h=1}^{N_t} C_t^h + \tau_t^y \left( \tau_t^f \sum_{h=1}^{N_t} K_t^h + w_t Z_t \sum_{h=1}^{N_t} \tau_t^y H_t^h + \sum_{h=1}^{N_t} H_t^h \right)$ is tax revenue. Notice that $\Theta_t R_t$ can be either government revenue taken away (i.e., privileged tax treatments) and as extra benefits recorded as expenditure (i.e., privileged spending subsidies).

Public investment $G_t^i$ is used to augment the stock of public capital, whose motion is:

$$K_t^{G^i} + 1 = (1 - \delta^G) K_t^G + G_t^i$$

(11)

where $0 < \delta^G < 1$ is a depreciation rate and initial $K_0^G$ is given.

### 2.6. Exogenous stochastic variables and policy instruments

The exogenous stochastic variables include the aggregate productivity $A_t$, and five policy instruments $C_t$, $G_t$, $G_t^i$, $\tau_t^f$, $\tau_t^y$. We assume that productivity and policy instruments (in rates) follow stochastic AR(1) processes (see Baxter and King, 1993).

---

10 We include public investment, and hence public capital, because we wish to be as close as possible to the data concerning public finance. This helps us to calibrate the model more accurately (see also Baxter and King, 1993; Lansing, 1998). Nevertheless, we report in Section 4.4 below outcomes when $\varepsilon = 1 - \alpha$ so that there is no productive role for public expenditure.
Specifically, we define $s_i^t = \frac{C_i^t}{Z_t^t}$, $s_i^t = \frac{O_i^t}{T_i^t}$, $\tau_i^0 = \frac{\tau_i}{\mu}$ to be the three categories of government spending as shares of output. We assume that $A_i, s_i^t, s_i^t, \tau_i^t, \tau_i^t$ follow univariate stochastic AR(1) processes:

\[
\begin{align*}
\ln A_{i,t+1} &= (1 - \rho_s) \ln A_{0,t} + \rho_s \ln A_{i,t} + \varepsilon_s^{i,t+1} \\
\ln s_i^t &= (1 - \rho_s) \ln s_i^{0,t} + \rho_s \ln s_i^t + \varepsilon_s^{i,t+1} \\
\ln s_i^t &= (1 - \rho_t) \ln s_i^{0,t} + \rho_t \ln s_i^t + \varepsilon_t^{i,t+1} \\
\ln \tau_i^t &= (1 - \rho_t) \ln \tau_i^{0,t} + \rho_t \ln \tau_i^t + \varepsilon_t^{i,t+1} \\
\ln \tau_i^t &= (1 - \rho_t) \ln \tau_i^{0,t} + \rho_t \ln \tau_i^t + \varepsilon_t^{i,t+1}
\end{align*}
\]

where $A_{0,t}, s_i^{0,t}, s_i^t, \tau_i^{0,t}, \tau_i^t$ are means of the stochastic processes; $\rho_s, \rho_t, \rho_s, \rho_t, \rho_t, \rho_t$ are first-order autocorrelation coefficients; and $\varepsilon_s^{i,t}, \varepsilon_s^{i,t}, \varepsilon_t^{i,t}, \varepsilon_t^{i,t}, \varepsilon_t^{i,t}$ are i.i.d. shocks.

2.7. Economy-wide rent extraction

To close the model, we specify the economy-wide degree of rent extraction ($0 \leq \Theta_t \leq 1$). This can depend on many variables. Here, following for instance Zak and Knack (2001), Mauro (2004) and Park et al. (2005), we simply assume that $\Theta_t$ increases with per capita rent-seeking activities, $\sum_{h=1}^N (1 - \eta^h) H_i^h$ (see Section 7 for a richer specification). Using for simplicity a linear specification, we assume:

\[
\Theta_t = \frac{\sum_{h=1}^N (1 - \eta^h) H_i^h}{N_t} \quad (13)
\]

where $\theta_0 \geq 0$ is a technology parameter that translates rent-seeking effort into rent extraction. Higher values of $\theta_0$ indicate a more “efficient” rent-seeking technology, through permissive legal systems and permissible corruption, etc. Thus, $\theta_0$ is a measure of institutional quality, with higher values indicating worse institutions. Note that our model distinguishes between rent creation (government income, $R_t$), rent seeking efforts (each person $h$ allocates $(1 - \eta^h) H_i^h$ to rent seeking) and actual rent extraction in the economy ($\Theta_t R_t$).

2.8. Decentralized Competitive Equilibrium (DCE)

In a Decentralized Competitive Equilibrium (DCE): (i) Each individual household and each individual firm maximize respectively their own utility and profit by taking as given market prices, government policy and economy-wide outcomes. (ii) Markets clear through price flexibility.\(^{12}\) (iii) The government budget constraint is satisfied. This equilibrium holds for any feasible policy. We solve for a symmetric DCE. Equilibrium quantities will be denoted by letters without the superscripts $h$ (which was used to indicate quantities chosen by households) and $f$ (which was used to indicate quantities chosen by firms). The DCE is given by Eqs. (1)–(13). Looking ahead at the long run where all components of the national income identity grow at the same constant rate (the so-called balanced-growth rate), we transform these components in per capita and efficient unit terms to make them stationary. Thus, for any economy-wide variable $X_t, X_t = (Y_t, C_t, L_t, B_t, K_t, G_t, C_t, G_t, C_t)$, we define $X_t = \frac{X_t}{\mu_t}$, we also define $h_t = \frac{L_t}{N_t}$ to be per capita non-leisure time. It is then straightforward to show that Eqs. (1)–(13) imply the following stationary DCE:

\[
\begin{align*}
\frac{(c_i + \phi s_i y_i)}{(1 - h_t)} &= \frac{\mu}{(1 + \tau_i)(1 - \mu)} \theta_0 (\tau_i c_i + \tau_i y_i) \\
n_i h_t \theta_0 &= \frac{\varepsilon(1 - \tau_i) y_t}{(\tau_i c_i + \tau_i y_i)}
\end{align*}
\]

\(^{11}\) We could instead use a non-linear form like a Cobb–Douglas function. This would not affect our main results.

\(^{12}\) Thus, in each time period, $\sum_{h=1}^N k_i^h = \sum_{k=1}^N k_i^h$ in the capital market, $\sum_{f=1}^F q_i^f = 2 \sum_{k=1}^N k_i^h$ in the labor market, $\sum_{h=1}^N r_i^h = \sum_{h=1}^N r_i^h$ in the dividend market, and $b_i = \sum_{h=1}^N b_i^h$ in the bond market.
\[
\begin{align*}
\left( \frac{(c_t + \psi \xi y_t) \beta \gamma(1-h_t)^{\mu}}{1 + \tau_t} \right) = \\
\beta E_t \left[ \left( \frac{(c_t + \psi \xi y_t + \gamma y_t + 1) \beta \gamma(1-h_t)^{\mu}}{1 + \tau_t} \right) \right] + 1 - \beta E_t \left[ \left( \frac{(c_t + \psi \xi y_t + \gamma y_t + 1) \beta \gamma(1-h_t)^{\mu}}{1 + \tau_t} \right) \right]
\end{align*}
\]

where \( \beta \equiv \gamma^{\beta(1-\alpha) - 1} \). We thus have nine equations in the paths of \( h_t, c_t, y_t, r_t, \eta_t, b_t, k_t, \tau_t, \gamma_t \). This gives the paths of productivity \( A_t \) and the independent policy instruments, \( s_t, s_t^*, s_t^*, s_t^* \), whose motion is defined in Eqs. (12a–f) above. Our model economy in the long run is presented in Appendix A where variables without time subscripts denote long-run values.

3. Taking the model to the data

Our model includes variables that – although clearly identifiable from a theoretical point of view – are difficult or impossible to observe and measure. Prime examples are the fraction of effort time allocated to productive work relative to rent seeking \( 0 < \eta_t < 1 \) and hours devoted to productive work \( \eta_t h_t \). To address the measurement problem, we assume that effort at rent seeking takes place while at work. This reflects the view that trade union and lobbying activities are at the expense of hours of productive work. We

<table>
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</tbody>
</table>
thus distinguish hours at work $h_t$, which is measurable, from hours of productive work $\eta_t h_t$, which is unobservable. Although we do not have data on $\eta_t$, we can use the condition (14b) to deduce $\eta_t$ given time-series for $y_t$, $c_t$, $\tau_c$, $\tau_f$, $h_t$, and values for the model’s structural parameters, $\theta_0$ and $\varepsilon$, where these parameter values are calibrated below (for instance, all variables in Eq. (A.i) in Appendix A are observable so that this equation can give a calibrated value for $\theta_0$, the extraction technology parameter). This in turn gives the economy-wide degree of extraction, $\Theta_0$, via Eq. (13).

Also, public finance data do not distinguish between government spending arising from rent-seeking activities and government spending independent of such activities. Because the data contain both types, $G_t^c$ (i.e. transfers net of rent seeking) is unmeasured. However, since we have assumed that spending favors take the form of transfers, this means that only the government budget constraint (A.vi) is affected, and this can be rewritten as Eq. (A.vi’) which includes observables only (see Appendix A for details).

To use the theoretical framework for quantitative results, we calibrate the model by following a three-step procedure that follows the tradition in the literature. First, we assign numerical values to the parameters of the model. This requires setting as many numbers as possible according to balanced-growth conditions, i.e. our model economy mimics the actual economy in the long run. As long-run values of variables, we use the average values of the time-series in the data. Second, we linearly approximate the equilibrium conditions around the resulting long-run solution. Third, we study whether the linearized model can generate fluctuations that are associated with the business cycle. To do so, we simulate our model economy and compare key second-moment properties of the series generated by the model to those of the actual data (where we use the Hodrick-Prescott filter to obtain the cyclical component of the series). We also present impulse response functions.

4. Calibration and long run of the euro area

We first calibrate the model to the euro zone area as a whole. Our data source is the updated AWM dataset constructed by Fagan et al. (2001). Data are quarterly and cover the period 1980:1–2003:4. Table 1 reports the calibrated parameter values and the average values of exogenous variables (time-series) in the data. Table 2, column 1, reports the average values of endogenous variables (time-series) in the data, while the long-run solution of the model is in column 2.

4.1. Data averages

The average values of tax rates in the data are in Table 1. The income tax rate $\tau_c$ is obtained as the ratio of the collected income tax revenue to GDP. The consumption tax rate $\tau_f$ is the ratio of collected indirect tax revenue over private consumption. Data averages of the three government spending-to-output ratios are also in Table 1. Table 2, column 1, reports the average values of $c/y$, $i/y$, $h$ and $b/y$ in the data. The average quarterly real interest rate on public debt $r^b$ is 0.0089, which implies an annual value of 0.036. Since data on hours at work are not available for the euro zone area as a whole, the series of $h_t$ is computed as in for instance Correia et al. (1995) and its average value is found to be $h = 0.3713$.

13 See Burnside and Eichenbaum (1996) for a similar approach in an estimated RBC model with several unobservable variables because of factor hoarding.

14 We are grateful to Harald Uhlig for pointing out this problem. This implies that we may have a double-counting problem, in the government budget constraint in Eq. (10) if we use the available data on government spending to measure $G_t^c$, $G_t$ and $\hat{G}_t$, and in addition allow for rent seeking ($h_R$). Since we use data on collected tax revenue, a similar problem does not arise in the case where rent seeking takes the form of tax favors.

15 Total employment is equal to the employment rate multiplied by the labour force. On the assumption that there are $7 \times 14$ h per week and the average working week is 40 h, labour hours are obtained if we multiply total employment by the factor $40 / (7 \times 14)$. Note that this is not necessary for individual countries where data are available (see below).

---

Table 2
Data averages and long-run solution.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Data average</th>
<th>Long-run solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>$c/y$</td>
<td>Consumption-to-output ratio</td>
<td>0.5694</td>
<td>0.6348</td>
</tr>
<tr>
<td>$i/y$</td>
<td>Private investment to output ratio</td>
<td>0.18</td>
<td>0.18</td>
</tr>
<tr>
<td>$h$</td>
<td>Hours at work</td>
<td>0.3713</td>
<td>0.3188</td>
</tr>
<tr>
<td>$\eta_t$</td>
<td>Fraction of hours at work allocated to productive work</td>
<td>Na</td>
<td>0.8809</td>
</tr>
<tr>
<td>$n h_t$</td>
<td>Hours of productive work</td>
<td>Na</td>
<td>0.2809</td>
</tr>
<tr>
<td>$\theta$</td>
<td>Share of tax revenue extracted by rent seekers</td>
<td>Na</td>
<td>0.1807</td>
</tr>
<tr>
<td>$\theta r_g/k^c$</td>
<td>Transfers due to rent seeking as a share of total transfers</td>
<td>Na</td>
<td>0.3460</td>
</tr>
<tr>
<td>$\theta r_g/y$</td>
<td>Transfers due to rent seeking as a share of output</td>
<td>Na</td>
<td>0.0701</td>
</tr>
<tr>
<td>$k/y$</td>
<td>Private capital to output ratio</td>
<td>Na</td>
<td>5.3169</td>
</tr>
<tr>
<td>$k^c/y$</td>
<td>Public capital to output ratio</td>
<td>Na</td>
<td>0.8714</td>
</tr>
<tr>
<td>$\rho$</td>
<td>Return to bonds (quarterly)</td>
<td>0.0089</td>
<td>0.0089</td>
</tr>
<tr>
<td>$b/y$</td>
<td>Public debt-to-output ratio (quarterly)</td>
<td>2.3288</td>
<td>2.40</td>
</tr>
<tr>
<td>$s_0$</td>
<td>Government consumption-to-output ratio</td>
<td>0.2041</td>
<td>0.1557</td>
</tr>
</tbody>
</table>

Notes: Na denotes not available.
Table 3
Comparative statics and long-run solution.
Table 4
Rent seeking results in individual euro countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>$\theta_0$</th>
<th>$\eta_1$</th>
<th>$\Theta$</th>
<th>$\Theta r / g^r$</th>
<th>$\Theta r / y$</th>
<th>$\tau_0^s$</th>
<th>$\tau_0$</th>
<th>$g^r / r$</th>
<th>$g^r / y$</th>
<th>ICRG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>4.5 (2)</td>
<td>0.85 (6)</td>
<td>0.21 (7)</td>
<td>0.28 (5)</td>
<td>0.08 (6)</td>
<td>0.28</td>
<td>0.18</td>
<td>0.78</td>
<td>0.3</td>
<td>47.22 (5)</td>
</tr>
<tr>
<td>Belgium</td>
<td>4.9 (3)</td>
<td>0.84 (7)</td>
<td>0.20 (6)</td>
<td>0.36 (7)</td>
<td>0.09 (7)</td>
<td>0.32</td>
<td>0.16</td>
<td>0.57</td>
<td>0.23</td>
<td>47.46 (4)</td>
</tr>
<tr>
<td>Finland</td>
<td>4.45 (1)</td>
<td>0.97 (3)</td>
<td>0.03 (3)</td>
<td>0.05 (3)</td>
<td>0.01 (3)</td>
<td>0.3</td>
<td>0.18</td>
<td>0.67</td>
<td>0.26</td>
<td>48.76 (3)</td>
</tr>
<tr>
<td>France</td>
<td>5.47 (5)</td>
<td>0.92 (4)</td>
<td>0.1 (4)</td>
<td>0.16 (4)</td>
<td>0.04 (4)</td>
<td>0.28</td>
<td>0.19</td>
<td>0.65</td>
<td>0.25</td>
<td>46.62 (6)</td>
</tr>
<tr>
<td>Germany</td>
<td>5.6 (6)</td>
<td>0.82 (8)</td>
<td>0.26 (8)</td>
<td>0.41 (8)</td>
<td>0.1 (8)</td>
<td>0.29</td>
<td>0.18</td>
<td>0.64</td>
<td>0.25</td>
<td>48.92 (2)</td>
</tr>
<tr>
<td>Greece</td>
<td>7.36 (10)</td>
<td>0.8 (10)</td>
<td>0.53 (11)</td>
<td>0.77 (11)</td>
<td>0.16 (11)</td>
<td>0.19</td>
<td>0.14</td>
<td>0.7</td>
<td>0.20</td>
<td>34.36 (11)</td>
</tr>
<tr>
<td>Ireland</td>
<td>6.5 (8)</td>
<td>No RS (1)</td>
<td>No RS (1)</td>
<td>No RS (1)</td>
<td>0.2</td>
<td>0.14</td>
<td>0.67</td>
<td>0.18</td>
<td>0.7</td>
<td>44.37 (7)</td>
</tr>
<tr>
<td>Italy</td>
<td>5.66 (7)</td>
<td>0.8 (10)</td>
<td>0.32 (9)</td>
<td>0.56 (9)</td>
<td>0.12 (9)</td>
<td>0.28</td>
<td>0.16</td>
<td>0.58</td>
<td>0.22</td>
<td>40.90 (8)</td>
</tr>
<tr>
<td>Netherlands</td>
<td>5.36 (4)</td>
<td>No RS (1)</td>
<td>No RS (1)</td>
<td>No RS (1)</td>
<td>0.3</td>
<td>0.14</td>
<td>0.64</td>
<td>0.24</td>
<td>0.49</td>
<td>49.40 (1)</td>
</tr>
<tr>
<td>Portugal</td>
<td>7.58 (11)</td>
<td>0.81 (9)</td>
<td>0.52 (10)</td>
<td>0.71 (10)</td>
<td>0.13 (10)</td>
<td>0.18</td>
<td>0.11</td>
<td>0.74</td>
<td>0.18</td>
<td>40.13 (10)</td>
</tr>
<tr>
<td>Spain</td>
<td>6.56 (9)</td>
<td>0.9 (5)</td>
<td>0.19 (5)</td>
<td>0.28 (5)</td>
<td>0.05 (5)</td>
<td>0.22</td>
<td>0.1</td>
<td>0.69</td>
<td>0.19</td>
<td>40.4 (9)</td>
</tr>
</tbody>
</table>

Notes:
1. $\theta_0$ is a calibrated value, while $\eta_1$, $\Theta$, $\Theta r / g^r$ and $\Theta r / y$ are long-run solutions. $\tau_0^s$, $\tau_0$, $g^r / r$ and $g^r / y$ are data averages from OECD Economic Outlook. See the text for definitions.
2. The ICRG index is based on annual values for indicators of the quality of governance, corruption and violation of property rights over the period 1982–1997. It has been constructed by Stephen Knack and the IRIS Center, University of Maryland, from monthly ICRG data provided by Political Risk Services. This index takes values within the range 0–50, with higher values indicating better institutional quality. Our reported numbers are the averages over 1982–1997. Knack and Keefer (1995) provide a detailed description of this index.
3. Numbers in parentheses denote the ranking of countries in each column. A smaller number indicates less rent seeking.
4. The correlation between ICRG and $(\theta_0, \eta_1, \Theta, \Theta r / g^r, \Theta r / y)$ is $[-0.81, 0.49, -0.78, -0.77, -0.66]$.

4.2. Calibration

Some parameter values in Table 1 are set on the basis of a priori information. Following the usual practice, the curvature parameter in the utility function $\sigma$ is set equal to 2. The parameter $\psi$, which measures the degree of substitutability/complementarity between private and public consumption in the utility function, is set equal to 0; as Christiano and Eichenbaum (1992) explain, this means that government consumption is equivalent to a resource drain in the macro-economy. Since quarterly population data for the euro zone as a whole are not available, we assume away population growth, $\gamma_n=1$. The private and public capital depreciation rates, and $\delta^p$, are both set equal to 0.025 (implying 0.10 annually), which are the values also used by Smets and Wouters (2003). The exponent of public capital in the production function $(1-\alpha)$ set equal to 0.0295, which is the average public investment to public output ratio ($s_0^i$ in the data (Baxter and King, 1993, do the same for the US). Following Kydland (1995), we set $\mu$ (the weight given to consumption relative to leisure in the utility function) equal to the average value of $h_1$ (see above). Both $Z_0$ (the initial level of technical progress) and $A_0$ (the level of long-run aggregate productivity) are scale parameters and are normalized to one (King and Rebelo, 1999). The growth rate of the exogenous labor-augmenting technology, is 1.0088, which is the average GDP growth rate of the Euro zone member countries during 1960–2003.

The remaining parameters are chosen to match the data averages. The time preference rate $\beta$ is calibrated from Eq. (A.iii). The capital share $\alpha$ is calibrated from Eq. (A.ii). Given the values of $\alpha=0.2503$ and $(1-\alpha-\epsilon)=0.0295$, the labor share is $\epsilon=0.7202$. The value of $\theta_0$ (the extraction technology parameter) is calibrated from Eq. (A.i) to give $\theta_0=4.7593$. As stressed above, these calibrated parameter values do not require data on $\eta_1$. We also report that Eqs. (A.ix) and (A.vii) imply respectively $k/y=5.3169$ and $k^f/y=0.8714$, which are private and public capital stocks as shares of output. An implied value of $\eta_1$ can follow from Eqs. (A.viii) and is found to be 0.78.

For the simulations below, we also need to specify the parameters (autoregressive coefficients and variances) of the stochastic exogenous processes in Eqs. (12a)–(12f). The coefficients $\rho_1, \rho_2$ and the associated standard deviations, $\sigma_\rho$, $\sigma_\xi$, $\sigma_\varsigma$, in Eqs. (12b)–(12d) are estimated via OLS from their respective AR(1) processes. Concerning Eq. (12a), we follow the usual practice by choosing the volatility of the Solow residual $\varsigma_t$ so that the actual and simulated series for GDP have the same variance. By the same token, we choose the persistence of the Solow residual $\rho_2$ so that our simulated series of output mimics as closely as possible the first-order autocorrelation of the actual series of output. All this is achieved when $\varsigma_0=0.0063$ and $\rho_2=0.99$. Finally, we treat $\tau^t$ and $\tau^r$ in Eqs. (12e)–(12f) as constant over time: this is justified by the infrequent changes in tax rates (King and Rebelo, 1999). Table 1 summarizes all these results.

4.3. Long-run solution

Table 2 reports the model’s long-run solution. This unique solution follows if we use the parameter values reported in Table 1 in Eqs. (A.1)–(A.4), (A.6) and (A.7) in Appendix A and solve for the model’s endogenous variables. In this solution, we have set the annual long-run public debt-to-output ratio to 0.6, or 2.4 on a quarterly basis, which is the reference rate of the Stability and Growth Pact, and allow the long-run public consumption-to-output ratio $s_0^i$ to be endogenously determined; the solution is $s_0^i=0.1557$. Thus, government consumption as a share of GDP should fall from 0.2041 in the data to 0.1557 to be consistent with the

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16 The AWM database does not report data on private and public capital. We choose to calculate the two long-run capital output ratios rather than to construct the respective series by using for instance a perpetual inventory method.
exogenous debt-to-output ratio. The long-run solution also gives $\eta = 0.8809$ and $\Theta = 0.1807$. Thus, agents allocate only 88.09% of their effort time to productive work, while the remaining 11.91% goes to rent seeking. As a result, rent seekers take 18.07% of the collected tax revenue. The latter translates to 34.60% of total transfers or 7.01% of GDP, denoted as $\Theta r / g^t$ and $\Theta r / y$ respectively in the tables.

These values imply high rent seeking. Although we examine the determinants of rent seeking in more detail below, it is important to point out here that total transfers as a share of GDP and total transfers as a share of tax revenue are as high as 0.2026 and 0.5378 in the data (these are data averages). Large parts of transfers are ostensibly the result of interest group activity (Tanzi and Schuknecht, 2000). Our solution numbers are lower than previous estimates of rent seeking based on partial equilibrium and proxy calculations (see Mueller, 2003, p. 355, for a review).

### 4.4. Comparative statics

We use the long-run solution to determine comparative static properties. These properties show what would happen if we were to depart from the calibrated, “actual” economy and move to a fictional case with different policies, better institutions, higher productivity, etc. To save on space, we focus on the behavior of the economy-wide degree of extraction ($0 \leq \Theta < 1$) and output $y$, and on how these two key endogenous variables are affected by exogenous variables and calibrated parameters. Specifically, we report the effects of the income tax rate $\tau_y$, the consumption tax rate $\tau_c$, the extraction technology parameter $\theta_0$, capital productivity $\alpha$, the growth rate of labor-augmenting technology $\gamma_z$, and labor productivity $\varepsilon$.

Numerical solutions are illustrated in Table 3. An increase in any of the tax rates ($\tau_y$, $\tau_c$) leads individuals to substitute from productive work to rent seeking (it increases $\Theta$) and reduces $y$. An institutional deterioration (a higher $\theta_0$) has also led to higher $\Theta$ and lower $y$. Increases in capital productivity and labor-augmenting technology (higher $\alpha$ or $\gamma_z$) lead to higher $\Theta$ and higher $y$; thus, a higher $y$ triggers rent seeking, but, despite the adverse effects of rent seeking, the net output effect is positive. A higher $\varepsilon$ leads to lower $\Theta$ and higher $y$; higher labor productivity pushes individuals away from rent seeking to productive work (see Eq. (14b) above), which stimulates output.

We finally report results when government expenditure does not play a productive role. In other words, what happens when $\varepsilon = 1 - \alpha$ in the private production function (7)? In this case, if we recalibrate and resolve the model, the calibrated value of labor productivity $\varepsilon$ increases from 0.7202 in Table 1 to 0.7497. Then, as expected from the comparative static effects illustrated in Table 3 above, the economy moves to a better outcome in the long run. For instance, the long-run value of the fraction of effort time

| $\tau_0$ | 0.7158 | 0.5650 |
| $\tau_0$ | 2.1482 | 2.6715 |
| $\alpha$ | 0.5717 | 0.9103 |
| $\gamma_z$ | 0.1905 | 0.9103 |
| $\varepsilon$ | 0.2499 | 0.1529 |
| $\varepsilon$ | 0.2558 | 0.1251 |
| $\varepsilon$ | 0.3882 | 0.1251 |
| $\varepsilon$ | 0.0854 | 0.1251 |
| $\varepsilon$ | 0.0084 | 0.0084 |

---

**Table 5**

Relative volatility, $x \equiv s_x / s_y$.

<table>
<thead>
<tr>
<th>$x$</th>
<th>Data</th>
<th>Full model</th>
<th>Model without rent seeking</th>
</tr>
</thead>
<tbody>
<tr>
<td>$c$</td>
<td>0.9578</td>
<td>0.7158</td>
<td>0.5650</td>
</tr>
<tr>
<td>$i$</td>
<td>4.3504</td>
<td>2.1482</td>
<td>2.6715</td>
</tr>
<tr>
<td>$h$</td>
<td>0.5306</td>
<td>0.4736</td>
<td>0.0927</td>
</tr>
<tr>
<td>$y/h$</td>
<td>0.6557</td>
<td>0.5717</td>
<td>0.9103</td>
</tr>
<tr>
<td>$w$</td>
<td>0.8307</td>
<td>0.1905</td>
<td>0.9103</td>
</tr>
<tr>
<td>$k$</td>
<td>Na</td>
<td>0.2499</td>
<td>0.1529</td>
</tr>
<tr>
<td>$k^f$</td>
<td>Na</td>
<td>0.2558</td>
<td>0.1251</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Na</td>
<td>0.3882</td>
<td>0.1251</td>
</tr>
<tr>
<td>$\eta h$</td>
<td>Na</td>
<td>0.0854</td>
<td>0.1251</td>
</tr>
<tr>
<td>$s_y$</td>
<td>0.0084</td>
<td>0.0084</td>
<td>0.0084</td>
</tr>
</tbody>
</table>

---

**Table 6**

Persistence $p(x_t, x_{t-1})$.

<table>
<thead>
<tr>
<th>$x$</th>
<th>Data</th>
<th>Full model</th>
<th>Model without rent seeking</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>0.8533</td>
<td>0.6920</td>
<td>0.6852</td>
</tr>
<tr>
<td>$c$</td>
<td>0.8339</td>
<td>0.7011</td>
<td>0.6907</td>
</tr>
<tr>
<td>$i$</td>
<td>0.8217</td>
<td>0.6773</td>
<td>0.6693</td>
</tr>
<tr>
<td>$h$</td>
<td>0.9512</td>
<td>0.6798</td>
<td>0.6808</td>
</tr>
<tr>
<td>$y/h$</td>
<td>0.6824</td>
<td>0.7111</td>
<td>0.6858</td>
</tr>
<tr>
<td>$w$</td>
<td>0.8230</td>
<td>0.6938</td>
<td>0.6858</td>
</tr>
<tr>
<td>$k$</td>
<td>Na</td>
<td>0.9471</td>
<td>0.9479</td>
</tr>
<tr>
<td>$k^f$</td>
<td>Na</td>
<td>0.8505</td>
<td>0.9479</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Na</td>
<td>0.6798</td>
<td>0.9505</td>
</tr>
<tr>
<td>$\eta h$</td>
<td>Na</td>
<td>0.6798</td>
<td>0.9505</td>
</tr>
</tbody>
</table>
allocated to productive work relative to rent seeking $\eta$ increases from 0.8809 in Table 2 to 0.9170, the long-run value of the economy-wide degree of extraction $\Theta$ falls from 0.1807 in Table 2 to 0.1260 and the long-run value of output expressed in efficiency units $y$ increases from 0.4992 in Table 2 to 0.5108.\(^{17}\)

5. Calibration and long run of individual euro countries

We calibrate and solve the model for individual euro countries, following the same steps as for the euro zone as a whole. We use annual data from the OECD Economic Outlook database over the same period 1980–2003 (data details are provided in Appendix B).\(^{18}\) Table 4 presents the values of $\theta_0$, $\eta$, $\theta$, $\sigma r/g^i$ and $\sigma r/y$ (respectively, the calibrated value of the extraction technology parameter, and the long-run solutions of the fraction of effort time allocated to productive work relative to rent seeking, the share of tax revenue extracted by rent seekers, transfers due to rent seeking as a share of total transfers and transfers due to rent seeking as a share of output) for each country. Numbers in parentheses denote the ranking of countries, with larger numbers indicating more rent seeking. Table 4 also provides the averages of four time-series in the data; the income tax rate $\tau_0^g$, the consumption tax rate $\tau_0^c$, government transfers as a share of tax revenue $g^t/r$, and government transfers as a share of GDP $g^t/y$. Finally, for comparison with the applied literature, we also present a relevant popular “real world” index, namely, the ICRG index, which is a widely used measure of institutional quality (for this index, see the notes of Table 4).

The calibrated values of the parameter $\theta_0$ provide a measure of institutional quality in the sense that the higher $\theta_0$ is, the easier it is for a given rent seeking effort to be translated into actual extraction (see Eq. (13) above). Conceptually, $\theta_0$ has the same connotation as the ICRG index: the correlation between our calibrated value of $\theta_0$ and the ICRG index is $-0.81$ (higher numbers of the ICRG index denote better outcomes, hence the minus). Apart from small differences, both measures classify countries into two subgroups. Based on the calibrated values of $\theta_0$ in the “good” subgroup Finland scores the best, followed by Austria, Belgium and the Netherlands. In the “bad” subgroup, Portugal is the worst, followed by Greece and Spain.

We consider some key endogenous variables: the long-run solutions for $\eta$ (the fraction of effort time allocated to productive work relative to rent seeking) and $\Theta$ (the economy-wide share of tax revenue extracted by rent seekers). In terms of both $\eta$ and $\Theta$, Ireland and the Netherlands score the best (essentially zero rent seeking) being followed by Finland where $\eta = 97\%$ and $\Theta = 3\%$. At the other end, Greece, Portugal and Italy are the worst with 53%, 52% and 32% respectively for $\Theta$. Germany follows with $\Theta = 26\%$. The long-run solutions for $\sigma r/g^i$ (transfers due to rent seeking as a share of total transfers) and $\sigma r/y$ (transfers due to rent seeking as a share of output) deliver a similar message: in Greece, Portugal and Italy 16%, 13% and 12% of GDP are grabbed by rent seekers, while Germany follows with 10%.

Why do countries differ? We can focus on $\theta$, which is the key variable in our model. $\theta$ depends on almost all exogenous variables and calibrated parameters. The comparative static properties reported in Section 4.4, combined with the results in Table 4, can also provide an answer to why countries differ. High values of $\theta$ in Greece and Portugal are mainly due to poor institutional quality (very high $\theta_0$ in both countries). The high value of $\theta$ in Germany is mainly due to high tax rates, especially income tax rates $\tau_0^g$. Ireland does

17 Detailed results are available upon request.
18 For Germany, we use data for the post-unification period, 1990–2003, only. We do not include Luxembourg. Detailed calibration results for each country are available upon request. We realize, of course, that different countries may need different models. Nevertheless, our model seems able to capture reasonably well the key characteristics of almost all euro countries. This should be expected to be the case since it is a straightforward extension of the neoclassical growth model which is the workhorse model in the RBC literature.
well (i.e. has a low \( \Theta \)) due to low tax rates (\( \tau_0 \)) despite poor institutions (relatively high \( \theta_0 \)). The same happens in Spain to a smaller extent. Finland and the Netherlands have low rent seeking mainly due to good institutions (low \( \theta_0 \)) despite high tax rates.\(^{19}\)

6. The linearized model and simulation results for the euro area

We now assess the performance of the model in terms of ability to replicate some of the second-moment properties of the actual data. To understand the working of the model, we also present impulse response functions. For comparison, we study the performance of the model without rent seeking (when we set \( \eta_t = 1 \) and hence \( \Theta_t = 0 \) at all \( t \)). We focus on the euro area as a whole.

6.1. Linearized decentralized competitive equilibrium

We first need to linearize Eqs. (14a)–(14i) around its long-run solution. Define \( \delta_t \equiv (\ln x_t - \ln x) \), where \( x \) is the model-consistent long-run value of a variable \( x_t \). It is then straightforward to show that the linearized DCE is a system \( E_t [A_1 \delta_{t+1} + A_0 \delta_t + B_1 \delta_{t+1} + B_0 \delta_t = 0] \), where \( A_1 \equiv [\delta_t, \delta_{t-1}, \delta_{t-2}, \delta_{t-3}, \delta_{t-4}, \delta_{t-5}, \delta_{t-6}, \delta_{t-7}, \delta_{t-8}, \delta_{t-9}] \) and \( A_0, A_0, B_1, B_0 \) are constant matrices of dimension \( 10 \times 10 \), \( 10 \times 6 \) and \( 10 \times 4 \) respectively. The elements of \( \delta_t \) follow the AR(1) processes in Eqs. (12a)–(12d) – recall that tax rates have been assumed to be constant. Thus we have a linear first-order stochastic difference equation system in ten variables, out of which three are

\(^{19}\) This may also contribute to explaining the non-conclusive evidence on the relationship between government size and measures of rent seeking activities. For instance, Park et al. (2005) provide evidence of a positive correlation between fiscal size and rent seeking in 108 countries, and Glaeser and Saks (2006) find a weak positive relationship between bigger governments and corruption using data for states in the US. On the other hand, Treisman (2000) reports that measures of government size are not significantly related with corruption in a world sample, and Fisman and Gatti (2002) report that a higher government share in GDP is reducing corruption in a sample of both developed and developing countries.
predetermined \((\hat{b}, \hat{k}, \hat{c})\) and seven are forward-looking \((\hat{\xi}, \hat{\xi}_c, \hat{\xi}_p, \hat{\xi}_b, \hat{\xi}_h, \hat{\xi}_2)\). When we use the calibrated values in Table 1, all eigenvalues are real and there are three eigenvalues with absolute value less than one, so that the model exhibits a saddle-path stability.

6.2. Second-moment properties

We simulate our model economy over the period 1980–2003 and evaluate its descriptive power by comparing the second-moment properties of the series generated by the model to those of the actual euro zone data. To obtain the cyclical component of the series, we take logarithms and apply the Hodrick–Prescott filter with a smoothing parameter of 1600 for both the simulated and the actual data. We study the volatility, persistence and co-movement properties of some key variables, \(y, c, i, h, y/h, w, k, k^g, \eta, \eta_h\).

Tables 5–7 summarize, respectively, results for standard deviation (relative to that of output), first-order autocorrelation and cross-correlation with output. This is done both for the simulated series and the actual data.

We start with relative volatility. Inspection of Table 5 reveals that the model does quite well in predicting the standard deviation of the key macroeconomic variables relative to that of output. Specifically, the full model does somewhat better than the same model without rent seeking in terms of consumption volatility (the latter is 0.9578 in the data, while the model with rent seeking and the same model without rent seeking predict respectively 0.7158 and 0.565) and somewhat worse in predicting investment volatility (4.3504 in the data, 2.1482 and 2.6715 in the models with and without rent seeking respectively). However, the full model does much better in terms of volatility of hours at work (the relative volatility is 0.5206 in the data, while the model with rent seeking and the same model without rent seeking predict respectively 0.4736 and 0.0927).

The channel through which rent seeking improves consumption and hours volatility will become clearer when we present impulse response functions below. Nevertheless, it is useful to point out the following at this stage. One of the weak points of the standard RBC model has been the difficulty with its prediction that hours at work are not volatile enough relative to output (King and Rebelo, 1999; Hall, 1999). The RBC literature has therefore searched for mechanisms that can predict higher hours volatility. Rent seeking provides such a mechanism by distinguishing between effort time devoted to productive work, \(\eta_h\), and effort time devoted to rent seeking, \((1 - \eta_h)h\). As the impulse response functions below confirm, this happens because, once there is a shock,
the fraction of effort time devoted to productive work, $\eta_t$, and the time devoted to productive work, $h_t$, move in opposite
directions, so that total effort time, $ht$, has to overshoot its value relative to standard RBC models.20

Persistence results are reported in Table 6. Both models do well by predicting high persistence, although not as high as observed
in the data (except for that of $y/h$, which is well-matched). The result that rent seeking does not affect persistence behaviour is not
surprising: the way that we have modelled rent seeking does not add any new extra mechanism through which shocks propagate
their effects over time.

Concerning cross-correlations with output, as can be seen in Table 7, both models give similar results. They do well in terms of sign and, to some extent, magnitude, although the predicted contemporaneous cross-correlation coefficients are higher than in the data.

To summarize, our model does well in reproducing several of the key stylized facts of the euro economy. It also scores better
than the same model without rent seeking in terms of hours at work volatility: our model does better because, once there is a
shock, the fraction of total hours at work allocated to productive work and the hours of productive work move in opposite
directions, so that total hours at work have to overshoot their value relative to standard RBC models. In other words, we distinguish
hours at work as observed in the data (which can also include rent seeking activities like trade unionism, lobbying, etc) from hours
of productive work.

6.3. Impulse response functions

We compute the responses of the key endogenous variables (measured as deviations from their model-consistent long-run value) to a unit shock to the exogenous processes. We examine temporary shocks to total factor productivity, government

20 The RBC literature has pointed out that one way of increasing the volatility of hours relative to output is to introduce a "third use of time", which is in addition
to work and leisure (King and Rebelo, 1999; Hall, 1999). Our rent seeking activity plays this very role of a third use of time. Alternative third uses of time include
home production and human capital. Other model specifications that also increase the volatility of hours include exogenous shocks and labour market frictions
(for a discussion of the related literature, see Chang and Kim, 2007, who develop a model with heterogeneous agents, incomplete capital markets and indivisible
labour supply).
Table 9a
Model without rent seeking – response to aggregate productivity shock ($A_i$).

Table 9b
Model without rent seeking – response to government consumption shock ($c_i$).
consumption and government investment. Results are reported in Tables 8a–8c. We also report what would happen in the same model without rent seeking (see Tables 9a–9c).

Table 8a reports the effects of a temporary shock to total factor productivity, $\overline{A}_t$. As is standard, an increase in $\overline{A}_t$ leads to more time allocated to productive work ($\eta_t h_t$ rises). At the same time, in our model, an increase in $\overline{A}_t$ signals a larger contestable pie that pushes individuals to devote a larger fraction of hours at work to rent seeking ($\eta_t$ falls initially). As a result, $h_t$ has to overshoot its value relatively to standard RBC models.

The full explanation is as follows. An increase in $\overline{A}_t$ increases income, which supports a rise in both current and future consumption. Since leisure is also a normal good, both current and future leisure have the tendency to follow consumption, namely to rise (or equivalently $h_t$ to fall). Nevertheless, a higher $\overline{A}_t$ also raises labor productivity and the real wage (as well as output, investment and capital) and creates a substitution effect that works in an opposite direction by increasing the time spent in productive work, $\eta_t h_t$. The latter effect dominates so that the net effect on $\eta_t h_t$ is positive (this result is as in most of the literature, see for instance Kollintzas and Vassilatos, 2000). Here there is an extra effect due to rent seeking. Since $\eta_t$ has fallen, $h_t$ has to increase more relative to standard models to support the higher value of $\eta_t h_t$.

Table 9a reports the effects of the same productivity shock when there is no rent seeking. Inspection of Tables 8a and 9a reveals that in Tables 8a private consumption $c_t$ jumps initially more, and then falls more abruptly, relative to Table 9a. Thus, extraction from state coffers allows a temporary rise in spending, only for private consumption to fall sharply afterwards when the adverse effects of rent seeking begin. Note this can also explain the higher consumption volatility in Table 5. Rent seeking in Table 8a also produces a big jump in hours at work $h_t$ relative to that in Table 9a (this is the overshooting effect discussed above). Note that this can also explain the higher hours volatility in Table 5.

Table 8b reports the effects of a temporary shock to government consumption as a share of output, $s_t$. An increase in $s_t$ creates a negative wealth effect that reduces consumption, investment and (after the demand stimulant fades away) output. Concerning leisure, there are two opposite effects. On the one hand, because of lower income, leisure tends to fall (or equivalently $h_t$ tends to rise) like consumption. On the other hand, a higher $s_t$ lowers the return to labor (the wage rate) and creates a substitution effect that tends to reduce the time allocated to productive work ($\eta_t h_t$), which can be achieved by lower $\eta_t$ and/or lower $h_t$. Here, as the impulses show, the former (income) effect dominates so that both $h_t$ and $\eta_t h_t$ rise. The rise in hours of productive work ($\eta_t h_t$) is standard in the RBC literature but here we have an additional effect: the lower return to productive work implies a lower $\eta_t$. In other words, individuals switch to rent seeking. Since $\eta_t$ falls, $h_t$ has to rise more relatively to standard models to support the higher value of $\eta_t h_t$.

Comparison of Tables 8b and 9b reveals that the initial fall in consumption $c_t$ is larger in the former; this is because aggressive rent seeking activities (lower $\eta_t$) allow a smaller initial reduction in wealth. By contrast, $h_t$ jumps much more in Table 8b than in Table 9b; this is due to the overshooting effect.
Finally, Table 8c reports the effects of a temporary shock to government investment as a share of output $s_l$. Although the response of the economy to a change in $s_l$ resembles that of a change in $s_i$ in the very short run, after some time private consumption, investment and capital all rise above their initial long-run values. Output and wages are also higher all the time contrary to what happened with an increase in $s_i$. Thus, after some periods of time, a shock to $s_l$ is like a shock to productivity $A_i$ so that the qualitative effects on $\eta_k$, $\eta_ih_t$ and $h_t$ in Table 8c are the same as those in Table 8a.

Comparison of Tables 8c and 9c tells the same story as with shocks to productivity and government consumption. Namely, because of the overshooting effect, $h_t$ jumps much more in Table 8c than in Table 9c.

7. Institutional reforms and welfare implications in the euro area

We now quantify the potential welfare gains from institutional reforms. Recall that $\theta_0$ is a technology parameter that summarizes how easily rent-seeking attempts are translated into actual rent seeking, with reductions in $\theta_0$ making rent seeking more difficult (see Eq. (13)). We therefore study reforms that reduce the value of $\theta_0$. To make the study interesting, we assume that reductions in $\theta_0$ require the use of scarce social resources. In particular, we assume that this technology parameter is now endogenous depending on the fraction of output that the government earmarks for the financing of courts, inspectors, police, prisons, etc. This fraction, denoted as $s_l^*$, can reduce the economy-wide degree of extraction $0 \leq \theta < 1$. Eq. (13) changes to:

$$\Theta_t = \theta_0(s_l^*)^{-\xi_1} \left( \frac{\sum_{k=1}^{N_t} (1 - \eta_k^h)H_k^t}{N_t} \right)^{-\xi_2}$$

(13a)

where $\xi_1, \xi_2 \geq 0$ are parameters. That is, $\theta_0(s_l^*)^{-\xi_1}$ is now the composite technology parameter. If $\xi_1 = 1$ and $\xi_2 = 0$, we are back to the model in Section 2.

The government budget constraint changes from Eq. (10) to:

$$G_c^t + G_i^t + G_i^p + G_p^p + \left( 1 + r_t^h \right)B_t = B_{t+1} + (1 - \Theta_t)R_t$$

(10a)

where $G_p^p$ is the new category of public spending (and where $s_l^* = \frac{G_p^p}{G_c^t}$). All other equations remain as in Section 2.

To compare the benchmark economy to a reformed one, we follow Lucas (1990) and most of the literature on welfare regime comparisons in micro-founded general equilibrium models. We thus compute the percentage compensation in consumption that the household would need under the calibrated existing benchmark economy so as to be indifferent between this structure and a comparisons in micro-founded general equilibrium models. We thus compute the percentage compensation in consumption that has a simple interpretation and is popular. We focus on the effects of such reforms upon long-run welfare. The calculations are in Appendix C.

We first solve the new theoretical model working as in Section 2, then we calibrate and solve for the long run as in Section 4,21 and finally calculate the value of $\xi$ that equates welfare across different policy regimes or equivalently across different values of $\theta_0$, which denotes the long-run value of $s_l^*$. The results are reported in Table 10, where the welfare gains are with respect to the value of $s_l^*$ in the data, 1.6%. As can be seen, institutional improvements via higher $s_l^*$ imply substantial social welfare gains relative to those in the related literature on tax reforms (see for instance Lucas, 1990).22

<table>
<thead>
<tr>
<th>$s_l^*$</th>
<th>$\theta_0(s_l^*)^{-\xi_1}$</th>
<th>Percentage welfare gain ($\xi_2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.6%</td>
<td>4.7593</td>
<td>-</td>
</tr>
<tr>
<td>2.4%</td>
<td>4.7027</td>
<td>3.27%</td>
</tr>
<tr>
<td>3.2%</td>
<td>4.6630</td>
<td>5.66%</td>
</tr>
<tr>
<td>4.0%</td>
<td>4.6324</td>
<td>7.55%</td>
</tr>
<tr>
<td>4.8%</td>
<td>4.6075</td>
<td>9.12%</td>
</tr>
<tr>
<td>5.6%</td>
<td>4.5866</td>
<td>10.47%</td>
</tr>
</tbody>
</table>

21 In the new numerical solution, we set $s_l^* = 0.016$, which is the average value of government spending on “public order and safety” in the data, and we also set $\xi_1 = 1$ and $\xi_2 = 1 - \alpha = s_l^* = 0.0295$ (the value of $\xi_2$ reflects the assumption that all types of productive government spending are equally efficient whether used in the production of goods or in the protection of institutions; see also the discussion in the beginning of Section 4.2). All other parameter values are as in Table 1, since the value of the composite technology parameter, $\theta_0(s_l^*)^{-\xi_1}$ remains as in the baseline calibration, i.e. 4.7593.

22 We report that these welfare gains remain unchanged when we recalibrate and resolve the model without public productive expenditures (i.e. when we set $\alpha = 1 - \alpha$ in the private production function (7) above). This is because a different value of $\varepsilon$ affects both the starting economy and the transformed one by the same proportion so that the welfare gains or losses remain unchanged. Detailed results are available upon request.
8. Discussion of key assumptions and possible extensions

We now consider key assumptions of the model and discuss possible extensions. First, we have assumed that government assets are a common property or common pool. Then, as in all common-pool models, socially suboptimal behavior (in our case rent seeking) can result from the attempt of rational individuals to benefit from the common property. In other words, rent seeking arises because of the possibility that rents can be extracted. It is this possibility, jointly with decision making in a decentralized economy, which makes rent seeking optimal from an individual point of view (\(0 < \eta_i < 1\)). We have taken these circumstances and the associated institutions as given, and have studied the macroeconomic implications.

Second, we assumed that only households engage in rent seeking. We could take into account that firms also rent seek: however, households are firm-owners in this class of model. Also we have not allowed for rent-seeking government officials (bureaucrats and politicians). From the viewpoint of self-interest, government officials do not differ from other individuals so that adding more types of rent-seeking individuals would not change our main predictions (for instance, rent seeking activities would be increasing in the perceived pie, and hence in the tax rate, etc). On the other hand, the government officials’ optimization problem is more complicated for at least two reasons: First, in addition to private choices (consumption, savings, work effort, rent seeking effort, etc.), they also choose policy instruments (tax rates, public spending, etc.), as well as political favours in return for bribes, campaign contributions, political support, etc., where the latter are chosen by rent-seeking private agents. Second, to the extent that government officials act as Stackelberg leaders vis-à-vis private agents, their dynamic optimization problem is non-recursive and hence typical time inconsistency problems arise (even in the basic neoclassical growth model, the solution for time-consistent optimal fiscal policy is not trivial). All this complicates our DSGE model and the algebra considerably. We have therefore treated policy as exogenously set and did not model the strategic interaction between private agents and government officials.23

Third, we did not distinguish between insiders (who spend resources to maintain their insider status and rents) and outsiders (who compete to become insiders). Instead, we assumed that there are no barriers so that everybody who so wishes can compete over common-pool resources. This is as in Svensson (2000), Mauro (2004), and Park et al. (2005). On the other hand, Hillman and Ursprung (2000) distinguish between rent seeking by insiders and outsiders under different conditions of outsider access to rents.

Fourth, rent seeking is a negative-sum game for the society but is privately rational from an individual point of view. Rent-seeking behavior would cease to be optimal for the individual, if common property becomes critically low (with rent seeking inducing the decline) or if trigger strategies sustain a cooperative outcome.24

Fifth, we did not elaborate on the contest-success function for rent-seeking contests. We also did not model collective rent seeking and did not consider how rents might be unequally divided among rent seekers.25 In practice, rent seeking is often delegated: interest groups hire professional lobbyists, employees are represented by trade-union leaders, or firms hire lawyers to win lawsuits.26 Such cases require elaboration to include the relation between individual rent-seeking effort in the case of no representation and the rent-seeking effort of delegated rent seekers.

There are rent-seeking models that include these various extensions (see Congleton et al., 2008b, volume 1). However, the more limited representation of underlying rent-extracting and rent-seeking behavior employed here has allowed our dynamic general-equilibrium model to remain tractable.

9. Conclusions

We have provided first estimates of the social cost of rent seeking in Europe through fiscal privileges sought through government (or state coffers). Our estimates reveal potential welfare gains from institutions and incentives that reduce rent extraction and rent seeking through the public finance of government. We, nevertheless, acknowledge that possible model qualifications may affect our estimates. We are thus looking forward to comparisons with results from subsequent studies of the social cost of rent seeking in Europe.27

Acknowledgements

Two anonymous referees provided constructive suggestions. This paper was presented at the CESifo-Delphi Conference on “Government, institutions and macroeconomic performance” held in Munich, 29–31 May 2008. We thank Harris Dallas, George

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23 By contrast, it is straightforward to model the behavior of a benevolent government device. Park et al. (2005) show that a growth-maximizing government finds it optimal to choose a government size that is inversely related to the degree of rent seeking in the society.


25 Papers on collective rent seeking focusing on how the prize is divided among group members, information asymmetries, heterogeneity in preferences and group size, the degree of cooperation within groups, etc, include Baik et al. (2006), Baik and Lee (2007) and Cheikbossian (2008).

26 Papers that study the option to hire a delegate who acts on behalf of group members in rent-seeking group contests include Schoonbeek (2004), who specifies the conditions under which zero, one, or all groups choose to hire a delegate.

27 For estimates on the U.S., see Laband and Sophocleus (1992).
Economides, Jim Malley, Jacques Melitz, Evi Pappa, Hyun Park and Harald Uhlig for their comments. Dimitris Papageorgiou provided excellent research assistance.

Appendix A. Long-run equilibrium of Eqs. (14a)–(14i)

In the long run, there are no shocks and variables remain constant. Thus, \( x_{t+1} = x_t = x_{t-1} \equiv x \), where variables without time subscript denote long-run values. Eqs. (14a)–(14i) imply:

\[
\left( c + \psi_s s_{0t} \right) \left( \frac{1}{\tau_0 c + \tau_0 y} \right) (1 - h) = \frac{\mu}{(1 - \mu) c_0} \left( \frac{1}{1 + \tau_0^2} \right) \tag{A.i}
\]

\[
y = \frac{1}{\tau_0 (1 - h_0) c_0} \left[ \frac{1}{j^2} - 1 + \delta^p \right] \tag{A.ii}
\]

\[
r^b = \frac{1 - \beta}{{\beta}^\delta} \tag{A.iv}
\]

\[
\left( 1 - \delta^p \right) y = c + i \tag{A.iii}
\]

\[
y = Ak^\alpha \left( \eta h \right) \left( \begin{array} {c} k^\gamma \end{array} \right) \tag{A.v}
\]

\[
\begin{align*}
\left[ y_n y_n - (1 + r^b) \right] \frac{b}{y} + \left[ \frac{\tau_0^2 c + \tau_0^2 y}{y} \right] &= s^c_0 + s^i_0 + s^b_0 + \theta_0 (1 - \eta) h \left[ \frac{\tau_0^2 c + \tau_0^2 y}{y} \right] \tag{A.vi}
\end{align*}
\]

\[
\begin{align*}
\left[ y_n y_n - 1 + \delta^p \right] \frac{k^g}{y} &= s^j_0 \tag{A.vii}
\end{align*}
\]

\[
\eta h \left[ \frac{\tau_0^2 c + \tau_0^2 y}{y} \right] = \frac{1 - \tau_0^2 c_0}{\theta_0} \tag{A.viii}
\]

\[
\left[ y_n y_n - 1 + \delta^p \right] = \frac{i}{k} \tag{A.ix}
\]

which is a system in \( y, k, c, k^g, i, h, \eta, b, r^b \). If we set \( b = 2.4 y \) (i.e. the public debt-to-GDP ratio is 60% on an annual basis, which is the EU reference rate in the long run), then one of the other five policy instruments should follow residually to satisfy the government budget constraint (A.vi). We choose the long-run government consumption-to-GDP ratio \( \left( s^c_0 \right) \) to play this role.

Since rent seeking takes the form of government transfers, Eq. (A.vi) can be written as:

\[
\left[ y_n y_n - (1 + r^b) \right] \frac{b}{y} + \left[ \frac{\tau_0^2 c + \tau_0^2 y}{y} \right] = s^c_0 + s^i_0 + s^j_0 + s^b_0 + s^d_0 (1 - \eta) h \left[ \frac{\tau_0^2 c + \tau_0^2 y}{y} \right] \tag{A.vi'}
\]

where \( s^d_0 = s^b_0 + \theta_0 (1 - \eta) h \left[ \frac{\tau_0^2 c + \tau_0^2 y}{y} \right] \) and \( s^d_0 \) is the mean of the time-series of transfers in the data (equivalently, \( G(d)^0 \equiv G^0 + \Theta_0 R \) in Eq. (10) in the text, where \( G(d)^0 \) denotes the time-series of transfers in the data). The long-run system consists of Eqs. (A.i)–(A.v), (A.vi') and (A.vii)–(A.ix).

Appendix B. Data for individual countries

For individual EU-12 countries, we use annual data from the OECD Economic Outlook to construct the data averages as for the euro zone case. Concerning the depreciation rates and the growth rate of the labor-augmenting technology, we set (on annual basis) \( \delta^p = \delta^b = 0.1 \) and \( \gamma_2 = 1.035 \) for each country (as we did for the euro area as a whole). For the real government interest rate, we use the “benchmark risk free” Treasury bill interest rate as implied by the World Bank’s database World Development Indicators (the source is the IFS). Since this is not available for Austria and Finland, we use the euro zone value of 0.036 annually for these two countries. With respect to \( h \), we use data for average hours at work per week when available in the OECD Economic Outlook database. Since such data are not available for Austria, Greece and Portugal, for these countries, we work as in the euro zone above.
Finally, for those countries with an average annual public debt-to-GDP ratio \( \frac{b}{y} \) higher than 0.6, we set \( \frac{b}{y} = 0.6 \) and let \( s^r \) follow residually, as explained in Appendix A. In those countries with an average annual public debt-to-GDP ratio lower than 0.6, we set \( \frac{b}{y} \) at its data average and again let \( s^r \) follow residually.

**Appendix C. A measure of welfare gains**

Household’s within-period utility function (2), written in stationary form, is:

\[
    u_t = \frac{M_t \left( (c_t + \psi g^t)^{0.5}(1 - h_t)^{-1} \right)^{1 - \alpha}}{1 - \alpha}
\]

where \( M_t \equiv \gamma^{0.5(1 - \alpha)} \mu^t(1 - \alpha) \) includes exogenous variables only. For notational convenience, we define composite consumption as \( \bar{c}_t \equiv \left( c_t + \psi g^t \right) \).

Let us say there are two regimes, denoted by superscripts \( A \) and \( B \), and let \( \zeta \) be a constant fraction of consumption that serves as a compensating consumption supplement in regime \( B \) that makes the household indifferent between \( A \) and \( B \). Thus, in each time period, \( u^A_t = (1 + \zeta) u^B_t \). Using the above expression for the utility function and solving for \( \zeta \), we have (from now on, we focus on the long run and drop time subscripts):

\[
    \zeta = \bar{c}^A \left( (1 - h^A)^{1 - \mu} / \mu \right) - 1
\]

If \( \zeta > 0 \) (resp. \( \zeta < 0 \)), there is a welfare gain (resp. loss) of moving from \( B \) to \( A \). We choose \( \zeta > 0 \) to be the existing calibrated structure and \( A \) to be a fictional structure with better institutional quality, namely a lower \( \theta_0 \).

**References**


