Rent seeking and the excess burden of taxation

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Abstract

The social costs of rent seeking and the excess burden of taxation have been studied and evaluated independently. We show that, when rent seekers earn taxable income, there is interdependence between the two types of social losses. Rent seeking increases the excess burden of taxation under risk neutrality when leisure is non-inferior. We derive a condition for rent seeking to increase the excess burden of taxation under risk aversion. When rent seekers can earn taxable income, rent seeking is more socially costly than is inferred from contest models alone, because of an increased excess burden of taxation.

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1. Introduction

Gordon Tullock (1967) observed that a social cost is incurred when time and resources are attracted into contesting available benefits or rents. The primary concern of the literature (see Congleton, Hillman, and Konrad 2008) that followed on from Tullock's observation has been evaluation of the social cost of rent seeking. With no official data on rent seeking available and contested rents in general not observable, the approach to measurement of the social cost of rent seeking has been through modeling the behavior of rent seekers in the theory of contests (Konrad, 2009; Long, 2013). Empirical studies have used the conclusions from the models to infer social costs through dissipation of rents, usually under the assumption of complete dissipation (Hillman, 2013).

The studies of the social cost of rent seeking have had in common the assumption that contests occur in isolation from other sources of income and from leisure. Yet in general rent seekers can also earn incomes in labor markets and allocate time to leisure. The incomes are subject to taxation. We show that when rent seekers earn – or can earn – taxable income and can allocate time to leisure, under reasonable conditions the social cost of rent seeking exceeds the social losses inferred from the presence of a rent-seeking contest alone.[1]

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[1] There has been recognition that rent seeking is included in possible allocation of time. See Weiss (2009). The interdependence between the social costs of rent seeking and the excess burden of taxation has not been studied.

The excess burden of taxation is associated with the Harberger triangle (see Harberger, 1964; Hines, 1999). In the special case in which the compensated labor supply is linear, the excess burden of taxation can be measured by using a formula for the Harberger triangle that includes the tax rate and the compensated elasticity of labor supply (for an exposition, see Hillman, 2009 chapter 4). We use the equivalent variation to measure the excess burden of taxation.[2]

In section 2 we add a rent-seeking opportunity to time-allocation options of earning taxable income or having utility from leisure. We do not introduce further time allocation options such as home production or an informal sector, which, unlike rent seeking, can be non-strategic and risk-free. In section 3, with leisure non-inferior, we obtain the quite intuitive result using the equivalent variation that the excess burden of taxation is greater in the presence of a rent-seeking opportunity. The core intuition is that a tax on earned income decreases the opportunity cost of leisure and when present, also of rent seeking. Therefore time is substituted from labor to leisure but also from labor to rent seeking. An adverse effect of a tax on earned income on a rent seeker is that, unlike leisure, the expected return from participating

[2] Although the formula for the area of the Harberger triangle can be used as an approximation for measuring the specific excess burden with infinitesimal rate of taxation, because of the possible different direction and magnitude of errors in consequence of using an approximation, to compare between different excess burdens, we require an accurate measure such as the equivalent variation. On measurement of the excess burden, see Willig (1976) and Hausman (1981).

in a strategic rent seeking contest may not increase when substituting more time into a contest. With identical individuals the expected return is unchanged. These effects increase the excess burden of taxation. We also provide a more technical detailed explanation of the increase in the excess burden of taxation. [3]

In section 4 we introduce risk-aversion. Rent seeking in addition to being strategic is also risky. The excess burden of taxation with risk aversion regarding rent seeking includes the effect of risk on time substitution and a reevaluation of the uncertain income from rent seeking due to a change that can occur in the individual's risk premium. With additive utility, constant absolute risk aversion is a sufficient condition for the result that rent seeking increases the excess burden of taxation.[4]

Section 5 notes applicability of the conclusions to extensions of the basic rent-seeking model. We note studies that, in distinction to the separation common in the literature, recognize interdependence between issues of public finance and rent seeking. We give examples of coexistence of rent-seeking

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[3] Rent seeking increases the excess burden of taxation and at the same time, because of the greater excess burden of taxation, the social cost of rent seeking is greater when rent seekers earn taxed productive income. There is only one additional social loss.

[4] Risk aversion was introduced in models of rent seeking in Hillman and Katz (1984) under the assumption of constant relative risk averstion, which results in diminished rent-seeking outlays as risk aversion increases. More generally, risk-aversion introduces ambiguities into rent-seeking models (Skaperdas and Gan 1995; Konrad and Schlesinger, 1997; Treich 2010).

opportunities with taxable income and note the implications of our results for the socially desirable size of government.

2. Labor supply, leisure, and rent seeking

We begin with the standard labor-supply model of an individual who earns taxed income and confronts a labor/leisure choice with no rent seeking opportunity. The individual i assigns time to leisure l_i and time to productive work, $L_i = \overline{T} - l_i$, where $\overline{T}$ is available time, and receives a net-of-tax wage rate of W_i per hour. The individual also has non-contestable non-labor income M_i. There is no saving. Utility U_i depends on consumption of market goods C_i and leisure l_i. Individual i solves the time allocation problem (Becker, 1965):

(1) $$\max_{l_i} U_i(C_i, l_i),$$

where $C_i = (\overline{T} - l_i)W_i + M_i$. In an interior solution,

(2) $$\frac{dU_i}{dl_i} = U_{il_i} - W_i U_{ic_i} = 0,$$

and

(3) $$\frac{d^2U_i}{dl_i^2} = U_{il_il_i} + W_i^2 U_{ic_ic_i} - 2W_i U_{ic_il_i} < 0,$$

where

$$U_{ik} \equiv \frac{\partial U_i}{\partial k}, \; U_{ikk} \equiv \frac{\partial^2 U_i}{\partial k^2}, \; k = C_i, l_i, \text{ and } U_{ic_il_i} \equiv \frac{\partial^2 U_i}{\partial c_i \partial l_i}.$$

Applying the implicit function theorem in (2) results in:

$$(4) \qquad \frac{\partial l_i}{\partial M_i} = \frac{U_{il_ic_i} - W_i U_{ic_ic_i}}{-\dfrac{d^2U_i}{dl_i^{\,2}}}$$

and

$$(5) \qquad \frac{\partial l_i}{\partial W_i} = (\overline{T} - l_i)\frac{\partial l_i}{\partial M_i} + \frac{U_{ic_i}}{\dfrac{d^2U_i}{dl_i^{\,2}}}.$$

Leisure is a normal, neutral or inferior good according to whether $U_{il_ic_i} - W_i U_{ic_ic_i} \underset{<}{\overset{>}{=}} 0$, respectively. With leisure normal, the response to an increase in the net-of-tax wage is ambiguous. Under the standard assumption that, with leisure normal, the substitution effect of an increase in the net wage $\frac{U_{ic_i}}{\frac{d^2U_i}{dl_i^{\,2}}} < 0$ dominates the income effect $(\overline{T} - l_i)\frac{\partial l_i}{\partial M_i}$, labor supply increases with the net-of-tax wage.

We now introduce the opportunity to contest a rent. A rent of common-value V, yielding only private benefit, is indivisibly assigned to one successful rent seeker.[5] We assume that the rent is not taxed and nor is the value of inputs into rent seeking a tax credit or deduction from taxes paid on productively earned income. Of course, some rents are taxed. However, we

[5] We thus adopt the standard rent-seeking model. See Long (2013).

focus on non-taxed rents which are usually associated with low-income countries but, although less common, exist also in high-income countries. [6]

We also assume that the activity of rent seeking by individual i requires a combination of the use of resources x_i and time. Use of x_i entails assignment of $\beta_i x_i$ hours to rent seeking, where $\beta_i > 0$. Through β_i we include a measure of individual effectiveness in rent seeking. More adept rent seekers have lower values of β_i. Our formulation acknowledges that time itself is in general not enough as an input into rent seeking. For example, convincing effort that takes time may be complementary to a money payout. [7]

We use a general contest-success function. The probability that individual i secures the rent V is $P_i(x_1, \cdots, x_i, \cdots, x_n)$ where $x_j \geq 0 \quad j \neq i$

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[6] Glazer and Konrad (1999) describe taxation in the context of rent seeking. If the benefit from rent seeking is taxed independently of the tax on labor income, the value of the rent V is diminished by the value of the tax payment with no effect on our results. Domar and Musgrave (1944) studied the effects of an proportional tax on both certain and uncertain income, which in our case would entail taxing uncertain income from rent seeking and certain labor income at the same rate. They concluded that, because the tax absorbs part of the risk by decreasing the variance of expected income, in some circumstances investment in risky assets increases when the rate of taxation increases. In our case only labor income is taxed and the taxation therefore does not reduce the variance of expected income.

[7] See also Epstein and Hefeker (2003), who propose two substitutable inputs for influencing the probability of rent-seeking success. Our inputs are complementary.

denotes resources used in the contest by others. The function P_i has the usual properties of:

(6) $0 < P_i < 1 \quad \forall x_i > 0, \quad \frac{\partial P_i}{\partial x_i} > 0, \quad \frac{\partial^2 P_i}{\partial x_i^{\,2}} < 0, \quad \frac{\partial P_i}{\partial x_j} < 0$ and for $x_1 = x_i \cdots = x_n$

$$P_i = \frac{1}{n} \ \forall i = 1, \ldots, \ n.$$

Post-contest income and consumption depend on whether an individual has been successful in rent seeking and are therefore state-contingent.[8] After the outcome of the rent-seeking contest has been determined, the successful rent seeker will cosume $C_i^V = (\overline{T} - l_i - \beta_i x_i)W_i + M_i + V - x_i$, and will have resulting utility $U_i^V = U_i(C_i^V, l_i)$. Consumption of an unsuccessful rent seeker will be $C_i^{-V} = (\overline{T} - l_i - \beta_i x_i)W_i + M_i - x_i$, with utility $U_i^{-V} = U_i(C_i^{-V}, l_i)$.

The expected utility of individual *i* is:

(7) $$EU_i(x_i, l_i, x_{-i}; W_i, \beta_i, M_i, V) = P_i U_i\left(C_i^V, l_i\right) + (1 - P_i) U_i\left(C_i^{-V}, l_i\right),$$

where $x_{-i} = (x_1, \cdots, x_{i-1}, x_{i+1}, \cdots, x_n)$.

Certainty equivalent consumption $\tilde{C}_i$ satisfies:

(8) $$EU_i = U_i(\tilde{C}_i, l_i) = \tilde{U}_i.$$

With risk aversion,

[8] We do not consider the possibility of insurance. In practice, insurance regarding the outcome of partipcation in rent-seeking contests is not available.

(9) $U_{ic_ic_i} < 0$ and $\tilde{C}_i = C_i^{-V} + P_iV - \varepsilon_i$, where $\varepsilon_i \geq 0$ is the risk premium.[9]

Before the outcome of the rent-seeking contest is known, individual i solves:

(10) $$\max_{x_i,\, l_i} EU_i(x_i, l_i, x_{-i}; W_i, \beta_i, M_i, V) = \max_{x_i,\, l_i} \tilde{U}_i(x_i, l_i, x_{-i}; W_i, \beta_i, M_i, V).$$

With identical individuals, so that $x_1 = x_2 = \cdots = x_n = x$ and $l_1 = l_2 = \cdots = l_n = l$, in a symmetric Nash equilibrium,

(11) $$\frac{\partial \tilde{U}}{\partial x} = \tilde{U}_{\tilde{c}} \left(\frac{\partial P}{\partial x} V - \frac{\partial \varepsilon}{\partial x} - (1 + \beta W) \right) = 0$$

and

(12) $$\frac{\partial \tilde{U}}{\partial l} = \tilde{U}_l - (W + \frac{\partial \varepsilon}{\partial l}) \tilde{U}_{\tilde{c}} = 0 .$$

With $\tilde{U}_{\tilde{c}} > 0$, (11) is equivalent to:

(13) $$\frac{\frac{\partial P}{\partial x} V - (\frac{\partial \varepsilon}{\partial x} + 1)}{\beta} = W .$$

We denote by (x^*, l_R^*) the solution to (12) and (13) and by l_{NR}^* and $C(l_{NR}^*)$ the solution to (2). In the remainder of the paper we consider only interior solutions. That is, in the presence of rent seeking, in equilibrium, we assume that time is allocated to labor, leisure and rent seeking.

[9] With risk neutrality, $U_{ic_ic_i} = 0$ and $\varepsilon_i = 0$.

3. Risk neutrality

Under risk neutrality, equations (12) and (13) are independent, with x^* chosen in the Nash equilibrium of the rent-seeking game (the solution to (13)) and l_R^* chosen to maximize expected utility with the marginal rate of subsitution between leisure and expected consumption equal to the net-of-tax wage W as indicated by (12). With risk neutrality, in equilibrium, we have:[10]

$$(14) \qquad (\beta W + 1)x^* < \frac{V}{n} .$$

The following lemma compares leisure of risk-neutral individuals who respectively confront and do not confront a rent-seeking opportunity.

Lemma 1: *For risk neutrality,* $l_R^* > l_{NR}^*$ *if leisure is a normal good,* $l_R^* = l_{NR}^*$ *if leisure is a neutral good, and* $l_R^* < l_{NR}^*$ *if leisure is an inferior good.*

All the proofs appear in the Appendix.

Assume now that a tax of rate t is levied on productively earned income. Let W_b and W_a be the wage before and after tax, respectively. That is, $W_a = W_b(1-t)$. Thus, the amount of tax paid is $R = tW_bL^*(W_a)$, where $L^*(W_a)$ is the time assigned to productive work. In the following we compare the excess burden of the tax with and without a rent-seeking opportunity.

[10] The *LHS* of (14) is the alternative cost of time and resources foregone in participating in rent seeking and the *RHS* is the expected rent. In an interior equilibrium in which an individual chooses to participate in rent seeking, the expected return from the contest is greater than the alternative cost of resources.

Proposition 1:

For leisure non-inferior, under risk neutrality, a rent-seeking opportunity increases the excess burden of taxation.

Using the equivalent variation Ψ, the excess burden of taxation S is the amount in excess of paid taxes, R , that an individual is willing to pay to return to a no-tax state (see Mohring, 1971) – which is obtained by deducting the taxes paid R from the maximum amount that the individual would be willing to pay , Ψ, to avoid the tax. That is, $S = \Psi - R$. The effect of rent seeking on Ψ may be opposite to the effect of rent seeking on R. While R declines in the presence of rent seeking, because of the substitution from time spent earning taxable income to rent seeking and to leisure if leisure is normal, Ψ may go in either way. Ψ can be smaller, unchanged or greater with rent seeking according to whether the elasticity of demand for rent seeking, in absolute terms, is smaller, equal or greater than one. However, as shown in the proof of Proposition 1, with leisure non-inferior, the effect of R overweight the effect of Ψ. Thus, the total effect of rent seeking on the excess burden of taxation is unambiguously positive i.e., the excess burden of taxation is greater in the presence of rent seeking.

4. Risk aversion

We now introduce risk aversion. After-tax income and leisure are available with certainty but the rent is uncertain or subject to risk. With additive constant absolute risk aversion *(CARA)* utility, the result for risk neutrality in Lemma 1 that leisure is greater with rent seeking is replicated.

Lemma 2:

If $U_{cl} = 0$ *(i.e., additive utility) and CARA then:* [11]

$l_R^* > l_{NR}^*$.

Under these conditions, the result under risk neutrality in Proposition 1 that rent seeking increases the excess burden of taxation is also replicated.

Proposition 2

With additive CARA utility, the presence of rent seeking increases the excess burden of taxation.

With risk aversion, the revaluation of the uncertain income from rent seeking (i.e., the change in the risk premium) due to the tax on earned income in principle also affects the excess burden of taxation. With additive *CARA* utility, the valuation of the uncertain income does not change with wealth.[12] Although in the rent seeking literature risk neutrality is a common assumption, we acknowledge that in general, risk neutrality or a *CARA* utility is not necessarily the common assumption. We find that with these utilities

[11] Note that under risk aversion $U_{cl} \geq 0$ implies that leisure is a normal good.

[12] That is, with an additive *CARA* utility $\frac{d\varepsilon}{dW} = 0$.

the model is solvable and our main point is clear. One possible direction for future research may be to generalize our results.[13]

5. Conclusions

5.1 Applicability to generalizations of rent seeking contests

We have shown that, under risk neutrality and for additive constant absolute risk aversion utility, when rent seekers can earn taxed income, the social costs of rent seeking include an increased excess burden of taxation. We have derived our results using a standard model in which rent seeking is an individual activity in quest of a personally assigned indivisible private benefit. Extensions to rent seeking by interest groups to include shared rents, public good benefits, and rent seeking as a collective activity require re-specification of the rent-seeking contest.[14] Our results are general in applying to group activities. Whatever time and resources are used in rent seeking,

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[13] It is widely observed that people exhibit decreasing absolute risk aversion. This link between wealth and risk aversion is also observed empirically- not as a rule but as a general pattern (for example see, Friend and Blume, 1975). In spite of this empirical evidence, economists often make the simplifying assumption that people have constant absolute risk aversion. This may be a reasonable approximation for our model, as long as the tax does not significantly decrease the individual's income.

[14] Long and Vousden (1987) describe private benefits shared by a group, Ursprung (1990) describes rents that provide group public-good benefits, and Nitzan (1991) describes collectively provided inputs into rent seeking. See also Congleton, Hillman, and Konrad (2008, volume 1, part 2) and Ursprung (2012).

individuals confronting the opportunity of participation in rent seeking are subject to the income and substitution effects that we have described and that increase the excess burden of taxation including in the case of risk aversion the risk premium that discounts the individual's uncertain income from rent seeking. Our conclusions are also independent of the means of measurement of social loss from rent seeking. Indirect means of measuring the social losses from rent seeking have been proposed by Sobel and Garrett (2002), who suggest using differences in allocation of resources in the regions of capital cities where political decisions are made and other regions. Katz and Rosenberg (1989) suggested using changes in the government budget as an approach to measuring rent seeking. Whatever the social cost of rent seeking through time and other resources used in rent seeking, the excess burden of taxation is greater because of rent seeking.

5.2 Applications

Our model of people earning taxable income and confronting rent-seeking opportunties applies to a wide range of circumstances. Distraction from earning taxable income may occur through the opportunity to influence assignment of budgetary revenue (Park, Philippopoulos, and Vassilatos, 2005) or government officials may offer rent sharing through sale of state assets at privileged prices (Gelb, Hillman, and Ursprung, 1998). Political decision makers may be subject to influence regarding environmental policies (Dijkstra, 1999), the designation of beneficiaries of monopoly or protectionist rents (Peltzman, 1976; Hillman, 1989; Grossman and Helpman, 2001), or regarding determination of land values through land rezoning (Altshuler and Gómez-Ibáňez, 1993). Productively engaged researchers may find themselves with the opportunity to compete for a research or travel grant that would yield private but not social benefit. Individuals employed in a government bureaucacy may confront opportunities to influence their pomotion prospects (Kahana and Liu, 2010). Quite generally, rent seekers in general have options for income from other than rent seeking and where such income is taxed our conclusions apply.[15]

5.3 Separation between rent seeking and public finance

Rent seeking and taxation both involve efficiency losses due to government but have been addressed in separate literatures. Rent seeking has been a topic in the context of a public-choice or political-economy view of government. The efficiency loss due to the excess burden of taxation, also known as deadweight loss, has been traditionally studied in a classical public-finance context (see Ballard and Fullerton, 1992; Slemrod and Yitzhaki; 2001; Auerbach and Hines, 2002). Recent studies have departed from the separation

[15] A rent-seeking opportunity may be due to new rent creation or the rent can have been pre-existing but not previously contestable. On rents that are assigned for limited duration and the change from a non-contestable to a contestable rent, see Aidt and Hillman (2008). We set aside the ethical aversion to participation in rent seeking as described by Guttman, Nitzan, and Spiegel (1992).

between rent seeking and public finance. Baldacci, Hillman, and Kojo (2004) found that, for 39 low-income countries, contraction of public spending increases growth, which is attributed to the diminished incentives for rent seeking because of a smaller size of government. Park, Philippopoulos, and Vassilatos (2005) found, from a study of 108 countries, that rent seeking is positively related to the size of the public sector and proposed that incentives for rent seeking imply lower socially desirable taxation and smaller size of government. Rothschild and Scheuer (2011) take the same point further by introducing rent seeking into the normative public-finance model of optimal taxation. They show that, when asymmetric information prevents a government from knowing with certainty whether individuals are engaged in rent seeking or productive activity, optimal taxation of income is lower because of substitution incentives to rent seeking.[16] These studies do not consider the social loss because of the interdependence between rent seeking and the excess burden of taxation.

5.4 Insitutions and political discretion

Rent seeking takes place in different institutional contexts (Congleton, 1980, 2011). Because of the increased burden of taxation, social costs of privileged rent extraction (see Tullock, 1989; Murphy, Shleifer, and Vishny, 1993; Gelb,

[16] The model requires benevolent government officials or political decision makers who are concerned with maximizing social welfare as was Mirrlees and other officials or political decision makers who benefit from rent creation and rent assignment.

Hillman, and Ursprung, 1998; Cheikbossian, 2003) have been higher than noted. In low-income countries, where contestable rents have included personal gain from corruption and personal benefit from the distribution of foreign aid (for example, see Pedersen, 1997; Easterly, 2001; Svensson, 2000) social costs of rent seeking have likewise been higher. The interdependence between the excess burden of taxation and rent seeking implies, quite generally, greater social benefit from diminished political discretion to assign rents in both high and low-income countries, and from retreat of the state from "entrepreneurial activities" (Schuster, Schmitt, and Traub, 2013).

5.5 The size of government

Our results indicate that independent computations of the excess burden of taxation and social losses from rent seeking are lower bounds for social costs.[17] The increased social losses because of the greater excess burden of taxation in the presence of rent seeking suggest a smaller socially desirable size and scope of government when rent seeking is present.[18]

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[17] See Stuart (1984), Browning (1987), Fullerton (1991), and Goulder and Williams (2003) for computations of the excess burden of taxation. For estimates of the social cost of rent seeking, see Laband and Sophocleus (1992) for the United States and Angelopoulos, Philippopoulos, and Vassilatos (2009) for Europe.

[18] For influences on the size of government, see Tridimas and Winer (2005) and Hillman (2009, chapter 10). Facchini and Melki (2013) provide an example of empirical compution of the efficient size of government.

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Appendix: Proofs of Lemmas and Propositions

Proof of Lemma 1:

With risk neutrality (i.e., $U_{cc} = 0$) (4) implies that leisure is a normal, neutral or inferior good, according to whether $U_{lc} \gtreqless 0$, respectively. From inequality (14), it follows that $C(l^*_{NR}) < \tilde{C}(x^*, l^*_{NR})$. Substituting x^* and l^*_{NR} into (12) results in $\frac{\partial \tilde{U}}{\partial l} \gtreqless 0$ if leisure is respectively a normal, neutral or inferior good. From the second order conditions for expected-utility maximization, we have $\frac{\partial^2 \tilde{U}}{\partial l^2} < 0$, and thus, $l^*_R \gtreqless l^*_{NR}$ as leisure is respectively normal, neutral or inferior.

QED

Proof of Proposition 1:

Let $\tilde{U}^*_R(W)$ and $U^*_{NR}(W)$ be the indirect utility when an individual respectively confronts and does not confront a rent-seeking opportunity. Denote by $e(W, \tilde{U}^*_R)$ and $e(W, U^*_{NR})$ the corresponding expenditure functions. In the absence of a rent seeking opportunity, the equivalent variation is:

(15) $$\Psi_{NR} = e\left(W_b, U^*_{NR}(W_b)\right) - e\left(W_b, U^*_{NR}(W_a)\right).$$

The excess burden of taxation in the absence of rent seeking is:

(16) $$S_{NR} = \Psi_{NR} - tW_b L^*_{NR}(W_a),$$

where $L^*_{NR}(W_a)$ is the time assigned to productive work in the absence of a rent seeking opportunity. Correspondingly, the excess burden in the presence of the rent-seeking opportunity is:

(17) $S_R = \Psi_R - tW_b L_R^*(W_a) = e\left(W_b, \tilde{U}_R^*(W_b)\right) - e\left(W_b, \tilde{U}_R^*(W_a)\right) - tW_b L_R^*(W_a)$,

where $L_R^*(W)$ is the time assigned to work. With risk neutrality:

(18) $\Delta e(W_a) = e\left(W_a, \tilde{U}_R^*(W_a)\right) - e\left(W_a, U_{NR}^*(W_a)\right) = P\left(x_1^*(W_a), \cdots, x_n^*(W_a)\right)V - (1+\beta W_a)x^*(W_a)$,

where $x_1^*(W_a) = x_2^*(W_a) = \cdots\cdots = x_n^*(W_a) = x^*(W_a)$.

Thus, in a symmetric Nash equilibrium,

(19) $\dfrac{d\Delta e}{dW} = -\left(\beta x^*(W) + (1+\beta W)\dfrac{\partial x^*(W)}{\partial W}\right)$.[19]

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[19] $\sum_{i=1}^{n} P_i = 1$ and by symmetry $dx_i = dx_j = dx$, $\dfrac{\partial P_i}{\partial x_j} = \dfrac{\partial P_j}{\partial x_i} = \dfrac{\partial P_k}{\partial x_l}$, $\dfrac{\partial x_i}{\partial W} = \dfrac{\partial x}{\partial W}$ and $\dfrac{\partial P_i}{\partial x_i} = \dfrac{\partial P_j}{\partial x_j}$ $\forall i, j, k, l$. Therefore,

$$\sum_{j=1}^{n}\sum_{i=1}^{n}\frac{\partial P_i}{\partial x_j}dx_j = \left(n\frac{\partial P_k}{\partial x_k} + n(n-1)\frac{\partial P_k}{\partial x_l}\right)dx = 0 \;\; \forall k, l$$

,

$$\sum_{j=1}^{n}\frac{\partial P_i}{\partial x_j} = \frac{\partial P_i}{\partial x_i} + (n-1)\frac{\partial P_i}{\partial x_k} = 0 \;\; \forall i, k$$

$$\frac{dP}{dW} = \frac{dP_i}{dW} = \sum_{j=1}^{n}\frac{\partial P_i}{\partial x_j}\frac{\partial x_j}{\partial W} = \frac{\partial x}{\partial W}\sum_{j=1}^{n}\frac{\partial P_i}{\partial x_j} = 0 \;\; \forall i.$$

Because $\dfrac{dP}{dW} = 0$, the expected rent PV does not change with W and in equilibrium is equal to $\dfrac{V}{n}$. Yet, with $p_x = (1+\beta W)$, which is the price of one unit of rent seeking x, $\dfrac{dx^*}{dW} = \dfrac{dx^*}{dp_x}\dfrac{dp_x}{dW} = \beta\dfrac{dx^*}{dp_x}$ and the change in the expenditure on rent seeking is $\dfrac{d(p_x x^*)}{dW} = \beta(p_x\dfrac{dx^*}{dp_x} + x^*)\substack{\geq \\ <}0$ as the elasticity $E_{x/p_x} = \dfrac{dx^*}{dp_x}\dfrac{p_x}{x^*}\substack{\geq \\ <}-1$. Thus, $\dfrac{d\Delta e}{dW}\substack{\leq \\ >}0$ according to whether $E_{x/p_x}\substack{\geq \\ <}-1$.

Applying the mean value theorem on (19) results in:

(20) $$\frac{\Delta e(W_b) - \Delta e(W_a)}{(W_b - W_a)} = \frac{d\Delta e}{dW}(W_c) = -\left(\beta x^*(W_c) + (1+\beta W_c)\frac{\partial x^*(W_c)}{\partial W}\right)$$, where

$W_a < W_c < W_b$.

The difference in the excess burden with and without a rent seeking opportunity is:

(21) $$\Delta S = S_R - S_{NR} = \Delta e(W_b) - \Delta e(W_a) + tW_b\left(L^*_{NR}(W_a) - L^*_R(W_a)\right).$$

Substituting (20) and $L^*_{NR}(W_a) - L^*_R(W_a) = l^*_R(W_a) - l^*_{NR}(W_a) + \beta x^*(W_a)$ into (21) we have:

(22) $$\Delta S = tW_b\beta\left(x^*(W_a) - x^*(W_c)\right) + tW_b\left(l^*_R(W_a) - l^*_{NR}(W_a)\right) - tW_b(1+\beta W_c)\frac{\partial x^*(W_c)}{\partial W}.$$

Applying the implicit function theorem in (13) results in:

(23) $$\frac{\partial x^*}{\partial W} = \frac{\beta}{\frac{\partial^2 P}{\partial x^2}V} < 0.$$

From (23), it follows that the first and the third terms on the RHS of (22) are positive. From Lemma 1, with leisure non-inferior, the second term is non-negative. Therefore, if leisure is non-inferior, $\Delta S > 0$. [20] QED

Proofs of Lemma 2 and Proposition 2:

Under risk aversion,

(24) $$PU\left(C^V, l\right) + (1-P)U\left(C^{-V}, l\right) - U\left(C^{-V} + PV - \varepsilon, l\right) = 0,$$

[20] When leisure is inferior, because the second term in (22) is negative, the effect of rent seeking on the excess burden of taxation is ambiguous.

where $\varepsilon(x^*(W_a),\ P,\ l_R^*(W_a),\ W_a, V, M) > 0$. Applying the implicit function theorem in (24) given that $U_{cl} = 0$ results in:

(25) $$\frac{\partial \varepsilon}{\partial x} = \frac{\partial \varepsilon}{\partial P}\frac{\partial P}{\partial x} + \varepsilon_x,$$

where $\frac{\partial \varepsilon}{\partial P} = \frac{U(C^{-V},\ l) - U(C^{V},\ l)}{U_c(\tilde{C},\ l)} + V$ and $\varepsilon_x = (1+\beta W)\frac{EU_c - U_c(C^{-V} + PV - \varepsilon,\ l)}{U_c(\tilde{C},\ l)}$,

(26) $$\frac{\partial \varepsilon}{\partial V} = P\frac{U_c(\tilde{C},\ l) - U_c(C^{V},\ l)}{U_c(\tilde{C},\ l)} > 0,$$

(27) $$\frac{\partial \varepsilon}{\partial W} = -(\overline{T} - l - \beta x)\frac{EU_c - U_c(C^{-V} + PV - \varepsilon,\ l)}{U_c(\tilde{C},\ l)}$$

and

(28) $$\frac{\partial \varepsilon}{\partial l} = \frac{WEU_c - WU_c(\tilde{C},\ l) - PU_l(C^{V},\ l) - (1-P)U_l(C^{-V},\ l) + U_l(\tilde{C},\ l)}{U_c(\tilde{C},\ l)},$$

where $EU_c = U_c(C^{-V} + PV - \hat{\varepsilon},\ l)$.

$U_{cl} = 0$ implies that $PU_l(C^{V},\ l) + (1-P)U_l(C^{-V},\ l) = U_l(\tilde{C},\ l)$ and thus:

(29) $$\frac{\partial \varepsilon}{\partial l} = W\frac{EU_c - U_c(C^{-V} + PV - \varepsilon,\ l)}{U_c(\tilde{C},\ l)}.$$

With *CARA* utility, we have,

(30) $$EU_c = U_c(C^{-V} + PV - \hat{\varepsilon},\ l) = U_c(C^{-V} + PV - \varepsilon,\ l).$$ [21]

[21] The risk premium ε associated with U is proportional to the measure of absolute risk aversion, $r(C,l) = -\frac{U_{cc}}{U_c}$, and the risk premium $\hat{\varepsilon}$ associated with $-U_c$, is proportional to the measure of absolute risk aversion, $\hat{r}(C,l) = -\frac{U_{ccc}}{U_{cc}}$. A necessary and sufficient condition for $\hat{\varepsilon} = \varepsilon$ is $\hat{r}(C,l) = -\frac{U_{ccc}}{U_{cc}} = r(C,l) = -\frac{U_{cc}}{U_c}$ or alternatively, $U_c U_{ccc} - U_{cc}^2 = 0$, which is a necessary and sufficient condition for *CARA*. See Kimball (1990) for "absolute prudence".

Substituting (30) into (25), (27) and (29) result in:

(31) $$\frac{\partial^2 \varepsilon}{\partial l \partial x} = \frac{\partial \varepsilon}{\partial l} = \frac{\partial \varepsilon}{\partial W} = 0 ,$$

(32) $$\varepsilon_x = (1+\beta W)\frac{EU_c - U_c(C^{-V} + PV - \varepsilon, l)}{U_c(\widetilde{C}, l)} = 0 ,$$

and

(33) $$\frac{\partial \varepsilon}{\partial x} = \left(\frac{(U(C^{-V}, l) - U(C^{V}, l))}{U_c(\widetilde{C}, l)} + V \right) \frac{\partial P}{\partial x}.$$

Proof of Lemma 2:

From (31) it follows that with additive *CARA* utility, equations (11) and (12) are independent. Therefore, applying the implicit function theorem in (12) results in:

(34) $$\frac{\partial l_R^*}{\partial V} = -\frac{\frac{\partial^2 \widetilde{U}}{\partial V \partial l}}{\frac{\partial^2 \widetilde{U}}{\partial l^2}} = \frac{(P - \frac{\partial \varepsilon}{\partial V}) W U_{\tilde{c}\tilde{c}}}{\frac{\partial^2 \widetilde{U}}{\partial l^2}} .$$

Substituting (26) into (34) result in:

(35) $$\frac{\partial l_R^*}{\partial V} = \frac{P \frac{U_c(C^V, l)}{U_c(\widetilde{C}, l)} W U_{\tilde{c}\tilde{c}}}{\frac{\partial^2 \widetilde{U}}{\partial l^2}} .$$

With $U_{\tilde{c}\tilde{c}} < 0$ and the second order condition $\frac{\partial^2 \widetilde{U}}{\partial l^2} < 0$ we obtain that $\frac{\partial l_R^*}{\partial V} > 0$.

Therefore:

(36) $$l_R^*(V) - l_{NR}^* = l_R^*(V) - l_R^*(0) = \int_0^V \frac{\partial l_R^*}{\partial V} dV > 0 .$$[22] QED

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[22] Notice that if $V = 0$ then $x^* = 0$ and $l_R^*(0) = l_{NR}^*$.

Proof of Proposition 2:

With risk aversion the equivalent to equation (18) is:

(37) $$\Delta e(W_a) = P\left(x_1^*(W_a),\cdots,x_n^*(W_a)\right)V - \varepsilon(x^*(W_a),\, P,\, l_R^*(W_a),\, W_a,\, V, M) - (1+\beta W_a)x^*(W_a)\,,$$

where $x_1^*(W_a) = x_2^*(W_a) = \cdots\cdots = x_n^*(W_a) = x^*(W_a)$.

Thus, in a symmetric Nash equilibrium,

(38) $$\frac{d\Delta e}{dW} = -(\beta x^*(W) + (1+\beta W)\frac{\partial x^*(W)}{\partial W} + \frac{d\varepsilon}{dW})$$

where

(39) $$\frac{d\varepsilon}{dW} = \varepsilon_x \frac{\partial x}{\partial W} + \frac{\partial \varepsilon}{\partial P}\frac{dP}{dW} + \frac{\partial \varepsilon}{\partial l}\frac{\partial l}{\partial W} + \frac{\partial \varepsilon}{\partial W}\,.$$

With additive *CARA* utility, (31) and (32) imply that:

(40) $$\frac{d\varepsilon}{dW} = 0\,.$$ [23]

Substituting (40) into (38) results in:

(41) $$\frac{d\Delta e}{dW} = -(\beta x^*(W) + (1+\beta W)\frac{\partial x^*(W)}{\partial W})\,.$$

With additive CARA utility, the equivalent to equation (22) is:

(42) $$\Delta S = tW_b\beta\left(x^*(W_a) - x^*(W_c)\right) + tW_b\left(l_R^*(W_a) - l_{NR}^*(W_a)\right) - tW_b(1+\beta W_c)\frac{\partial x^*(W_c)}{\partial W}\,.$$

From Lemma 2, under additive *CARA* utility, $l_R^* > l_{NR}^*$, that is, the second term on the RHS of (42) is positive. With additive *CARA* utility, equations (11) and (12) are independent. Therefore, applying the implicit function theorem in (13) and taking into account (31) and (33), results in:

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[23] Notice that $\frac{dP}{dW} = 0$. See the proof in footnote 19.

(43) $$\frac{\partial x}{\partial W} = \frac{\beta}{\frac{\partial^2 P}{\partial x^2}V - \frac{\partial^2 \varepsilon}{\partial x^2}} = \frac{\beta U_c\left(\tilde{C}, l\right)}{\frac{\partial^2 P}{\partial x^2}\left(U\left(C^V, l\right) - U\left(C^{-V}, l\right)\right)} < 0 .$$ [24]

(43) implies that the first and the third terms on the RHS of (42) are also positive. Thus, with *CARA* and $U_{cl} = 0$, the excess burden of taxation is greater in the presence of rent seeking. QED

[24] Notice that with additive CARA (i.e., $U(C,l\ ) = -\beta e^{-aC} + f(l)$), $\frac{\partial^2 \varepsilon}{\partial x^2} = \frac{\partial^2 P}{\partial x^2}\left(\frac{\left(U\left(C^{-V}, l\right) - U\left(C^V, l\right)\right)}{U_c\left(\tilde{C}, l\right)} + V\right).$

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