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Abstract. I examine a simple model of rent seeking behavior in order to determined the correct way to measure welfare loss due to rent seeking. I conduct this analysis using a general equilibrium version of the standard partial equilibrium consumers' surplus cost-benefit setup. I conclude that the ordinary tools of cost-benefit analysis, such as consumers' and producers' surplus are up to the task of measuring the deadweight loss due to rent seeking, as long as they are applied in the proper general equilibrium context.

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Traditionally, economists have focused on analyzing productive activity. In the past several years, however, there has been considerable interest in analyzing *unproductive* activity. In synthesizing these developments, Bhagwati (1982) evolved the general concept of "directly unproductive profit seeking (DUP)" activities.

Following Bhagwati's (1982) useful classification, these DUP activities include rent-seeking activities aimed at capturing rents or scarcity premia on quantitative restrictions. The classic articles on this subject being Krueger's (1974) analysis of premium-seeking triggered by import restrictions, and Posner's (1975) analysis of lobbying to acquire the rents from artificial monopoly, along with the parallel analysis by Bhagwati and Srinivasan (1980) of "revenue seeking" activities designed to capture revenues generated by price intervention instead.

They also include, however, *rent-creating* activities, as analyzed in Tullock's (1967) classic treatment of tariff-seeking. The further extend to policy-evading economic activities, as analyzed in the literature on tax evasion by Bhagwati and Hansen (1973) et. al. The analyses have come from a variety of sources, including the (partial equilibrium) public choice school as represented in the collection of readings by Buchanan, Tollison and Tullock (1980) and the (general equilibrium) trade-theory school as surveyed cogently in Bhagwati (1982).

The focus of this paper will be on analyzing the welfare costs of the subset of DUP activities constituted by rent seeking activities, though the methods can be extended readily to analyzing other classes of DUP activities.

The key insight involved in this literature is that when private benefits and costs are created by government policy in a market, resources in other markets will be devoted to an attempt to capture those benefits and escape the costs. Hence the conventional partial equilibrium measures of deadweight loss will not be appropriate measures of the true deadweight burden of a given policy. In fact, as Bhagwati and Srinivasan (1982) and Bhagwati (1980) have pointed out, DUP activities may in some cases *increase* social welfare when compared to the second-best equilibrium with the distortion, but with no DUP activities. Hence partial equilibrium measures of welfare loss due to DUP activities can even exhibit the wrong sign!

Some examples will help to clarify the concept of rent seeking behavior.

Example 1. Theft (Tullock(1967)). In a partial equilibrium setting theft appears to be a purely redistributive activity that therefore involves no deadweight loss. However, upon reflection it is clear that considerable economic resources are devoted to the *prevention* of theft. Thus any computation of the deadweight burden of changes in governmental policy towards theft such as a change in the level of law enforcement, must include not

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only the direct expenditures on enforcement, but also the indirect effects of changes in the demand and supply for locks, alarms, insurance, etc.

Example 2. Taxes and subsidies (Goetz(1978), Bhagwati and Srinivasan (1980)). In the partial equilibrium analysis of taxes the deadweight loss is usually taken to the be familiar triangle that measures the net sum of consumer surplus, producer surplus and tax revenue. However upon reflection it is clear that this sort of calculation may well understate the true burden of the tax. When the tax is imposed it immediately creates a demand for resources that allow one to *avoid* paying the tax. Thus the demand for lawyers, accountants, Swiss bank accounts, and so on all increase. The shift of such resources from productive uses to uses involved in tax avoidance creates a deadweight loss that should be counted in any complete analysis of the effect of the tax.

Example 3. Monopoly power (Posner (1975). The conventional measure of deadweight loss is simply the value of the foregone output. But if monopolies can be created by the state, people will devote resources to attempting to acquire these monopolies. These resources should be counted as part of the deadweight costs of the monopoly.

In each of the cases described above there is a direct effect on welfare due to the changed production or consumption of some good, and an indirect effect on welfare due to the redirection of other resources that are used in an attempt to acquire benefits in the first market. It is easy to construct cases where the indirect effects are of major importance. Suppose, for example, that a tax is imposed on a good in fixed supply so that it creates no deadweight burden at all in a partial equilibrium view. Such a tax may however create considerable demand for tax avoidance, so that the resulting maldistribution of resources in the secondary markets could well constitute the major part of the deadweight loss.

These examples illustrate the prevalence of rent seeking and DUP phenomena. Although it is clear that the measurement of the deadweight burden of such costs is important, it is perhaps not so clear how one should proceed in practice to measure them. The analysis in the international trade literature has illustrated the burden of rent seeking in the "two-by-two" framework standard there, while the analysis in the public finance literature has been primarily of a discursive nature, coupled with some single market diagrams.

There have been some attempts to construct more detailed measurements of the cost of rent seeking and DUP activities. Bhagwati (1980) describes a complete general equilibrium model and measures the overall cost of DUP activities in Hicksian equivalent variation context. Posner (1975) attempts to measure the total deadweight loss due to a monopoly in a partial equilibrium model use tools of consumer and producer surplus. More recently, Long et. al. (1982) have attempted to measure the social benefits of antitrust enforcement using Posner's methodology.

In this paper I will attempt to provide a somewhat more formal investigation of the welfare costs of rent seeking behavior. In doing this I will formulate and analyze a very simple general equilibrium model of rent seeking behavior. My purpose in doing this is to illustrate that such phenomena can be analyzed quite easily using the standard tools of applied welfare economics. This more formal analysis can be used to examine some of the claims made concerning the social costs of rent seeking behavior.

1. A Simple Analysis

We begin by describing the conventional analysis described in Posner's (1975) paper, for example. The same general discussion can be found in several of the public choice works reprinted in Buchanan, Tollison and Tullock (1975).

Let us consider a single market in which a subsidy may be imposed. The effect of the subsidy is illustrated in Figure 1. The price paid by the demanders falls and the amount received by the suppliers rises as compared to the pre-subsidy situation. However, these benefits incurred by the producers and consumers are outweighed by the costs paid by the taxpayers in order to support the subsidy. The net deadweight loss as conventionally measured is the area BCD.

The conventional treatment of deadweight loss stops at this point. The rent seeking literature goes on to argue the following: if the subsidy offers potential benefits to some group of economic agents, they will attempt to acquire those rents. In particular they will devote resources to seeking those benefits, and these resources should be counted as part of the deadweight loss of the subsidy.

How much will this loss be? It is often argued that the area $ABCDE$ offers a measure of these "secondary" losses. For this area measures the total benefits to the recipients of the subsidy and thus serves as a measure of how much they are *willing* to spend on resources to acquire the subsidy. The total deadweight loss will therefore be the area of the rectangle $ABDE$.

It is clear that in most realistic situation, the area of the rectangle will be much larger than the area of the triangle. Hence, it is argued that the deadweight loss due to rent seeking often far outweighs the conventional welfare triangle. One of the goals of this paper is to investigate this argument. Is it really true that we can simply use the area of the rectangle or trapezoid in a single market as a proxy for deadweight loss? Or will a more complex measure be needed?

2. A Methodological Digression

We start from a simple methodological premise: there is only one correct way to do cost benefit analysis. First formulate an economic model that determines the entire list of prices and incomes in an economy. Next forecast the impact of some proposed change on this list of prices and incomes. Finally use the utility functions of the individual agents to value the pre- and post-change equilibria. The resulting list of utility changes can then be summarized in various ways and presented to decision makers.

Given the simple nature of this procedure, it is surprising how rarely it is acknowledged. But it is clear that *any* acceptable procedure for cost benefit analysis must ultimately reduce to the above procedure.

Of course simplifying assumptions can be made. We often assume that demand and supply curves takes certain forms, that certain prices will not change, and that utility functions have some special structure. All of these assumptions may be reasonable in their place, but we must, of course, demand consistency. If we assume that utility functions have a special form, then we should use demand functions that are consistent with the assumed structure of utility functions. Similarly, if we assume that certain prices do not change, we should have a model of demand and supply that implies this.

In what follows below I will illustrate such an internally consistent model. It is I believe the type of model hypothesized by many practitioners of consumer surplus analysis, and it lends itself quite readily to the analysis of rent seeking behavior. I have deliberately chosen the simplest sort of model that is capable of capturing the rent seeking phenomena, but it can easily be generalized.

3. A Simple Economy

We consider a three good economy with goods denoted by q_1, q_2, and x. The goods q_1 and q_2 are produced from the x good, which we will choose as numeraire. The consumer side of the economy is assumed to be described by a representative consumer with utility function

$$u(q_1, q_2, x) = u_1(q_1) + u_2(q_2) + x.$$

We denote the prices of goods 1 and 2 by p_1 and p_2 and the money income of the representative consumer by m. The demand functions for this sort of utility function will be of the form:

$$\begin{aligned} q_1 &= d_1(p_1) \\ q_2 &= d_2(p_2) \\ x &= m - p_1 d_1(p_1) - p_2 d_2(p_2) \end{aligned}$$

The indirect utility function will therefore have the form:

$$v(p_1, p_2, m) = v_1(p_1) + v_2(p_2) + m$$

This particular case of an additive utility function with constant marginal utility of income implies that the demand function for a good will depend only on its own price. Hence each market can be treated in isolation in the following equilibrium and welfare analysis. The complete *general equilibrium* analysis of this economy is simply a sequence of *partial equilibrium* analyses.

Turning to the production side of the economy we assume that goods 1 and 2 can be produced solely by use of the numeraire. In order to produce q_1 units of good 1 we require $c_1(q_1)$ units of the numeraire and similarly for good 2. The profit functions of the two firms are therefore given by:

$$\begin{aligned} \pi_1(p_1, p_2) &= \max_{q_1} \; p_1 q_1 - c_1(q_1) \\ \pi_2(p_1, p_2) &= \max_{q_2} \; p_2 q_2 - c_2(q_2) \end{aligned}$$

For this simple technological structure the supply curves for each good depend only on the own price. In order to compute the equilibrium price and quantity in this simple economy, we need only to draw the two demand and supply functions and note the points of intersection.

Suppose now that a specific subsidy of size σ is imposed in the market for good 1. The demand curve for good 1 shifts up by the amount of the subsidy and the equilibrium moves from (p_1^*, q_1^*) to (p_1', q_1') as illustrated in Figure 1. The price facing the demanders of the

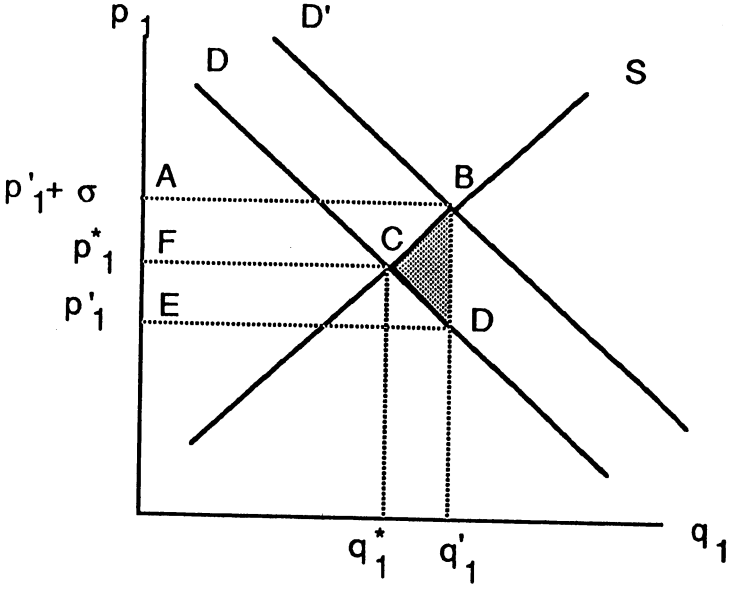

Figure 1. The welfare loss of a subsidy in the market for good 1.

good is p_1' and the price facing the suppliers is $p_1' + \sigma$. The demand and supply curves for good 2 do not move so that the equilibrium price and quantity in this market remain at (p_2^*, q_2^*). How do we compute the welfare loss associated with this change?

There are various measures that can be considered for this purpose such as the compensating variation, the equivalent variation, consumer's surplus, etc. In the constant marginal utility of income case considered here all of these measures coincide and can be viewed as simply as the change in total utility, measured in units of good x.

In order to compute this change we need to know the prices and income of the consumer in the two situations. The prices have been computed above. In order to compute the income we adopt the usual convention that the consumer receives the profits of the firms and must pay the taxes necessary to cover government expenditures. We also assume that the consumer has some initial endowment of the numeraire good, w, which he sells to the firms to use in production.

Hence the income of the consumer at each equilibrium is given by:

$$m^* = w + \pi_1(p_1^*) + \pi_2(p_2^*)$$
$$m' = w + \pi_1(p_1' + \sigma) + \pi_2(p_2^*) - \sigma q_1'$$

The change in (indirect) utility is therefore:

$$\Delta U = v_1(p_1') - v_1(p_1^*) + \pi_1(p_1' + \sigma) - \pi_1(p_1^*) - \sigma q_1'$$

This change can be given the usual diagrammatic interpretation. Since the demand function for good one is given by the derivative of the indirect utility function with respect to price 1,

$$d_1(p_1) = -\frac{\partial v_1(p_1)}{\partial p_1},$$

the fundamental theorem of calculus implies that

$$v_1(p_1') - v_1(p_1^*) = -\int_{p_1^*}^{p_1'} d_1(p_1)\,dp_1.$$

Similarly, since the supply function for good 1 is given by the derivative of the profit function, we have

$$\pi_1(p_1' + \sigma) - \pi_1(p_1^*) = \int_{p_1^*}^{p_1'+\sigma} s_1(p_1)dp_1.$$

Hence the total change in utility can be written as the usual sum of producer surplus, consumer surplus, and expenditures on the subsidy:

$$C = -\int_{p_1^*}^{p_1'} d_1(p_1)\,dp_1 + \int_{p_1^*}^{p_1'+\sigma} s_1(p_1)\,dp_1 - \sigma q_1'.$$

These integrals are depicted in Figure 1. The first term is the consumer's surplus which is given by area $FCDE$. The second term is the producer's surplus which is given by area $FCBA$. The third term is the cost of the subsidy which is given by area $ABDE$. The signed sum of these three areas is the familiar deadweight loss given by BCD. As indicated above this area measures the total change in utility resulting from the subsidy. Since utility is linear in the numeraire good we can interpret this as the amount of the numeraire good that can be taken away from the consumer in the initial situation in order to leave him at the same level of utility he would achieve at the final situation.

All of the above analysis has been quite standard, if a bit more carefully described than usual. And of course we have ended up with the usual result. Let us now turn the point of this paper, namely the measurement of the additional distortions that are created by rent seeking behavior.

We note that the firm and the consumer have benefited from the subsidy by the amounts given by the sum of the consumer and producer surpluses. The taxpayer has lost by the amount of the subsidy. (We adopt the usual convention of distinguishing the three roles of the representative consumer.) The fact that there are private gains to be had from the subsidy may induce the producers and consumers to spend resources in an attempt to acquire these gains.

We suppose that the subsidy level σ can be acquired by purchasing Σ units of good 2. For now we will think of this as an all or nothing decision; it is not difficult to extend the analysis to the case where different amounts of the subsidy can be purchase by different amounts of expenditure but little new is gained. I describe this case briefly in Appendix I.

The interpretation of this rent seeking is of the sort mentioned in the introduction. One can think of Σ as expenditures on goods which can be used in a lobbying effort to acquire the subsidy. The important fact is that these expenditures may change the price and quantity of good 2 that remains for consumption purposes.

Let us now derive the demand for lobbying expenditures on good 2. This demand will depend on how well the beneficiaries of the subsidy manage to cooperate in furthering their interests. If all the beneficiaries manage to cooperate fully then they will be willing to

spend up to the total benefit they would get from the subsidy, namely the sum of producer and consumer surplus, $CS + PS$. In this case the rent seeking demand for good 2 can be written as:

$$D_2^r = \begin{cases} \Sigma & \text{if } CS + PS > p_2\Sigma \\ 0 & \text{otherwise} \end{cases}$$

To get the total demand for good 2 we add this rent seeking demand to the original demand curve. Diagrammatically, this is just a horizontal shift to the right by Σ units at all prices below some critical value $p_2'' = (CS + PS)/\Sigma$, as depicted in Figure 2. This has the effect of pushing the price for good 2 up to p_2' and the total quantity sold up to q_2'. Of this amount Σ is the demand for good 2 for rent seeking purposes and $q_2' - \Sigma$ is the amount that is left for consumption by the representative consumer.

Notice that the total *willingness* to pay for good 2 used in rent seeking is equal to the sum of the consumer's surplus and the producer's surplus. But how much the consumers and producers *actually have* to pay will depend on the *supply* conditions in the second market. Thus the sum of the consumers' and producers' surpluses will serve only as an *upper bound* to the deadweight loss from rent seeking. This is our first reason why the rectangle in the market for good 1 provides an inappropriate measure of total deadweight loss.[1]

It is worth considering what might happen if the beneficiaries of the subsidy can not succeed in cooperating sufficiently in order to purchase the subsidy. For example, it may be that only the producers are able to collude and organize an interest group that lobbies for the subsidy. In this case the demand curve for the rent seeking activity would be

$$D_2^r = \begin{cases} \Sigma & \text{if } PS > p_2\Sigma \\ 0 & \text{otherwise} \end{cases}$$

In this case good 2 will be demanded for rent seeking purposes only when the equilibrium price in market 2 was less that PS/Σ.

In many circumstances we would expect the potential producer surplus to be the primary determinant of rent seeking expenditures. This analysis suggests that constant cost/free entry industries would not tend to engage in lobbying (since the expenditures could not be recaptured in increased profits) while industries with restricted entry would find it profitable to lobby for subsidies due the profits such subsidies would generate. The prevalence of subsidies for agricultural products seems to support this observation.

But even if we suppose that only producers will be interested in lobbying for a subsidy, there is still some question as to whether they will actually succeed in forming a viable political coalition. If the industry is composed of many independent producers then they

[1] Franklin Fisher (1985), has independently made the same observation in a critique of Posner's article. Of course, one could *assume* that the good used in rent-seeking is produced by a constant returns to scale industry and thus can be supplied in arbitrarily large amounts at a constant price. However, this assumption is not a reasonable one in this context. For one thing, a natural candidate for good 2 is labor by lobbyists. In the short-run this would certainly be upward sloping. Even in the long-run it is plausible to suppose an upward sloping supply function, if one believes that lobbying involves scarce talents or skills. Fisher (1985) gives several other arguments why the sensible assumption is that of an upward sloping supply curve. In any event, it is surely worthwhile to examine the general case of an upward sloping supply curve for good 2 simply because it subsumes a perfectly elastic supply curve as a special case.

each might attempt to free ride on the lobbying effort of a producer organization. Hence an inefficient amount of effort (from the viewpoint of the producers!) would be devoted to seeking the subsidy. This sort of phenomena has been pointed out by Browning (1974) and Brock and Magee (1978); it gives us our second reason why the rectangle in market one will overstate the true losses due to rent seeking. In Appendix II, I argue in the context of a simple model that free riding on industrial lobbying may be quite severe.

However, let us leave these issues for now and conduct the welfare analysis under the maintained hypothesis that the relevant coalition forms and "purchases" a sufficient amount of good 2 to acquire the subsidy. The incomes of the consumer at the two equilibria are:

$$m^* = w + \pi_1(p_1^*) + \pi_2(p_2^*)$$
$$m' = w + \pi_1(p_1' + \sigma) + \pi_2(p_2') - \sigma q_1' - \Sigma p_2'$$

The last two terms in the second expression are the payment of the subsidy and the expenditure on rent seeking respectively, which of course are subtracted from income.

The consumer and producer surpluses in the first market are the same as given previously. The change in the consumer and producer surpluses in the second market are given by:

$$\Delta CS + \Delta PS = -\int_{p_2^*}^{p_2'} d_2(p_2)\, dp_2 + \int_{p_2^*}^{p_2'} s_2(p_2)\, dp_1$$

The net sum of these two areas is given by the triangle ABC in Figure 2. The final expression for the overall change in utility is given by:

$$C = v_1(p_1') - v_1(p_1^*) + \pi_1(p_1' + \sigma) - \pi_1(p_1^*) - v_2(p_2') + v_2(p_2^*) + \pi_2(p_2') - \pi_2(p_2^*) - \sigma q_1' - \Sigma p_2'$$

The first eight terms are the consumer and producer surpluses which have already been considered. The ninth term is the tax paid to cover the subsidy. The last term is the amount spent for the rent seeking activities.

As before these amounts can be represented by various consumer and producer surplus areas. The total deadweight loss is thus the area BCD in Figure 1 *plus* the area $ACBDE$ given in Figure 2. Let us verify that the area in Figure 2 is correct.

The price of the good in market 2 rises from p_2^* to p_2' and the consumption of good 2 is reduced from C to A. Thus the loss in consumer surplus is given by $FCBG$. On the other hand the producers of good 2 gain some producer surplus in the amount $FCBA$. Hence the net change in consumer plus producer surplus in market 2 is the area ABC. From this amount we must subtract the total expenditures on good 2, which by assumption represent a pure social cost. The net result is the area $ACBDE$, as claimed.

Note that the deadweight loss due to the expenditures on rent seeking are offset to some degree by the net gain in producer surplus in the secondary market, since the increase in demand for the goods used in rent seeking will benefit the producers of those goods. The deadweight loss in market 2 due to rent seeking is neither a rectangle nor a triangle, but a fishtail! This is the third reason why the rectangle is an inappropriate measure.

A special case is depicted in Figure 3. Here the services of the rent seeking activity are supplied at constant average cost so that there is no loss of consumer and producer surplus

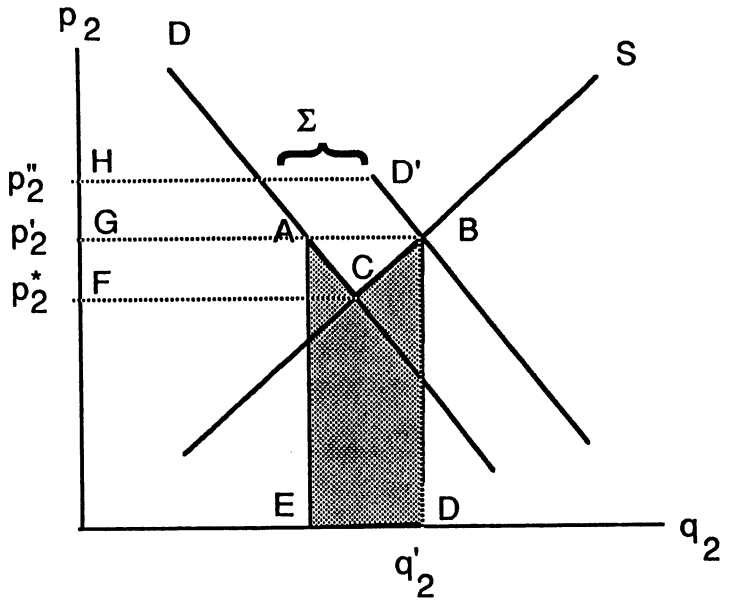

Figure 2. Cost of rent seeking in market 2.

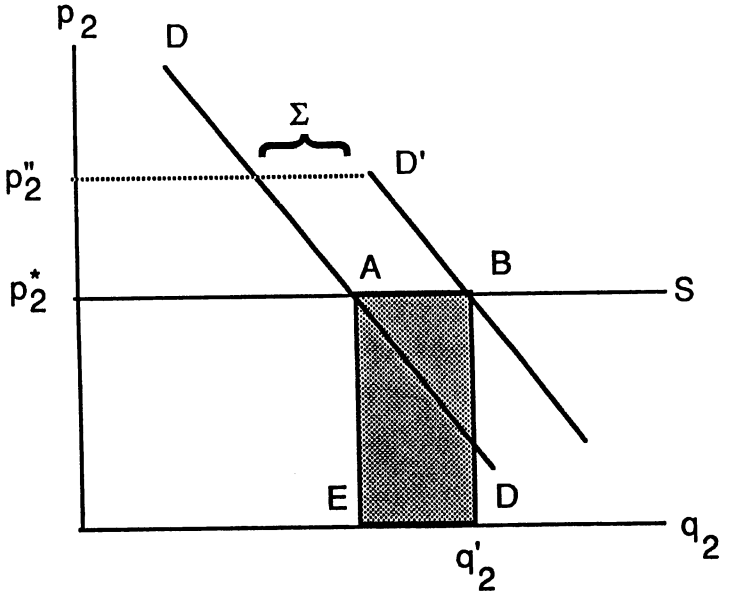

Figure 3. A special case of rent seeking in market 2 with constant marginal costs.

in the second market. The only loss is that of the expenditures on the rent seeking activity itself. Even in this case the Posner measure of the rent seeking costs, $p_2''\Sigma$, is much larger than the true measure $ABDE$.

Bhagwati and Srinivasan (1980) and Bhagwati (1980), (1982) have shown that in the

context of a full general equilibrium model it is possible that the social costs of rent seeking, or more general DUP activities, can even be negative, when measured relative to the distorted equilibrium without rent seeking. As Bhagwati (1980) has emphasized, analysis of DUP activities involves cost-benefit analysis in an inherently second-best context and one must necessarily face up to the possibility of counter-intuitive results in this context. The Bhagwati and Srinivasan "paradox" cannot arise in the simple model specified here, although it is not difficult to modify the model so that it can arise. However, there can easily be pre-existing distortions in either market that may be amplified or mitigated by the rent seeking activity, so the analysis must be done with some care.

In these calculations I have followed the standard practice of treating all benefits and costs with the same weight. If the rent seeking activity is illegal, or otherwise socially undesirable, it may be that we would want to count the producer or consumer surplus from these activities differently from the legitimate activities given by good 1. If the weighting is specified it is simple to make this slight change in the analysis. However in practical cases when the rent seeking activity involves activities such as theft, bribery, and other sorts of corruption, such a weighting may be important, which provides a fifth reason for a general equilibrium analysis.

4. When Can We Use a Single Market Analysis?

In certain cases the above calculations can be reduced to an examination of only one market. There are two situations of interest. The first is where the rent seeking expenditures reduce to pure transfers. Bribes are a case in point. Here the seekers of rent can simply transfer an appropriate amount of some good to the authorities who can determine the subsidy, and thus ensure its imposition.

This, of course, involves no social costs at all since it is a pure transfer payment. Thus the entire deadweight loss of the subsidy will be measured by the usual triangle in the first market. Of course in many situations the payments for acquisition of subsidies, monopolies and the like are partially direct transfers and partially the "transactions costs" that are counted as rent seeking costs. Only the transactions cost component should be counted as part of the social loss, which gives us a sixth reason why the rectangle in market one overstates the social cost of rent seeking.

In terms of the algebra used in section 3 we might decompose the demand for goods used in rent seeking, Σ, into the part used as transfers, T, and the part expended in "transactions cost", C. The transfer component is not part of the social cost, but the transactions cost is. For a concrete illustration one might imagine the following story. Suppose that you can acquire a subsidy if you take enough Congressmen to enough lunches. Then the deadweight cost of this rent seeking activity is not the cost of the lunches, but the *difference* between how much the Congressmen value the lunches and how much the lunches cost the lobbyist. This is the true "transactions cost" in rent seeking.

The second case that is of interest is the case that seems to be implicitly assumed in much of the literature, namely the case where the *providers* of the rent are monopolists. We have assumed above that an expenditure of a certain amount of resources is sufficient to acquire the subsidy in question. But how much is needed may be determined endogenously.

Suppose, for example, that we consider the Posner case where a monopoly is to auc-

tioned off to the highest bidder. Then the winner of this auction would be willing to pay up to the present value of the stream of profits that the monopoly provides. Competition among the bidders for the rent would eliminate the gains from the rent seeking activity.

However, this will still be an overestimate of the *social* costs of the monopoly for two reasons. First, there may be some effect on the price of the good 2 and thus some effect on the original consumers and producers in the market for good 2, as discussed earlier. If the demand for restaurant meals goes up due to the demand by lobbyists, then the owners of the restaurants will earn some producer's surplus. The only case where these gains can be neglected is if the supply of good 2 is infinitely elastic so that there is no effect on either profits or price in this market.

Secondly, and more importantly, the supposed behavior of the rent provider is rather peculiar. For the amount that is spent on good 2 is not of great interest to the provider of the rent; presumably he is much more interested in the benefits that accrue to him! Insofar as some benefits are transferred directly to him, these do not count as part of deadweight loss and the area of the "transactions cost" rectangle is correspondingly reduced.

5. Summary

The true social costs of rent seeking depends on the technological characteristics of the production function for rents, as well as the nature of the competition involved in acquiring rents. Once this production function has been specified clearly, and the game among the parties has been clearly described, it is possible to solve for the equilibria with and without rent seeking and to use the standard tools of welfare analysis to measure the social costs of rent seeking.[2]

Our discussion has been conducted using the framework of a simple consumer surplus world, in order to maintain contact with the existing literature, but the methods can easily be extended to a framework involving more general types of utility functions and welfare measures.

Along the way we have examined the claim that the rectangle measuring rents in a single market may be a good approximation to the total deadweight loss due to rent seeking activities. We have found that this is unlikely to be the case except in very special circumstances for several reasons.

(1) The rent rectangle measures the amount that the beneficiaries are willing to pay for the rent, but the supply conditions for the rent are also needed to compute the total deadweight loss.

(2) Free rider problems may prevent the seekers of rent from expending the appropriate amount of resources in order to acquire the rent.

(3) If prices are changed in the secondary markets, there will be changes in the demand and supplies of the secondary factors that must be accounted for.

(4) There may be existing distortions in the secondary markets that are mitigated (or amplified) by the rent seeking distortion.

[2] Some recent papers that focus on the strategic issues of competition for rents are Rogerson (1982), Fudenberg and Tirole (1987), and Hillman and Riley (1987).

(5) The distributional considerations as to who pays and who receives the rents may be of considerable importance in many practical problems.

(6) Some part of the total demand for resources used in rent seeking may involve direct transfers to the providers of the services needed. Such transfers do not directly generate deadweight loss.

Appendix I. *Analysis with variable degrees of rent seeking*

In the text we analyzed a situation where the rent seeking behavior was an "all-or-nothing" proposition. Here we will examine briefly the case where various degrees of rent seeking behavior are possible. Since we argued earlier that the analysis of rent seeking behavior could be conducted using standard general equilibrium benefit cost analysis, it is not surprising that the same holds true in the more general case considered here.

Let us adopt the model of the text with one change. Now we suppose that a subsidy of size $\sigma(q_2)$ can be obtained by the purchase of q_2 units of good 2. The function $\sigma(q_2)$ is a kind of production function relating the input, q_2, to the output, σ. We will also suppose that the firm is the only rent seeker, and that any benefits accruing to the consumers from the subsidy are ignored by the firm. (There is no difficulty in relaxing this assumption.)

The problem facing the firm is then to maximize its profits:

$$\pi(p_1, p_2) = \max_{q_1, q_2} (p + \sigma(q_2))q_1 - c_1(q_1) - p_2 q_2$$

The solution to this problem generates a standard supply function of output $q_1(p_1, p_2)$ and a slightly nonstandard factor demand function $q_2(p_1, p_2)$. But from the viewpoint of pure theory this demand function has all the usual properties of a factor demand function. In particular, it satisfies Hotelling's lemma:

$$q_2(p_1, p_2) = -\frac{\partial \pi(p_1, p_2)}{\partial p_2}$$

This in turn implies that the fundamental theorem of calculus can be used to recover the change in profits between any two prices (p_1^*, p_2^*) and (p_1', p_2') by computing the line integral:

$$\pi(p_1', p_2') - \pi(p_1^*, p_2^*) = -\int_{p_1^*}^{p_1'} q_1(p_1, p_2^*)dp_1 - \int_{p_2^*}^{p_2'} q_2(p_1', p_2)dp_2$$

These two facts are sufficient to complete the standard program of cost benefit analysis outlined in the text. We simply add up the total demand for good 2 and use this aggregate demand curve to compute the equilibrium prices in market 2. Given the before and after prices for the two goods, it is simple to integrate the demand and supply curves to find the change in utility and profits and thus compute the total deadweight loss from the subsidy and the accompanying rent seeking.

Appendix II. *Free riding in lobbying activities*

It is not commonly recognized just how severe the free-rider problem can be in lobbying activities. In this appendix I illustrate that in the most straightforward model that one can write down, only the largest firm in an industry will engage in lobbying![3]

Suppose that we consider an industry with firms that are competitive as far as price setting goes, but can possibly collude to form a lobbying group to enact a subsidy. Each firm i in the industry can make a monetary contribution z_i to such a lobby, and the total contributions will be denoted by $Z = \sum_{i=1}^{n} z_i$, where n indicates the total number of firms.

As in Appendix I, let $\sigma(Z)$ measure the size of the subsidy that can be purchased with Z dollars of contributions. The profit maximization problem of firm i is

$$\max_{q_{i1}, z_i} (p_1 + \sigma(Z))q_{i1} - c_{i1}(q_{i1}) - z_i.$$

Thus, firm i must make both a production decision, q_{i1}, and a lobbying decision z_i. We seek a Nash equilibrium in contributions for this model.

Assume that $\sigma(Z)$ is a strictly increasing, strictly concave function. Then an *interior* solution for contributions by firm i must satisfy the first order condition

$$\sigma'(Z) = 1/q_{i1}.$$

If the production levels of the firms — the q_i's — are different, it follows that only the largest firm will contribute to the lobbying effort in the Nash equilibrium. Thus in this model there is extreme free riding — all of the firms in the industry will free ride on the lobbying efforts of the largest firm.

The lesson of the model is not that there is no lobbying in the real world, but rather that firms that do succeed in lobbying for industry subsidies do not behave as Nash competitors. They apparently have found ways to get around the free rider problem and to enforce contributions which benefit the industry as a whole.

[3] Mancur Olson (1965) and several other authors have examined this kind of strong free-rider result. For a brief survey of this literature and a formal analysis of private provision of public goods, see Bergstrom, Blume and Varian (1986).

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