UNIVERSITY OF OSLO

HEALTH ECONOMICS RESEARCH PROGRAMME

Budget deficits as devices for appropriating extra funds:

An investigation of sharing rules

Sverre Grepperud

Centre for Health Administration
University of Oslo

Working Paper 2002: 11

Budget deficits as devices for appropriating extra funds:

An investigation of sharing rules*

by Sverre Grepperud

May 2002

Health Economics Research programme at the University of Oslo
HERO 2002

* I am grateful to Derek Clarke, Kjeld Møller Pedersen, Michael Hoel, Tor Iversen and Pål Andreas Pedersen for very helpful suggestions.

Author: Sverre Grepperud, Center for Health Administration, Rikshospitalet, 0027 Oslo, Norway
E-mail: sverre.grepperud@samfunnsmed.uio.no

Keywords: Budget deficits, bailouts, appropriating activities.
JEL – Classification: D29, I18, H72.

Health Economics Research programme at the University of Oslo
Financial support from The Research Council of Norway is acknowledged.
ISSN 1501-9071, ISBN 82-7756-091-5

Abstract:
This paper considers a model with a sponsor and several bureaus to analyse the role of sharing rules. Various incentives for budget overspending are identified among them the overspending of budgets due to soft budget constraints. Four different sharing rules are also considered that differ with respect to their strategic properties and whether the share is exogenous or endogenous. The results show that sharing on the basis of egalitarian principles yields a lower budget deficit than sharing based upon relative deficits both in symmetric and asymmetric games. The ranking of deficits that follow from sharing based upon relative budgets and sharing that equalises ex-post debt ratios is shown to depend on the properties of the health production function.

1. INTRODUCTION

Public and private bureaus conduct decentralised spending while being centrally financed by a sponsor that who repeatedly transfers a given amount of resources (budget-periods). The (planned) budget reflects the sponsor's willingness to pay for the services provided relative to costs, and budget revisions occur over time in response to changes in sponsor priorities or costs. However, bureaus themselves may also influence budgets (see e.g. Niskanen, 1971). Bureaus have information on costs and returns that in principle can be truthfully reported in order to aid sponsors in defining optimal budgets. Another possibility is to use sponsor-bureau information asymmetries strategically when interests are conflicting (see e.g. Moene, 1986 and Chan and Mestelman, 1988). Bureaus may also invest resources to influence decision makers (rent seeking and lobbying) to increase budgets. In this paper the focus is one type of such an activity - the campaigning for extra funding by overspending budgets.

Deviations between budgets (planned resource use) and actual resource use can be the result of stochastic events outside the influence of the bureau, but also follow from insufficient management control. In some cases, however, deficits seem to be pervasive phenomena that cannot be fully understood by the above explanations. Rather, deficits arise because of moral hazard behaviour trying to appropriate resources beyond those already allocated ex-ante in terms of a fixed budget. In this perspective, the fundamental reason for budget deficits appears to be the bureau's expectations that the sponsor will bail-out. A sponsor's inability to commit to (planned) budgets can follow from weak political leadership induced by lacking majority control or ideological differences within ruling coalitions. In the literature, soft budget constraints are discussed in relation to state-owned enterprises (firms) and the banking sector (see e.g. Kornai, 1986). Dewatripoint and Maskin (1995) and Qian and Roland (1998) attribute the occurrences of extra funds to the time-inconsistency problem. Sponsors choose not to commit since bailing-out becomes preferable at later dates. In this perspective, soft budget constraints becomes a policy for reaching a socially optimal outcome. Dalen et al., (2001), on the other hand, assume that governments have private information on the consequences of sticking to hard budget constraints. Here, a uniformed electorate is the reason for why governments choose not to commit to fixed budgets.

Public health care, at least in Norway, appears to be a sector characterised by soft budget constraints. Hospital budget deficits and subsequent sponsor bailouts are both pervasive and significant. Magnussen (2000) reports that actual resource use for 18 Norwegian hospitals exceeded their global budget by 4.5% (1997), 7% (1998) and 10% (1999)[1] in a three-year period. However, the

[1] Applying information on initial budgets to estimate deficits is associated with both uncertainty and biases (see Bjørnenak et al., (2000) for more on this issue). One example is that some expenses, being expected and already agreed upon, are not necessarily parts of the initial budget e.g. real wage adjustments for hospital employees.

remuneration system changed in 1997 from being one based upon block grants to partly activity based financing. This reform may in itself have introduced sufficient uncertainty to cause such deficits. However, other studies analysing the situation under the former remuneration system, also found deficits to be frequent as well as significant. One example is Pettersen (1995) who presents data on budgets and accounts for the Norwegian hospital sector for the period 1989-1991. From these data, the global (national) deficit can be estimated by calculating the difference between total actual budgets and total planned (initial) budgets relative to the planned (initial) budget; this yields the following results; 7% (1989), 11.6% (1990) and 12,7% (1991).[2] An accounting study referred to in Carlsen (1995), studying a single regional hospital (RiT[3]), identified more than 2% overspending of hospital department budgets in 45% of the cases during a 4-year period (1986-89).

Table 1: **Global budgets and actuals for 7 hospitals in the county of Nordland, Norway (1991-1997). Million NOK[a] (1997).**

	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Initial (planned) budget (IB)	1095.5	1147.0	1167.3	1218.4	1183.3	1268.0	1278.7
Adjusted Budget (AB)	1193.9	1230.9	1267.5	1257.8	1314.6	1374.8	1398.2
Actual Budget (A)	1231.2	1268.8	1356.7	1349.8	1377.8	1421.2	1493.1
α = *(A-IB)/IB*	12.4%	10.6%	16.2%	10.8%	16.4%	12.1%	16.8%
β = *(AB-IB)/(A-IB)*	72.5%	68.8%	52.9%	30.0%	67.5%	69.7%	55.7%

[a)] NOK = Norwegian kroner. 1$ = 9 NOK (2001)
Source: Pettersen (2000).

Supplementary grants from sponsors to Norwegian hospitals have also occurred. During the last two years about 1.80 billion NOK (2001), 1.75 billion[4] NOK (2000) and 800 million NOK (1999) have been provided by the central government to this sector.[5] More dis-aggregated data are scarce, however, a study by Pettersen (2000) for a county (Nordland) with 7 hospitals do provide some information. Here data on planned (initial) budgets, adjusted budgets and actual budgets are available for a 7-year time period. From Table 1, a systematic gap is observed over time between planned (initial) and actual budgets. If α in Table 1 is interpreted as a proxy for the budget deficit as a share of the planned (initial) budget it follows that deficits constitute from 10% to 17% of the planned budget with an average of 13.6%. If β is interpreted as the degree of bailing-out, it follows from Table 1 that the degree of compensation for the 7 hospitals was between 30,3% to 72.5% with an average close to 60%. Carlsen (1995), analysing one regional hospitals (RiT) in the period 1987-1992, found budget

[2] Data were collected by National Institute of Public Health (1992) and SINTEF NIS (1993).
[3] Regionsykehuset i Trondheim
[4] The central government first suggested additional funds for year 2000 amounting to 1,25 bill. NOK, however, the parliament granted an additional 500 mill. NOK.
[5] This figures follow from personal communication with the Ministry of Health.

deficits as well as extra central government funding, which amounted annually to more than 100 million NOK.

There are several reasons for why supplementary grants are common in the Norwegian hospital sector. First, health care is a large sector that produces an essential service; this makes it a major issue in national politics. Second, potential health gains from investing additional resources in this sector can more easily be linked to identifiable individuals than is the case for competing activities where gains relate to statistical benefits (e.g. traffic safety measures). Third, health care is a sector very much characterised by equality concerns, both socially and geographically, in that uniform services are to be provided. Disruptions, in terms of sticking to hard budget constraints, may generate political costs in terms of voter dissatisfaction. This is especially so in a situation where excess demand is easily observed through media focus, but also because of former government commitments such as the establishment of legal rights to treatment within a certain time period. A central government that abstains from bailing out faces the risk of being considered unable to handle crucial welfare issues, while those who do intervene appear strong.

The purpose of this paper is to analyse the strategic incentives of bureaus when budget deficits themselves are portrayed as appropriating activities. In particular, the focus is on the role of sharing rules and whether the number of bureaus and bureau size asymmetry affect the various equilibria. The institutional setting chosen in this analysis is one with multiple bureaus (hospitals) having a common interest in aggregate extra funds from a single sponsor, while at the same time competing for shares. In section 2 we present the model and derives symmetric equilibria outcomes for two different sharing rules - sharing based upon relative deficits and egalitarian sharing – assuming Nash behaviour. In section 3, the focus is on budget size asymmetry and the analysis is now restricted to two bureaus. First, the two sharing rules already analysed in section 2 are considered, then two additional ones are analysed – sharing based upon relative size and sharing that equalises ex-post debt-activity ratios. Section 4 concludes.

2. SYMMETRIC EQUILIBRIA FOR A MIXED SHARING RULE.

In the following we present a two-period model with multiple bureaus each receiving known transfers from the sponsor. The budget deficit is the decision variable in the model and is assumed to reflect real budget overspending in the sense that deficits are not the outcome of creative budgeting or accounting manipulation (hidden savings). Furthermore, we do not consider possible devices sponsors may have to penalize budget overspending such as investigations, auditing or managerial replacement as well as moral costs that may go with bureau strategic behaviour.

Consider a model where the bureau's strictly concave production function in period j = 1,2 is as follows;

$$H_j^i = F(R_j^i) \qquad i = 1......n; \quad j = 1, 2. \tag{1}$$

In the context of the hospital sector, H_j^i can be interpreted as the health gains obtained for bureau i in period j as function of resource spending, R_j^i, in the same period. Thus, we have a single output production function where resources are invested efficiently. Period 1 resources may come from two different sources; i) the (planned) budget determined by the sponsor in this period, b_1^i, and ii) by overspending the (planned) budget, d, in the following denoted as the budget deficit. As in period 1 the bureau receives a known and fixed budget in period 2, b_2^i, however, since only two periods are considered, having a deficit in period 2 is not possible and the deficit in period 1 must be covered by the period 2 budget. Any debt service costs (interest payments and instalments) are ignored.

Consider now an exogenous number of bureaus, n, each being confronted with the following beliefs about it's compensation function;;

$$s^{i,mr} = \left(a\frac{d^i}{D} + (1-a)\frac{1}{n} \right) rD \quad where \quad D = \sum_i d^i \quad and \quad i = 1.....n \tag{2}$$

where D is the global (aggregate) deficits and $0 \le r \le 1$ is the exogenous fraction of the global deficit which is to be shared among the participating bureaus (the degree of liability).[6] It follows from (2) that a deterministic and positive relationship is assumed between the size of the deficit for bureau i, d^i, and sponsor compensation to bureau i, $s^{i,mr}$. The parenthesis in (2) defines a mixed sharing rule (*mr*) where the magnitude of the parameter a determines the relative weight of the two sharing rules where $0 \le a \le 1$.[7] For $a = 0$ each bureau receives 1/n of the global compensation, rD, while for $a = 1$ each bureau i receives a share equal to d^i / D. Consequently, the mixed sharing presented in (2) is a weighted average of an egalitarian principle (*e*) and sharing according to relative deficits (*rd*), where the global compensation function is approximated by a linear function in global deficits. It follows from our specification that we have a compensation function with public goods characteristics due to the presence of rD in (2), while the sharing itself introduces negative externalities via the number of

6 A strictly concave global compensation function is not obvious since bailouts may respond to a "too big to ignore" mechanism.
7 The mixed sharing rule is formerly applied in collective-group rent-seeking models (see e.g. Nitzan, 1991 and Lee, 1995)

bureaus, n, as well as the global deficit, D. Furthermore the model is not concerned with explaining why governments bailout but assumes a non-strategic sponsor where the sharing rule is known prior to the decisions made by the bureaus e.g due to earlier experiences.[8] The time additive utility function for bureau i is assumed to be of the following type;

$$V^i = H_1^i + \delta H_2^i \tag{3}$$

where V^i is utility of bureau i, δ is the discount factor where $0 < \delta \leq 1$, while H_1^i and H_2^i are health care production for bureau i in period 1 and period 2, respectively.[9] It follows from (3) that neither bureau activity (size) nor bureaucratic slack appear as independent arguments in the bureau utility function (see e.g. Niskanen (1971) and Moene (1986)). By using (1) , (2) and (3), the maximisation problem of bureau i can be presented as follows;

$$\underset{d^i}{Max} \quad V^i = F\,(b_1^i + d^i) + \delta F\left(b_2^i - d^i + \left[a\, d^i/D + (1-a)(1/n)\right] rD\right) \qquad \text{i = 1…..n} \tag{4}$$

where b_j^i is the (planned) budget for bureau i in period j and where we have utilised that $R_1^i = b_1^i + d^i$ and $R_2^i = b_2^i - d^i + s^i$.

Each bureau is now assumed to employ a Nash strategy, which implies that each player, when determining it's deficit, takes all other players' deficits as given. Now, maximising (4) w.r.t. d^i , we arrive at the following optimality conditions given interior solutions;[10]

$$\frac{\partial V^{i,mr}}{\partial d^i} = \frac{\partial F(R_1^i)}{\partial d^i} - \left[1 - r(a + \frac{1-a}{n})\right] \delta \frac{\partial F(R_2^i)}{\partial d^i} = 0 \qquad \text{i =1….n} \tag{5}$$

which determines the optimal budget deficit for bureau i. It follows from (5) that the marginal increase in health production from additional resources in period 1 is to be balanced against the discounted marginal production loss following from less resources being available in following period. The term in parenthesis determines the marginal net loss in available period 2 resources and depends upon a, r

[8] A simple stochastic formulation would be to introduce probabilities for sponsor compensation and absent compensation. However, the case with complete bureau accountability (absent compensation) can still be analysed within our framework by setting *r* = 0.
[9] Throughout the paper we keep the discount factors equal across bureaus.
[10] An interior solution is reached by assuming that the health production function is essential in resource spending.

and n and equals *(1-r)* for $a = 1$ (relative deficit) while it equals *(1-r/n)* for $a = 0$ (the egalitarian rule).

The second order condition for the problem described in (4) is;

$$\frac{\partial^2 V^{i,mr}}{\partial d^i \partial d^i} = \frac{\partial^2 F(R_1^i)}{\partial d^i \partial d^i} - \left[1 - r(a + \frac{1-a}{n})\right]^2 \delta \frac{\partial^2 F(R_2^i)}{\partial d^i \partial d^i} < 0 \qquad \text{i =1....n} \qquad (6)$$

which is fulfilled given our former assumption about the health production function.

In the following we will consider the symmetric Nash equilibrium which implies that all bureaus have identical budgets in each period; $b_1^1 = ... = b_1^n = b^1$ and $b_2^1 = .. = b_2^n = b^2$. The symmetric equilibrium outcomes for a representative bureau can now be described by the following expression;

$$MS_{1,2}^{mr} \equiv \frac{\dfrac{\partial F(b^1 + d)}{\partial d}}{\dfrac{\partial F(b^2 - d(1-r))}{\partial d}} = \left[1 - r(a + \frac{1-a}{n})\right]\delta \equiv Q^{mr} \qquad (7)$$

The expression on the left side is the marginal technical rate of substitution ($MS_{1,2}^{mr}$) between the two periods, while the constant Q^{mr} is the discounted net marginal loss of resources in the final period which is positive and less or equal to 1. Not surprisingly it follows from (7) the size of *r* has an positive impact on the equilibrium value. A higher value of *r*, ceteris paribus, lowers both the denominator on the left hand and Q^{mr}, consequently *d* must be higher. The higher the share of global deficits that is being compensated by the sponsor, *r*, the higher the deficit for the representative bureau. Thus limited liability acts as an incentive for bureaus to overspend budgets.

The same expression (see 7) can also be applied to analyse the situation with complete bureau liability in that the sponsor does not bailout for any positive deficit. By assuming no discounting, δ = 1, and hard budget constraints ($r = 0$), Q^{mr} equals 1 (see 7), and the following condition now describes the equilibrium value for a representative bureau;

$$\frac{b^1 + d}{b^2 - d(1-r)} = 1 \quad \Rightarrow \quad d = \frac{b^2 - b^1}{2} \qquad (8)$$

It follows from (8) that a necessary condition for a positive deficit to occur for a representative bureau is that the (planned) budget in period 2 is higher than the period 1 budget. The optimal resource allocation is to share the expected budget increase equally across both periods given absent discounting. Consequently a balanced budgeting in this perspective turns out to be inflexible even for a situation where extra grants from the sponsor are not provided in response to budget deficits. Furthermore, it is straightforward to show that the higher the degree of bureau impatience (lower δ) the stronger the incentives to overspend budgets. A $\delta<1$ implies a positive deficit even for the case where $b^2 = b^1$. A future technology improvement (a time invariant production technology) will induce an effect opposite of higher discounting creating an incentive for period 1 saving (disincentive for overspending budgets). Hence, we have identified four separate incentives for optimal budget deficits; time discounting, expectations about future budget increases, changes in technology over time, as well as soft budget constraints.

Now, we return to the case with soft budget constraints (limited bureau liability) where sponsor compensation is assumed to be provided with certainty (r > 0). Now, by letting $a = 0$ and $a = 1$, the following equilibria are derived for the egalitarian sharing rule (*e*) and sharing based upon relative deficits (*rd*), respectively;

$$MS^{e}_{1,2} \equiv \frac{\dfrac{\partial F(b^1 + d^e)}{\partial d^e}}{\dfrac{\partial F(b^2 - d^e(1-r))}{\partial d^e}} = \left[1 - \frac{r}{n}\right]\delta \equiv Q^e \qquad (9)$$

$$MS^{rd}_{1,2} \equiv \frac{\dfrac{\partial F(b^1 + d^{rd})}{\partial d^{rd}}}{\dfrac{\partial F(b^2 - d^{rd}(1-r))}{\partial d^{rd}}} = \left[1 - r\right]\delta \equiv Q^{rd} \qquad (10)$$

It is observed from (9) that the number of bureaus has an impact on the equilibrium value for the egalitarian sharing rule ($a = 1$), since Q^e increase with *n*, thus inducing a lower deficit in equilibrium for each bureau. However, the overall effect from a change in the number of bureaus on the global deficit remains indeterminate since two opposing effects are at work for this sharing rule. First, each "incumbent" bureau prefers a lower deficit for a higher number of bureaus. Second, an extra bureau, ceteris paribus, represents an addition to the global deficit. From (10) it follows that the optimal bureau deficit remains independent of the number of bureaus for sharing based upon relative deficit. An additional bureau does not influence the strategic behaviour of other bureaus, consequently the global equilibrium deficit increases with the number of bureaus. This result may appear somewhat surprising but is a direct consequence of the public good effect and the negative externality effect cancelling each other out for this sharing rule. Each bureau can be said to undertake budget decisions independently of each other.[11] In contrast to the case of sharing based upon relative deficit, a free-rider effect is introduced for egalitarian sharing, in that each bureau does not keep the entire increment of their own effort. Finally, by comparing the equilibrium levels for the two sharing rules in (9) and (10) it follows that $d^{rd} > d^{e}$ $for\ n > 1 \quad \Rightarrow D^{rd} > D^{e}$. Thus, substantial gains, in terms of a lower symmetric global deficit equilibrium, can be reached if the sponsor is able to pre-commit to an egalitarian sharing rule rather than the one based on relative deficit.[12]

A possible sponsor reform could be to change the number of bureaus in the sector while keeping the global budget constant (concentration or fragmentation). To analyse the marginal effect from such a structural reform, assume that the budgets in both periods are equal, $b^1 = b^2 = b$, which implies that $nb = \overline{B}$ where $\overline{B}$ is a fixed value of the global budget; The following two expressions can now be derived;

$$\frac{\partial D^{rd}}{\partial n /_{nb=\overline{B}}} = d^{rd} + n\frac{\partial d^{rd}}{\partial n} = d^{rd} + \frac{b\dfrac{\partial^2 V}{\partial d^{rd}\partial b}}{\dfrac{\partial^2 V}{\partial d^{rd}\partial^{rd}}} \tag{11}$$

$$\frac{\partial D^{e}}{\partial n /_{nb=\overline{B}}} = d^{e} + n\frac{\partial d^{e}}{\partial n} = d^{e} + \frac{b\dfrac{\partial^2 V}{\partial d^{e}\partial b} + \dfrac{1}{n}\delta\dfrac{\partial F(.,.)}{\partial d^{e}}}{\dfrac{\partial^2 V}{\partial d^{e}\partial^{e}}} \tag{12}$$

It follows from (11) and (12) that both expressions remain indeterminate since the cross partial derivative of the utility function, V, is not signed. If the cross partial derivative is assumed negative, then the global deficit equilibrium value for sharing based upon relative deficit will increase with the number of bureaus (see 11). The same condition, however, is not sufficient to reach the same conclusion for the egalitarian sharing rule (se 12). Here an additional negative effect is identified by the third term which captures the free-rider effect which is absent for relative deficit sharing.

Determinate conclusions may however be reached by assuming a logarithmic production technology. Given such an assumption the symmetric equilibrium values for the mixed distribution rule;

$$d^{mr} \quad = \quad \frac{b \ -b\ \delta\left[1-r/n\left(a(n-1)+1\right)\right]}{1-r+\delta\left[1-r/n\left(a(n-1)+1\right)\right]} \tag{13}$$

[11] This finding follows from the fact that the compensation function is linear.
[12] This conclusion implicitly assumes a sponsor welfare function decreasing with the size of the global deficit meaning that the planned budget for each bureau is considered the optimal one for the sponsor.

$$D^{mr} = n \cdot d^{mr} = \frac{nb \ - b\delta\left[n - r\left(a(n-1)+1\right)\right]}{1 - r + \delta\left[1 - r/n\left(a(n-1)+1\right)\right]} \tag{14}$$

where (13) describes the deficit for a representative bureau and (14) the global deficit. By using the above expressions the following results can be derived for each of the two sharing rules;

$$\frac{\partial D^{e}_{/B=\bar{B}}}{\partial n} = -\frac{B\delta(r/n^2)(2-r)}{(1-r+\delta(1-r/n))^2} < 0 \tag{15}$$

$$\frac{\partial D^{rd}_{/B=\bar{B}}}{\partial n} = \frac{b(1-\delta(1-r)) - b(1-\delta(1-r))}{(1-r)(1-\delta)} = 0 \tag{16}$$

It is observed from (15) that an increasing number of bureaus (for a fixed global budget) with necessity will lower the global deficit in equilibrium given egalitarian sharing. The free-rider effect can now be said to be dominating. From (16) it follows that the symmetric global equilibrium, for sharing based upon relative deficits, remains unaffected by sector fragmentation. Thus, the increase in the global deficit that follows from an additional bureau is exactly offset by the contradicting effect that follows from lower budgets to all "incumbent" bureaus.

3. EQUILIBRIA WHEN BUREAUS ARE HETEROGENEOUS.

In this section we focus at the role of heterogeneity by considering two bureaus that differ in size; $b_i^1 > b_i^2$ i =1,2. First, we reconsider the two sharing rules already analysed in section 2 (*rd* and *e*), now under asymmetry, thereafter, two additional sharing rules are introduced; i) sharing based upon relative size (*rb*) and ii) sharing that equalizes ex-post debt-budget ratios across bureaus (*dar*). It is also assumed that each firm has the same budget in both periods , $b_i^1 = b_i^2 = b_1 \quad i = 1, 2,$ which again implies that $B_1 = B_2 = b_1 + b_2 \equiv B$

3.1. The egalitarian distribution rule.

By following the same procedures as in the preceding section, the Nash equilibria for egalitarian sharing and sharing based upon relative deficits become, respectively;

$$MS_1^{a,e} \equiv \frac{\dfrac{\partial F(b_1 + d_1^{a,e})}{\partial d_1^{a,e}}}{\dfrac{\partial F(b_1 - d_1^{a,e}(1-r))}{\partial d_1^{a,e}}} = \left[1 - \frac{r}{2}\right]\delta = \frac{\dfrac{\partial F(b_2 + d_2^{a,e})}{\partial d_2^{a,e}}}{\dfrac{\partial F(b_2 - d_2^{a,e}(1-r))}{\partial d_2^{a,e}}} \equiv MS_2^{a,e} \tag{17}$$

$$MS_1^{a,rd} \equiv \frac{\dfrac{\partial F(b_1 + d_1^{a,rd})}{\partial d_1^{a,rd}}}{\dfrac{\partial F(b_1 - d_1^{a,rd}(1-r))}{\partial d_1^{a,rd}}} = [1-r]\delta = \frac{\dfrac{\partial F(b_2 + d_2^{a,rd})}{\partial d_2^{a,rd}}}{\dfrac{\partial F(b_2 - d_2^{a,rd}(1-r))}{\partial d_2^{a,rd}}} \equiv MS_2^{a,rd} \tag{18}$$

It follows from both equilibrium conditions that the marginal technical rate of substitution, MS_i^j, for each bureau is to be the same for each sharing rule, since the discounted marginal net loss is the same for both bureaus. It is also observed that the MS_i^j in optimum is to be lowest for the egalitarian sharing rule, $MS_i^{a,e} < MS_i^{a,rd}$, which again produces the following result;

$$d_i^{a,rd} > d_i^{a,e} \quad \text{i =1, 2.} \;\Rightarrow\; D^{a,rd} > D^{a,e} \tag{19}$$

The optimal bureau deficit in equilibrium is higher for sharing based upon relative deficit relative to egalitarian sharing rule for the same budget. This conclusion confirms the result already arrived at in section 3.1 for the symmetric case. It is, however, not possible to arrive at determinate conclusions as concerns the relationship between budget size and deficit within each sharing rule. The bureau being largest in size will not with necessity, induce the largest deficit in equilibrium.

3.2. Sharing based on relative size (rb).

A third sharing rule will now be introduced. In particular, we are interested in the consequences from sharing rules that distribute bailouts across bureaus according to the same criteria that governed the allocation of (planned) budgets in the first place.[13] Hence, we are concerned with the case for which extra grants are divided across bureaus according to relative activity (or size). The compensation function for bureau i is now;

$$s^{i,rb} = \gamma_i rD \qquad where \qquad \gamma_i = b_1^i / B_1 \qquad i = 1, 2. \tag{20}$$

where b_1^i and B_1 still denote the budget in period 1 for bureau i and the global budget in the same period. As observed from (20), relative size is measured by the ratio of the initial budget of bureau i to the global budget in the same period.

[13] Until 1997 the allocation of the global hospital budget (block grants) across hospitals in Norway was mainly based upon objective criteria such as demographic factors.

By following the same procedures as above, and keeping the assumption of the budget being constant across the two periods, the following expression for the global deficit in equilibrium for this sharing rule (*rb*) is derived;

$$MS_1^{a,rb} \equiv \frac{\dfrac{\partial F(b_1 + d_1^{a,rb})}{\partial d_1^{a,rb}}}{\dfrac{\partial F(b_1 - d_1^{a,rd} + \gamma_1 r(d_1^{a,rd} + d_2^{a,rd})}{\partial d_1^{a,rd}}} = [1 - r\gamma_1]\delta$$

(21)

$$MS_2^{a,rb} \equiv \frac{\dfrac{\partial F(b_2 + d_2^{a,rb})}{\partial d_2^{a,rb}}}{\dfrac{\partial F(b_2 - d_2^{a,rd} + \gamma_2 r(d_2^{a,rd} + d_1^{a,rd})}{\partial d_2^{a,rd}}} = [1 - r\gamma_2]\delta$$

The marginal technical rate of substitution in optimum now differs across the two bureaus since the discounted marginal net loss differs across the two bureaus since $\gamma_1 > \gamma_2$. Furthermore, it is observed that the difference increases with the degree of heterogeneity (γ). As a consequence, the effects on the equilibria from bureau size asymmetry, are more complex than was the case for the first two sharing rules considered. Now, let $\gamma_1 = 1$ and $\gamma_1 = 0,5$, which yield two special cases for sharing based upon relative size. For $\gamma_1 = 1$, the optimality condition in (21) coincides with the one that matters for sharing based upon relative deficit (see 18). This result arises because $\gamma_1 = 1$ implies a model with a single bureau, and sharing based upon relative size for one single bureau is in effect sharing based upon relative deficits. For $\gamma_1 = 0.5$, the conditions (see 21) coincide with the one that matters for the symmetric game given egalitarian sharing. Sharing based on relative size, given two bureaus of equal size, represents an egalitarian sharing rule.

It is not possible to identify a unique relationship between bureau size and the equilibrium deficit for this particular sharing rule, in addition it follows that D^{rb} can be higher than, equal to, or less than $D^{a,e}$ and $D^{a,rd}$.

3.3. Sharing that equalizes debt-activity ratios (dar).

Notions of fairness may be decisive for the actual sharing rule chosen, and those sharing rules already considered may yield outcomes that are inconsistent with such preferences. Consider for example the situation with an egalitarian sharing rule and a logarithmic production function, two bureaus, a global budget amounting to 100 and no discounting ($\delta = 1$). If one bureau controls 90% of the global (planned) budget and the sponsor is believed to cover 40% of the global deficit ($r = 0{,}4$), it follows that the equilibrium deficits for the two bureaus become 11,6 and 2,7. Assume that the sponsor is concerned with the relative performance of bureaus w.r.t remaining debt relatively to the activity level of the bureau, defined as follows, $\lambda^i = (d^i - s^i)/b_1^i$. By inserting the equilibrium outcomes for each bureau into λ^i it follows that the largest bureau will end up with an ex-post debt-activity ratio, $\lambda^{i,e}$, in equilibrium equal to 7,7% while for the smallest bureau the same ratio, $\lambda^{j,e}$, equals 16,2%. In this perspective, the equilibrium outcomes need not provide a fair allocation of ”burdens” across bureaus. Sponsors being concerned with notions of fairness of this type may wish to apply sharing rules that equalise ex-post debt–activity ratios across bureaus. A specification of preferences of this type is the following condition;

$$\lambda^i \equiv \frac{d^i - s^i}{b_1^i} = \frac{d^j - s^j}{b_1^j} \equiv \lambda^j \tag{22}$$

For positive values of *r* and *D*, a sharing rule that fulfils this condition is as follows;

$$s^{i,dar} = b_1^j d^i - b_1^i d^j + \frac{b_1^i}{B_1} rD \quad i, j = 1,2 \; and \; i \neq j \tag{23}$$

The following expression now describes the global Nash equilibrium deficit for this particular sharing rule (*dar*);[14]

$$MS_1^{a,dar} \equiv \frac{\dfrac{\partial F(b_1 + d_1^{a,dar})}{\partial d_1^{a,dar}}}{\dfrac{\partial F(b_1 - d_1^{a,dar} + b_2 d_1^{a,dar} - b_1 d_2^{a,dar} + \gamma_1 r(d_1^{a,dar} + d_2^{a,dar}))}{\partial d_1^{a,dar}}} = \left[1 - b_2 - r\gamma_1\right]\delta \tag{24}$$

$$MS_2^{a,dar} \equiv \frac{\dfrac{\partial F(b_2 + d_2^{a,dar})}{\partial d_2^{a,dar}}}{\dfrac{\partial F(b_2 - d_2^{a,dar} + b_1 d_2^{a,dar} - b_2 d_1^{a,dar} + \gamma_2 r(d_2^{a,dar} + d_1^{a,dar}))}{\partial d_2^{a,dar}}} = \left[1 - b_1 - r\gamma_2\right]\delta \tag{25}$$

---

[14] The second order condition for this problem is $-(1+\delta)\left[1 - (b_1^2 - b_1^1 r)/B_1\right] < 0$.

As was the case for sharing based upon size the marginal technical rate of substitution in optimum will differ across the two bureaus. However, it is not possible to arrive at determinant conclusions as concerns the relationship between bureau size and deficit and to rank the global equilibrium deficit relative to the same deficit for the three sharing rules already presented.

3.4. A comparison of sharing rules

In the following we will discuss and compare the four sharing rules for a logarithmic specification of the health production function. In addition the discount factor for both bureaus are set equal to 1. The global deficit for each of the four sharing rules now become;[15]

$$D^{a,rd} = \frac{rB}{2(1-r)} \tag{26}$$

$$D^{a,e} = \frac{rB}{4-3r} \tag{27}$$

$$D^{rb} = \frac{\gamma_1(1-\gamma_1)r^2B + 2r(\gamma_1 b_1 + (1-\gamma_1)b_2)}{-\gamma_1(1-\gamma_1)r^2 + 4(\gamma_1 r - 1)((1-\gamma_1)r - 1)} \tag{28}$$

$$D^{dar} = \frac{(1+r)(b_1 + b_2)}{3(1-r)} = \frac{(1+r)B}{3(1-r)} \tag{29}$$

From (26) and (27), the former conclusion, $D^{a,rd} > D^{a,e}$, is being confirmed;. Secondly, it follows from comparing (26) and (29) that $D^{dar} > D^{a,rd}$, saying that a sharing rule that aims to equalise relative ex-post debt burdens across bureaus yields a global deficit being higher than the same deficit for sharing based upon relative deficits (*rd*). The only remaining deficit to determine, in order to arrive at a complete ranking, is the one for sharing based on relative size (*rb*). By inserting for $\gamma_1 = 1$ (or $\gamma_1 = 0$) and $\gamma_1 = 0.5$ in (28) we arrive at the following expressions;

$$D^{a,rb}_{\gamma_1=1} = D^{a,rb}_{\gamma_1=0} = \frac{rB}{2(1-r)} = D^{a,rd} \tag{30}$$

$$D^{a,rb,}_{\gamma_1=0.5} = \frac{rB}{4-3r} = D^{e} \tag{31}$$

where we have utilised that $\gamma_1 = 1 \Rightarrow b_1 = B$. As already shown, the global equilibrium deficit is always higher for a sharing rule based on relative deficit (*rd*) than the egalitarian one (*e*), thus the

[15] In (28) we have utilised that $\gamma_2 = 1 - \gamma_1$.

global deficit for sharing based upon relative size is higher for γ_1=1 relative to γ_1= 0.5. D^{rb} in (28) reaches its minimum value when bureaus are of equal size (γ_1= 0.5). Since (28) is monotonically increasing for increasing values of γ_1 given that $\gamma_1 \geq 0.5$, the global equilibrium deficit must be increasing with the degree of bureau size asymmetry. An increasing degree of asymmetry can be said to strengthen the overall incentives for using deficit as a strategic appropriative device when sharing is based upon relative size. The reason is that a more skewed distribution with respect to size can be said to internalise externalities to an increasing degree.

We can now summarise our findings above with the following ranking of the four equilibria;

$$D^{dar} > D^{a,rd} > D^{rb} > D^{a,e} \tag{32}$$

The incentives for strategic behaviour are especially significant for sharing based upon ex-post relative debt "burdens" (*dar*). To understand the forces at play, assume that ex-post debt–activity ratios are equal for two bureaus. If bureau i now increases it's own budget deficit, it follows from (22) that $\lambda^{i,dar} > \lambda^{j,dar}$. For a given global compensation, the sponsor must now transfer funds from bureau j to i in order to balance the ratios. Consequently, a bureau can raise own compensation in two ways. First because a higher bureau deficit raise global deficits and secondly because the same increase (for a given global compensation) implies a redistribution of funds away from rivals being proportional to the budget size of the rival (see 23). A sharing rule based upon relative budgets (*rb*) represents an intermediate case with an equilibrium being lower than sharing based upon relative deficit (*rd*) but higher compared to the egalitarian sharing rule (*e*). However the actual equilibrium outcome may be close to both $D^{a,rd}$ and $D^{a,e}$ depending on the degree of bureau size asymmetry.

A feature that separates the four sharing rules is the marginal effect on own compensation in response to the deficit decision of other bureaus. For sharing based upon relative deficits the cross partial derivate is zero; $\partial s^{i,rd} / \partial d^j = 0$, while for an egalitarian sharing rule (*e)* and for sharing based upon relative budget (*rb*) the same effect equals r / n and $\gamma_i r$, respectively. For the last sharing rule, ex-post debt-activity ratios, the cross partial derivative equals $\partial s^{i,dar} / \partial d^j = -b^i / B(1-r) < 0$ which reflects two opposing effects. First, a higher rival deficit generates a reduction in own compensation being proportional to own budget size. Second, there is a positive effect following from own compensation rising with a higher global deficit. Since the expression is negative, the first effect (negative externality) always dominates the positive second effect. The sign of cross partial derivatives is also decisive for the strategic properties of the decision variables of our models. For sharing based upon relative deficits (*rd*) they become independent, for egalitarian sharing (*e*) and sharing based upon relative budgets (*rb*) they become strategic complements since an increase in a rival's decision variable (deficit) strengthens own incentives to raise the deficit (see Bulow et al., 1985). For the last sharing rule (*dar*), on the other hand, they are strategic substitutes.

An additional property distinguishing the four rules is that each bureau's share is independent of own effort (exogenous) for sharing based upon relative budgets (*rb*) and egalitarian sharing (*e*), while being endogenous for the last two rules considered (*rd* and *dar).* Finally, the four sharing rules differ with respect to what extent they equalise ex-post "burdens" across bureaus. Our numerical examples have made clear that in equilibrium both egalitarian sharing *(e*) and sharing based on relative budgets *(rb*) generate ratios that differ across bureaus. For sharing aimed at equalising ex-post debt–activity ratios the conclusion is obvious. The situation for sharing based upon relative deficit (*rd*) can be derived by inserting the associated equilibrium values for each bureau into (22) which yields the following expression; $\lambda^{i,rd} = \lambda^{j,rd} = r / 2$. Hence, in equilibrium for this sharing rule (*rd*), the relative ex-post "burdens" become equal for the participating bureaus.

4. CONCLUSION

This paper is inspired by observations of recurrent budget deficits and subsequent sponsor bailouts in the public hospital sector, which suggest that budget overspending may be motivated by strategic behaviour. The paper is framed into an institutional setting of multiple bureaus being financed by a common non-strategic sponsor who allocates extra funds after observing the overall deficit in this sector. This framework is then applied to investigate how various sharing rules may influence bureau incentives to behave strategically. The model has some similarities with the rent-seeking literature for which economic agents invest resources in order to increase their probability of appropriating some surplus. One example is the simple and influential model first suggested by Tullock (1980), where several agents compete for a given prize and where the probability of winning the prize increases with own efforts and decrease with the efforts of rivals. In our model, bureaus compete for a share of the prize (extra funds) and the rent-seeking activity is the overspending of budgets. Now, rent-seeking activities do not represent a pure social waste since the activity itself adds to social production. The model also differs from Tullock games in that the rent (extra funds) is determined endogenously, being a function of the sum of bureau deficits. Consequently, the aggregate prize sought by a group of agents has public good characteristics. Furthermore, the contest is not a probabilistic one over an indivisible object but a deterministic one for shares of the prize.

The paper shows that balanced budgeting need not to be an optimal way for bureaus to allocate resources even when sponsors are not bailing-out. Furthermore, the equilibrium values of the global deficit is found to differ across sharing rules. As a consequence, our analysis suggest the existence of considerable sponsor gains, in terms of lower equilibrium deficits, by a careful selection of distribution rules. However, pre-commitment to particular sharing rules may be difficult for the same reasons that make sponsors unable to pre-commit to (planned) budgets. If, however, the political costs associated with sticking to particular sharing rules are moderate, it may be possible for the sponsor to increase the share of the global budget deficit that determines extra funds and on the same time reduce the size of extra funds. In this perspective, the choice of sharing rules may be a possible device to weaken the long-term incentives for strategic behaviour. Future works could extend our model in several respects for example by analysing the role of uncertainty with respect to sponsor bailouts or by introducing some kind of welfare criterion together with strategic sponsor behaviour.

The public hospital sector in Norway consists of about 75 hospitals and there exist an hierarchy with three levels reflecting different degrees of specialisation (local hospitals, the counties main hospitals and five regional hospitals). Hagen (1996) finds that hospital size increase with degree of specialisation in a systematic way and size ranges from 1.500 to 70.000 inpatients annually.[16] As concerns the actual sharing rules applied for the Norwegian hospital sector not much evidence is available. In principle, sharing rules are decided upon annually, either on the basis of signals given by the government or Parliament commitees, or left to the Ministry of Health.[17] Anecdotal evidence and personal communication, however, suggest a shift over time, from sharing based upon relative deficits to sharing based upon relative budgets (size). In spite of some disparities between our model and the institutional environment of the Norwegian hospital sector, the conclusions of this study suggest that this change may have weakened the rationale for strategic overspending of budgets. However, the asymmetry in hospital size being observed for this sector suggests that the incentives need not be significantly reduced. If so, pre-commitment to an egalitarian sharing for all hospitals or, perhaps more realistically, for hospitals at each degree of specialization, most likely would have a strong negative impact on strategic behavior of this type.

[16] The correlation coefficient between Norwegian hospital types and size is 0.86 (Hagen, 1996).
[17] The actual criterias applied for the distribution of extra funds over counties and hospital may change from year to year.

REFERENCES

Bjørnenak, T. Kjøllesdal, K.S. and K. Nyland (2000): Dekomponering av budsjett og regnskap for utvalgte sykehus i 1998-1999. in eds. Bjørnenak, T., Hagen, T. P., Iversen, T., and J. Magnussen (2000) ”En bred kartlegging av sykehusenes økonomiske situasjon”. Helseøkonomisk Forskningsprogram Oslo (HERO), skriftserie Nr. 2.

Bulow, J., Geanakoplos, J., Klemperer, P. (1985): Multimarket oligopoly; Strategic substitutes and complements, *Journal of Political Economy* 93, 488-511.

Carlsen, F. (1995): Hvorfor rammefinansieringsystemet sviktet: En case studie av budsjettprosessen i Sør-Trøndelag Fylkeskommune i 1987-92.

Chan, K.S and S. Mestelman (1988): Institutions, efficiency and the strategic behaviour of sponsors and bureaus, *Journal of Public Economics*, 37: 91-102.

Dalen, D.M, E.R. Moen and C. Riis (2001): Politicians and soft budget constraints, Working Paper 2, Health Economics Research Programme (HERO), University of Oslo.

Dewatripoint, M. and E. Maskin (1995): Credit and efficiency in centralised and decentralised economies, *Review of Economic Studies*, 62, pp. 541-556.

Hagen, T. P., (1996): Models of decision-making in political institutions. Doctoral thesis, University of Oslo, Department of Political Science, 6/1996.

Høgheim, S., Monsen, N., Olsen, R., and O. Olsen (1989): Two worlds of management control, *Financial Accountability and Management*, Vol. 5, No. 3, 163-178.

Lee, S. (1995): Endogenous sharing rules in collective–group rent seeking, *Public Choice*, 85: pp. 31-44.

Kornai, J. (1986): The soft budget constraint, *Kyklos*, 39, pp. 3-30.

Magnussen, J. (2000): Forholdet mellom budsjett og regnskap – perioden 1997 til 2000. in eds. Bjørnenak, T., Hagen, T.P., Iversen, T., and J. Magnussen (2000) ”En bred kartlegging av sykehusenes økonomiske situasjon”. Helseøkonomisk Forskningsprogram Oslo (HERO), skriftserie Nr. 2.

Moene, K.E. (1986): Types of bureaucratic interaction, *Journal of Public Economics* 29: 333-345.

National Institute of Public Health (1992): Økonomisk analyse av somatiske sykehus, 1989-1992, Working Report No. 3, Oslo, Norway.

Niskanen, W.A. (1971) Bureaucracy and representative government. Chicago: Aldine-Atherton.

Nitzan, S. (1991): Collective rent dissipation, *The Economic Journal*, 101: 1522-1534.

Nitzan, S. (1994): Modelling rent-seeking contests, *European Journal of Political Economy* 10, 41-60.

Pettersen I. J. (1995): Budgetary control of hospitals – ritual rhetorics and rationalized myths? *Financial Accountability and Management*, 11(3) August, 207-221.

Pettersen, I. J. (2000): Implementing management accounting reforms in public sector - the difficult travel from intentions to effects, unpublished manuscript, Bodø Graduate School of Business.

Qian, Y and G. Roland (1998): Federalism and the soft budget constraint, *American Economic Review*, 88, pp. 1143-1162.

SINTEF NIS (1993) Norwegian Institute for Hospital Research, Samdata for sykehus.

Tullock, G. (1980): Efficient rent-seeking in eds. Buchanan, J., R.D. Tollison, and G. Tullock. Toward a theory of the rent seeking society. College station: Texas A&M University Press, pp. 97-112.