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A Model of Hospital Manager Behaviour

by

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Abstract

In this paper a model of hospital manager behaviour is developed. The hospital manager has a utility function in which health and production variables (bed-days and outpatient services) feature as arguments. Two cases are treated: one in which the manager maximizes his utility subject to a zero budget constraint, the other in which the manager is allowed to choose an optimal deficit level. For both cases, a price and an input allocation rule is derived.

1. Introduction

Health care has been and still is a rapidly growing industry in terms of the amount of resources it uses or in terms of its money cost.
Health economics explores this growth by investigating the institutional arrangements in which health care is provided. Very often the focus is on *physicians*, whose incentives to induce demand by patients are seen as a major cause of oversupply of health care in general. In other cases *health insurance* is supposed to lead to an upward spiralling demand and supply increase. In this paper we suggest still another explanation for the growth of the health care system; we develop a model of *hospital manager* behaviour.

There are at least two reasons for treating hospital manager behaviour as a *separate cause* of the costliness of health care. *First*, even if hospitals are dominated by their physicians[1)], their managers may still pursue goals beyond those of any physician's scope, such as the proliferation of public health, the amelioration of sophisticated medical knowledge, a reputation of high quality, or simply permanent existence. Some of these goals stimulate an excessive supply of health care facilities. *Second*, independently of physicians' behaviour, the hospital manager will tend to oversupply given particular *institutional arrangements* such as government appropriations to cover eventual deficits or lack of outside auditing inducing the anticipation of public health insurance contributions beyond those agreed upon. The former is reported for Belgium, the latter is practiced on some scale in Holland[2)].
Hence such institutions give hospitals managers some discretionary power to expand health care services at their own wishes[3)].
Taking these two reasons as an intuitive and plausible starting point for considering hospital manager behaviour as a possible source of costly health care, we now formulate a general economic model.

We start from the assumption that the hospital manager's utility is mainly determined positively by three factors, namely the net operating surplus of the hospital, the proliferation of public health and the production of health care. His utility function is therefore to be written as U (¶, h, b, q) with ¶ as the net operating residual, h being a health status index and b representing the total number of (annual) bed-days and out-patient services rendered. The hospital manager will also obey some (weak or strong) constraint on the financial viability of his hospital. Given this utility function the manager will set prices and allocate inputs differently according to the institutional arrangements in which he operates. The latter will be represented by various constraints on ¶ urging the manager to set ¶ equal to zero (*zero profit case*) or allowing him to run any deficit as he wishes (*deficit-coverage case*)[4].

In the next section, we first consider the zero-profit case. In a number of countries, such a case would be thought of as most appropriate: society does not expect hospital managers to make profits because health is not a *commercial* commodity; yet, it would not tolerate managers incurring losses either. The third section is devoted to the deficit-coverage case, in which the hospital manager chooses an optimal deficit level. It is understood in such a case that sponsors such as governments finance the deficits. In some countries, governments are doing just that in view of a proclaimed *public interest* in health care provision. It is evident that the maximum profit case could be studied as well. However, the results of that case being well known and given that, in general, profit maximization is held to be socially undesirable, we restrict ourselves to the two cases above.

2. The zero-profit case

(i) The hospital manager is supposed to maximize

$$U(¶, h, b, q) \text{ with } ¶ = 0. \tag{1}$$

This utility function is assumed to be quasi-concave and twice differentiable in the arguments. We can express h more explicitly, either as the average life expectancy or as some set of weighted morbidity rates, both with respect to a specific population. The explanatory variables b (bed-days) and q(out-patient services) are proxies for the two complexes of health care offered by a standard hospital. In reality b is decomposed into treatments associated with in-patient services, whereas q stands for all treatments of out-patients.

Such a utility function seems very plausible if the hospital manager sees himself as setting production and financial targets (represented by b, q and ¶) as well as the proliferation of health, which is nothing else but a positive externality. Incorporating h into his utility function then reflects his awareness of his responsibility towards society. There is no need for an explicit exposition of the motives for such a social responsability, as long as they result in similar attitudes. Hence we do not differentiate among charity, humanity, religious inspiration or any other principle promoting health as a positive externality.

Those who prefer a more objective statement on hospital manager behaviour may note that attitudes towards public and subsidized hospitals reflect at least two of the three targets we mentioned. Hence politicians, interest groups such as medical insurers and insured and people in general expect hospital managers to care about *health*, besides *running their hospitals*. In such a context of aspirations managers reply by exactly doing this. Only recently has the third target (*cost control or financing viability*) become important.

(ii) We now assume that h, b and q are produced by the following inputs:

- doctors' time x_1
- nurses' time x_2
- medical equipment x_3.

We therefore have

$$h = h(b, q)$$
$$b = b(x_1^b, x_2^b, x_3^b)$$
$$q = q(x_1^q, x_2^q, x_3^q)$$

with $x_1 = x_1^b + x_1^q$; $x_2 = x_2^b + x_2^q$ and $x_3 = x_3^b + x_3^q$.

Obviously such a production function oversimplifies the complexities of real life health care provisions. Nevertheless the simple version serves our purpose very well, as is to be shown in later stages. The production functions are assumed to be concave in the inputs. This is sufficient to guarantee quasi-concavity of the indirect utility function[5)] [6)].

There are n consumers indexed i = 1,...,n, having demand functions for b and q written as

$$b_i = b_i(m_i, p, p_b, p_q, s_i) \qquad (3\ a)$$

and

$$q_i = q_i(m_i, p, p_b, p_q, s_i) \qquad (3\ b)$$

where m_i denotes income of i, p refers to the price of a non-medical composite commodity, p_b refers to the patient's price of a bed-day and p_q refers to the price of the out-patient services. s_i stands for a measure of individual health and serves as a demand shift parameter. Both bed-days and out-patient services are normal goods. We will avoid the question whether demand for these "commodities" is induced by physicians or not, by assuming that in either case meaningful demand functions can be constructed.

(iii) Let us now treat the case where the hospital manager maximizes (1), given that he wants to reach equilibrium between demand and supply of b and q given that he wants to satisfy a budget constraint

$$p_{x_1}x_1 + p_{x_2}x_2 + p_{x_3}x_3 = p_b^* + p_q^* q \tag{4}$$

where p_{x_1}, p_{x_2} and p_{x_3} are the prices of doctors' time x_1, of nurses' time x_2 and of equipment x_3 and where p_b^* and p_q^* are the producer prices of b and q. It is assumed that input prices are given, i.e. the hospital manager has to hire doctors and nurses and he has to acquire equipment at the going wage rates viz at the going capital costs. However, he will set producer prices for b and q.

If medical insurance is available patients face prices for b and q below producer prices. Given a uniform rate of insurance coverage ρ, we may express consumer prices p_b and p_q as follows:

$$p_b = p_b^* (1-\rho) \text{ and } p_q = p_q^* (1-\rho) \tag{5}$$

The hospital manager now maximizes the following Lagrangian:

$$\begin{aligned} &\text{Max } U(\P, h, b, q) \\ &- \alpha_1(\Sigma b_i - b) \\ &- \alpha_2(\Sigma_i q_i - q) \\ &- \alpha_3(x_1^b + x_1^q - x_1) \\ &- \alpha_4(x_2^b + x_2^q - x_2) \\ &- \alpha_5(x_3^b + x_3^q - x_3) \\ &- \alpha_6(p_{x_1}x_1 + p_{x_2}x_2 + p_{x_3}x_3 - p_b^* b - p_q^* q) \end{aligned} \tag{6}$$

where α_i $(i = 1,\ldots,6)$ are the Lagrangian multipliers. The first and the second constraint tell the manager to match supply with demand, the next three constraints imply that input factors x_1, x_2 and x_3 (doctors' time, nurses' time and equipment) are exhaustively allocated over the two service "lines" b and q. The last constraint implies that costs are covered by receipts. Solving this maximization programma implies developing both a *price rule* and an *allocation rule*: hence the hospital manager determines p_b^* and p_q^* and allocates the inputs.

(iv) To obtain the first order conditions, we differentiate the Lagrangean (6) with respect to p_b and p_q and to all inputs and we set the resulting derivatives equal to zero. This gives:

$$-\alpha_1(1-\rho)\Sigma\frac{\partial b_i}{\partial p_b} - \alpha_2(1-\rho)\Sigma\frac{\partial q_i}{\partial p_b} + \alpha_6 b = 0 \qquad (7a)$$

$$-\alpha_1(1-\rho)\Sigma\frac{\partial q_i}{\partial p_q} - \alpha_2(1-\rho)\Sigma\frac{\partial b_i}{\partial p_q} + \alpha_6 q = 0 \qquad (7b)$$

$$U_b\frac{\partial b}{\partial x_1^b} + \alpha_1\frac{\partial b}{\partial x_1^b} - \alpha_3 + \alpha_6 p_b^*\frac{\partial b}{\partial x_1^b} = 0 \qquad (8a)$$

$$U_q\frac{\partial q}{\partial x_1^q} + \alpha_1\frac{\partial q}{\partial x_1^q} - \alpha_3 + \alpha_6 p_q^*\frac{\partial q}{\partial x_1^q} = 0 \qquad (8b)$$

$$U_h\frac{\partial h}{\partial x_1} + \alpha_3 - \alpha_6 p_{x_1} = 0 \qquad (8c)$$

$$U_b\frac{\partial b}{\partial x_2^b} + \alpha_1\frac{\partial b}{\partial x_2^b} - \alpha_4 + \alpha_6 p_b^*\frac{\partial b}{\partial x_2^b} = 0 \qquad (9a)$$

$$U_q\frac{\partial q}{\partial x_2^q} + \alpha_1\frac{\partial q}{\partial x_2^q} - \alpha_4 + \alpha_6 p_q^*\frac{\partial q}{\partial x_2^q} = 0 \qquad (9b)$$

$$U_h\frac{\partial h}{\partial x_2} + \alpha_4 - \alpha_6 p_{x_2} = 0 \qquad (9c)$$

$$U_b\frac{\partial b}{\partial x_3^b} + \alpha_1\frac{\partial b}{\partial x_3^b} - \alpha_5 + \alpha_6 p_b^*\frac{\partial b}{\partial x_3^b} = 0 \qquad (10a)$$

$$U_q\frac{\partial q}{\partial x_3^q} + \alpha_1\frac{\partial q}{\partial x_3^q} - \alpha_5 + \alpha_6 p_q^*\frac{\partial q}{\partial x_3^q} = 0 \qquad (10\ b)$$

$$U_h\frac{\partial h}{\partial x_3} + \alpha_5 - \alpha_6 p_{x_3} = 0 \qquad (10\ c)$$

These expressions can be simplified by eliminating some Lagrangian multipliers and substituting them in other equations. We begin by eliminating α_3, α_4 and α_5. They measure the net marginal utility gain from a marginal change of total doctors' time x_1, total nurses' time x_2 and total equipment x_3 respectively. By way of example we rearrange (8c) and find

$$-\alpha_3 = -\alpha_6 p_{x_1} + U_h\frac{\partial h}{\partial x_1}.$$

(8c) is now used in (8a) and (8b) and gives us a *rule for the allocation* of doctors' time x_1 over the two service lines b (bed-days) and q (out-patient services):

$$U_h\frac{\partial h}{\partial x_1^b} + U_b\frac{\partial b}{\partial x_1^b} = \alpha_6\left(p_{x_1} - p_b^*\frac{\partial b}{\partial x_1^b}\right) - \alpha_1\frac{\partial b}{\partial x_1^b} \qquad (11\ a)$$

$$U_h\frac{\partial h}{\partial x_1^q} + U_q\frac{\partial q}{\partial x_1^q} = \alpha_6\left(p_{x_1} - p_q^*\frac{\partial q}{\partial x_1^q}\right) - \alpha_1\frac{\partial q}{\partial x_1^q} \qquad (11\ b)$$

It will pay to rewrite this rule in a more simple way. If we assume *zero cross-price elasticities of demand* for bed-days and out-patient services, equations (7a) and (7b) reduce to

$$\alpha_1 = \frac{\alpha_6 b}{(1-\rho)\sum_i\frac{\partial b_i}{\partial p_b}} \qquad (12\ a)$$

$$\alpha_2 = \frac{\alpha_6 q}{(1-\rho)\sum_i \frac{\partial q_i}{\partial p_b}} \tag{12 b}$$

Substituting the right-hand side of (12 a) and (12 b) in equations (11 a) and (12 b) we find:

$$U_h \frac{\partial h}{\partial x_1^b} + U_b \frac{\partial b}{\partial x_1^b} = \alpha_6 \{ p_{x_1} - p_b^* \frac{\partial b}{\partial x_1^b} - \frac{\partial b}{\partial x_1^b} (\frac{b}{(1-\rho)\sum_i \frac{\partial b_i}{\partial p_q}}) \} \tag{13a}$$

$$U_h \frac{\partial h}{\partial x_1^q} + U_q \frac{\partial q}{\partial x_1^q} = \alpha_6 \{ p_{x_1} - p_q^* \frac{\partial q}{\partial x_1^q} - \frac{\partial q}{\partial x_1^q} (\frac{q}{(1-\rho)\sum_i \frac{\partial q_i}{\partial p_q}}) \} \tag{13b}$$

Defining price elasticities of (individual) demand

$$\varepsilon_i^b = \frac{p_b \cdot \partial b_i}{b_i \cdot \partial p_b} \quad \text{and} \quad \varepsilon_i^q = \frac{p_q \cdot \partial q_i}{q_i \cdot \partial p_q}$$

we have

$$U_h \frac{\partial h}{\partial x_1^b} + U_b \frac{\partial b}{\partial x_1^b} = \alpha_6 \{ (px_1 - \frac{\partial b}{\partial x_1^b} p_b^* (1 + \frac{1}{\sum_i \beta_i \varepsilon_i^b}) \} \tag{14a}$$

$$U_h \frac{\partial h}{\partial x_1^q} + U_b \frac{\partial b}{\partial x_1^q} = \alpha_6 \{ (p_{x_1} \frac{\partial q}{\partial x_1^q} p_q^* (1 + \frac{1}{\sum_i \gamma_i \varepsilon_i^q}) \} \tag{14b}$$

where $\beta_i = \frac{b_i}{b}$ and $\gamma_i = \frac{q_i}{q}$ represent demand for bed-days and out-patient services by patient i as a share of total demand. The last two terms on the right-hand sides of (14 a) and (14 b) show the *value of the marginal product* of x_1^b (doctors' time for bed-days) and of x_1^q (doctors' time for out-patient services).

Expressing these values by $MVP_{x_1^b}$ and $MVP_{x_1^q}$ for short and writing (14 a) and (14b) as a ratio we find

$$\frac{U_h \frac{\partial h}{\partial x_1^b} + U_b \frac{\partial b}{\partial x_1^b}}{U_h \frac{\partial h}{\partial x_1^q} + U_b \frac{\partial b}{\partial x_1^q}} = \frac{p_{x_1} - MVP_{x_1^b}}{p_{x_1} - MVP_{x_1^q}} \qquad (15)$$

or even simpler:

$$\frac{MU_{x_i^b}}{MU_{x_i^q}} = \frac{p_{x_i} - MVP_{x_i^b}}{p_{x_i} - MVP_{x_i^q}} \qquad \text{with } i = 1,2,3. \qquad (16)$$

The left-hand side of equation (15) tells us that the hospital manager derives utility from inputs since they affect the production of health and of bed-days or out-patient services. The manager will therefore *exhaust* available inputs, even if their marginal productivity falls below their price. This explains why hospital manager behaviour can be seen as a *separate* cause of the costliness and the explosive growth of the health care system. In order to produce health and health care hospitals attract whatever inputs they can get and keep them in use irrespective of their productivity in the sense suggested by equations (15) and (16). In a dynamic context this implies a growing number of hospital beds and other health care facilities viz growing numbers of doctors and of nurses up to a point of chronic shortage.

Given this decision to expand the demand for inputs, their allocation over the two service lines depends on the *ratio of marginal losses of the alternative uses*. This ratio (the right-hand side of equation (16)) must be equal to the *ratio of marginal utilities* derived from the allocation. Hence the more the hospital manager values doctors for the production of bed-days, the more he will *ceteris paribus* tolerate larger differences between their cost and their marginal value product. Also, the more nurses' wages p_{x_2} exceed their marginal product MVP_{x_2}, the more the manager has an incentive to economize on nurses producing out-patient services, given the ratio of marginal utilities of allocation. In general one can say that, given his utility function or in other words, his preference schedule for the use and the allocation of various inputs, the hospital manager will have an excessive demand for inputs, yet allocate these such as to minimize their marginal losses. In other words, although his staff and medical equipment are too large, since their prices exceed their marginal value products he will nevertheless commission inputs to such tasks as he thinks they fit best. From his own perspective he therefore behaves efficiently, in the sense that he allocates according to his preferences. But that does not mean he behaves efficiently with respect to his patients, since their preferences can be and presumably are very different from his. Nor does he necessarily behave efficiently with respect to the objectives of the health insurance system.

(v) The second task which the hospital manager sets himself is the *pricing of outputs*. Given the budget constraint which forces him to match revenues to expenditures, he needs to set prices in such a way that exactly a demand for his services is generated, which yields sufficient receipts. We will show that this is possible and that a pricing rule for outputs can be derived.

Equations (12) serve as a starting point.

$$\alpha_1 = \frac{\alpha_6 b}{(1-\rho)\sum_i \frac{\partial b_i}{\partial p_b}} \qquad (12\ a)$$

$$\alpha_2 = \frac{\alpha_6 q}{(1-\rho)\sum_i \frac{\partial b_i}{\partial p_b}} \qquad (12\ b)$$

in (12 a) we replace $(1-\rho)$ by $\frac{p_b}{p_b^*}$ from equation (5). Similarly we substitute $\frac{p_b}{p_q^*}$ for $(1-\rho)$ in equation (12 b).

Rearranging and using the elasticity definitions again we obtain

$$p_b^* = \frac{\alpha_1}{\alpha_6} \sum_i \beta_i \varepsilon_i^b \qquad (17\ a)$$

$$p_q^* = \frac{\alpha_2}{\alpha_6} \sum_i \gamma_i \varepsilon_i^q \qquad (17\ b)$$

with $\beta_i = \frac{b_i}{b}$ and $\gamma_i = \frac{q_i}{q}$. Equations (17 a) and (17 b) can be summarized in a ratio:

$$\frac{p_b^*}{p_q^*} = \frac{\sum_i \beta_i \varepsilon_i^b}{\sum_i \gamma_i \varepsilon_i^q} \cdot \frac{\alpha_1}{\alpha_2} \qquad (18)$$

When the price elasticities of demand of individual patients are more or less equal, equation (18) is simplified into

$$\frac{p_b^*}{p_q^*} = \frac{\varepsilon^b}{\varepsilon_q} \cdot \frac{\alpha_1}{\alpha_2} \qquad (19)$$

given the fact that $\sum_i \beta_i = \sum_i \gamma_i = 1$ and assuming $\varepsilon_i^b = \varepsilon^b$ and $\varepsilon_i^q = \varepsilon^q$, all i.

Equation (19) may not be the usual result. Indeed, most models of monopolistic pricing imply pricing rules exhibiting some sort of *inverse proportionality* between the price elasticity of demand and the price. This applies to the model of a profit maximizing monopolist, as well as to models of monopolistic behaviour with financial constraints leading to second-best solutions [7]. In the present model prices vary *proportionately* with the price elasticities of demand. This is mainly due to the fact that the hospital maanger maximizes *utility* (and not profit for that matter), which implies maximizing output. From the constraints in (6)

$$(\sum_i b_i - b) \qquad \text{and} \qquad (\sum_i q_i - q)$$

expressing equality between supply and demand, it follows that every marginal output increase has to be "sold". The hospital manager therefore needs to make price concessions and it seems plausible to take the demand curve and its price elasticity as a starting point. Output will be maximized more easily the larger this elasticity will be for given values of α_1 and α_2 [8].

Inelastic behaviour on the part of consumers implies that $\alpha_6 = 0$. The latter can be derived from (12 a) and (12 b). It follows that inputs will be used up to the point where the marginal utility of an extra input becomes *zero*. Hence *the more consumers are* elastic, *the more the hospital manager is likely to expand production.* Manipulating prices in order to expand demand for health care constitutes a strategy to which very few hospital managers would openly commit themselves. But even given this reluctance the conclusions of the present model are not unrealistic.

Summarizing the *zero-profit case* we get the following result:

If the hospital manager maximizes the utility he derives from supplying health, bed-days and out-patient services and if he is bound to cover costs, he will allocate inputs and set prices according to rules:

1a. *The allocation rule* tells him to use up all available inputs such that marginal losses are proportional to the marginal utilities from various uses, as experienced by the manager.

1b. *The price* rule tells him to expand output by making price concessions which are directly related to the price elasticity of demand for each service.

3. The deficit-coverage case

In this case it is assumed that the hospital receives subsidies in order to cover eventual deficits. What is special about this case is that he chooses the optimal deficit himself. Practically, his sponsors are likely to be local or central government that guarantee coverage of any deficit. In certain countries like Belgium, this practise is met very frequently. Assuming that this behavior does not change the utility function, the maximization programme (6) is only slightly changed. The budget constraint now becomes *soft* and reads as

$$p_{x_1}x_1 + p_{x_2}x_2 + p_{x_3}x_3 + \P = p_b^* b + p_q^* q \qquad (20),$$

where ¶ is now allowed to be negative. There is also an additional first order condition:

$$\frac{\partial U}{\partial \P} = \alpha_6 \qquad (21),$$

implying that α_6 measures the marginal utility of an infinitesimal change in ¶. Equations (14 a) and (14 b) can now be rewritten as

$$U_h \frac{\partial h}{\partial x_i^b} + U_b \frac{\partial b}{\partial x_i^b} = \frac{\partial u}{\partial \P} \{p x_i - MVP_{x_i^b}\} \qquad (22a)$$

$$U_h \frac{\partial h}{\partial x_i^q} + U_q \frac{\partial q}{\partial x_i^q} = \frac{\partial u}{\partial \P} \{p x_i - MVP_{x_i^q}\} \qquad (22b);$$

for $i = 1,2,3$.

The bracketed terms on the right hand side of (22) represent the marginal loss of using an extra x_i^b viz. x_i^q. From (22), one can deduce that overall deficits (covered, of course, by an outside sponsor) may be optimal. Indeed, as long as additional utility from increments in h, b and q exceeds the loss of marginal utility due to marginal losses, it pays to expand health care. This expansion *can* now entail an overall deficit and still constitute an optimum. Hence it follows that given a strong inclination of the hospital manager towards the proliferation of health and/or the production of bed-days and out-patient services, he will *ceteris paribus* willingly plan a deficit in order to pay for the necessary excessive amounts of inputs.

Rewriting (22a) and (22b) in ratio from results in an expression identical to (16). All interpretations of (16) and the derivation of the price rule from the previous section carry over to the present case.

4. Conclusion

In this paper we have developed a model of hospital manager behaviour.
In the model it is assumed that a hospital manager maximizes utility from health (h), health care (b and q) and the financial viability of the hospital (¶). Starting from an institutional arrangement in which ¶ = 0, it was shown that outputs of band q are expanded by pricing them *proportionately* to the respective price elasticities of demand. This in turn leads to an *excessive demand* for inputs by the manager for doctors' time (x_1), nurses' time (x_2) and medical equipment (x_3), in the sense that their marginal value product is smaller than their price. Nevertheless the hospital manager will allocate these inputs over the two service lines in order to minimize these marginal losses.

In the more general case in which ¶ is to be chosen by the hospital manager, the two rules are supplanted by a choice of the appropriate ¶, which is dependent on the preferences of the manager for health and health care. The stronger they are the larger the deficits he will incur. The conclusion for *health care policy* then is very obvious: if sponsors such as local and central governments reject tight financial targets and let hospital managers choose their own so-called optimal deficit level, health care will remain a costly industry. Given the fact that the latter is also true for the zero-profit case, tolerating soft budget constraints is the worst incentive to control hospital managers' behaviour.

Notes

1) In the relevant literature physicians are very often depicted as if in charge of hospital management. See e.g. M. Pauly and M. Redisch (1973) or M. Pauly (1980). In other studies such as R.E. Berry (1970) hospitals are seen as production units with given cost curves. Articles treating hospital management as a separate production factor include M.W. Reder (1965) and J. Newhouse (1970).

2) Evidence is not made public due to the extreme sensitivity of the problem. Yet in January 1982 Dutch newspapers brought an alarming report on "almost (sic) twenty hospitals and nursery homes" having permanently overspent on personnel and equipment and now being financially broke, while the public medical insurance fund refused to refund those expenses. One on the authors collected similar evidence during confidential talks with Belgian hospital managers in 1981.

3) The literature on property rights abunds with theory and evidence on managerial discretionary power developing in corporate businesses, (See e.g. E. Furubotn and S. Pejovich (1972, 1974) or M. Jensen and W. Meckling 1976) while still leaving out of the picture other institutions such as hospitals. There is no reason not to assume similar processes at work in these industries as well.

4) We are inspired by the work of J. Kornai (1980), who elaborates extensively on the assumptions of "hard", "almost-hard" and "soft" budget constraints and their predicted effects on the decisions of the typical business firm. His results presumably carry over to an non-business firm such as a hospital.

5) The proof was given by S. Kesenne (1979). W. Pauwels raised our attention to the problem and then suggested the solution. This is an example of excessive assistan-

6) By indirect utility function, we understand here the utility function with all inputs as arguments.

7) There is a growing amount of literature on the pricing behaviour of firms and other institutions selling *beyond* the point on their demand curve indicated by a price elasticity of *one*. In all cases some second-best solution incorporating the price elasticity is involved. See e.g. Sherman (1980) for an analysis of the budget maximizing bureaucracy.

8) α_1 and α_2 denote the marginal increase of utility given a marginal increase of b and q respectively. Since it may be assumed that the hospital manager has not reached a point of saturation for either output, these Lagrangian parameters are positive.

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