It takes three to tango: 
Soft budget constraint and cream skimming 
In the hospital care market 

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Abstract:
Cream skimming is an illegal behaviour that consists in choosing to treat patients according to their ability to recover. It arises from the use of prospective payment schemes in an asymmetry of information framework. In this context in fact the provider can observe some relevant information (freely or at a cost) before making its effort which will then be used to its own advantage. The paper studies the scope for these types of behaviour in a mixed market for hospital care where the hospitals do not share the same objectives. We show that in this context cream skimming is made possible by the presence of two important elements: the public hospital prefers to treat high severity patients and the regulator is unable to enforce hard budget constraint rules.

The paper adds an important dimension to the study of cream skimming as proposed by the traditional literature where asymmetry of information alone is considered the cause of this market failure. In our context, in fact, cream skimming arises mainly from a regulatory failure.

Keywords: Prospective payment system, hospital care, cream skimming, soft budget constraint

JEL Classifications: I11, I18, D82

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1. Introduction

In Western countries a substantial proportion of expenditure for health care is financed by the public sector. Since the first oil crisis in 1975, and more recently from the ‘90s, the objective of rationalising and controlling expenditure has become a priority for any effective government policy.

Health care systems have been widely reformed and a separation between purchasing and delivering health care has been enforced to mimic the structure of a competitive market. To enhance competition, some health care systems have allowed private hospitals to compete with public ones, but the effect of such a policy is still controversial. The outcome in terms of costs and quality depends on the payment scheme while the asymmetry of objectives of the competitors might become a problem rather than an instrument to improve the market (Levaggi, 2004; 2005).

The provision of health care services is characterised by uncertainty and asymmetry of information in the cost of treatment. Asymmetry of information exists because at the time the contract is established, both the purchaser and the provider share the same information set, but the purchaser can observe the prevailing state of the world (freely or at a cost) before making its effort.

This fact, combined with asymmetry in the objectives of the market competitors means that these reforms might not be effective in reaching their objectives unless the regulator can implement competition policies in a credible way.

In this paper we study a specific aspect of competition among hospitals in a market where a non-profit (public) hospital competes with a for-profit one (private institution). The analysis of this paper concentrates on the hospital’s strategic use of its information advantage vis-à-vis the other hospital and the regulator.

We will focus on the problem of selection of patients within the same diagnostic group according to their severity, a behaviour which the literature defines as market cream skimming or cherry picking. The literature has studied this problem in the context of a private market (Ellis, 1997, Lewis and Sappington, 1999) but only a few authors have approached the problem from the standpoint of a public provider. The objective of the paper is to bridge this gap by studying the causes that determine cream skimming and its consequences in a market where public and private hospitals compete for patients.

In our paper we define cream skimming as the process by which the hospital affects its expected cost of treatment by attracting those patients that, due to the severity of their case, require a lower than average level of care. Since cream skimming is an illegal behaviour, the actual choice can be made by quality discrimination, i.e. by offering patients a mix of quality that best suits their

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1 See Levaggi (2002a) for a review.
preferences. We argue that patients’ ignorance of the true relationship between care and health outcomes means that they choose their hospital using indices of perceived quality rather than appropriateness of the service delivered and the hospital, by an appropriate choice of quality, can influence its expected cost of care.

The scheme is designed from the standpoint of a private hospital that competes for patients with a public hospital in an environment where a purchaser (P) has to provide hospital care to its population at the least possible cost using a prospective payment system (PPS). Costs and quality cannot be verified by the purchaser, but the latter can be inferred through the choice of patients. We believe that this environment, which reflects the actual system adopted in several countries, is suitable for our analysis because:

a) it allows asymmetry to be modelled in the objectives pursued;
b) it permits study of the role of the regulator in the model and its failure to enforce hard budget constraint rules.

The model presented in this paper shows that there are several necessary conditions for the existence of cream skimming:

• competitors must have a different attitude towards the quality mix they offer, which might derive from asymmetry in the objectives pursued or in their cost function;
• due to a failure in the system of incentives, the public hospital might interpret its budget as soft, i.e. in defining its behaviour it does not take account of the budget constraint it faces.

The latter result has quite important policy implications since it shows that cream skimming is basically determined by a failure of the regulator to enforce the rules of the game it has chosen.

This failure might become a serious hurdle to the sustainability of the internal market in the long run.

The paper will be organised as follows: in section two we propose our model. Section three detects and analyses cream skimming in the health market. In section four a numerical simulation is provided in order to highlight cream skimming in the different scenarios. Section five presents the conclusions.
2. The model

The model presented here draws on Levaggi (2004) and Montefiori (2005) where two hospitals with asymmetric objectives compete for patients using the rules of spatial competition. Health care is financed by the public sector so that it is provided free of charge at the point of use; the provision is organised using an internal market where a private hospital competes with a public firm\(^2\). Although the focus of the model is on the behaviour of the private hospital, we need to model the behaviour of all the actors in the game, namely the public hospital, the patients and the regulator.

The structure of the game with regard to the payment scheme, the competition rules and restriction on the choice of case and quality mix is assumed to be determined outside the model.

The environment

Patients lie within a line of length one and are uniformly distributed; their number is normalised to one, so that demand can be interpreted in terms of market shares. They need uniform treatment \(T\), but the cost of provision depends on the level of patient severity so that the cost of producing health care is not uniform.

Such a cost is assumed to be a linear function of quality and patients’ characteristics. The cost function can be written as:

\[
C_i = (\beta_i + g(q)) \times D_i
\]

where \(q\) is the quality level, \(\beta_i\) is a patient-related cost and \(D_i\) is the number of patients treated in hospital \(i\). \(\beta_i\) can assume two values, \(L\) and \(H\) (\(L=\text{low cost}; H=\text{high cost}\)) with \(\beta_L < \beta_H\); both events have known probabilities equal to \(p\) and \((1-p)\) respectively.

In this paper we assume that the treatment offered is appropriate, hence quality can be defined as a multidimensional vector that includes medical and non-medical variables that affect the outcome of health care, i.e. prevention, treatment and aftercare\(^3\). Both medical and non-medical quality are extremely relevant to determine patients’ utility. The medical quality typically includes aspects like appropriateness, health, nursing, aftercare, etc., while the non-medical quality includes comfort, information, kindness, catering services and so on. We assume that the quality delivered by the hospital is made up of three elements:

- a minimum level that is implicit in the definition of \(\beta\);
- hotel services \((\tilde{q})\) which comprises all those services that are not strictly medical, but that can improve a patient’s stay in hospital. They are services such as the number of beds per room, visiting hours, private telephones, nurses per ward, etc.;

\(^2\) In Italy it would correspond to “aziende ospedaliere”.

\(^3\)
• health-related services ($\tilde{q}$) that improve the medical quality of the care delivered.

They are assumed to be perfect substitutes and their cost of provision is constant and equal to one to simplify the exposition.

The cost related to quality provision has two separate components: a variable cost which is linear in the number of patients treated and a fixed cost which is increasing in the level of quality supplied.

With this new hypothesis the cost for hospital services can be written as:

$$C_i = (\beta_i + \tilde{q} + \tilde{q}) \cdot D_i + \tilde{q}^2 + \tilde{q}^2$$

$$i = L, H$$

(2)

Quality cannot be verified, hence its level cannot be directly contracted for. The quality will have to be indirectly controlled through patients’ choices and hospitals’ reaction functions.

The timing of information in the contract can be described as follows:

Fig.1: The timing of information

<table>
<thead>
<tr>
<th>P sets contract</th>
<th>realisation of $\beta$</th>
<th>outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>hospital observes $\beta$</td>
<td></td>
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</tbody>
</table>

When the contract is stipulated both parties have the same information on $\beta$, but the hospital can observe it before setting its effort and can hide it from the purchaser.

This means that the provider has in fact no uncertainty on severity because it can observe this parameter before setting its effort. The timing of information has important consequences on contract setting since in this case the risk cannot be effectively transferred to the provider.

The actors in the game

The model presented in this paper aims at explaining the main interactions that take place among the different players in the hospital care market. For the purpose of our analysis these actors can be reduced to: the patient, the two hospitals and the purchaser.

The patient

In our model we assume that the patient plays an active role since he chooses his provider of health care, i.e. the hospital to which to be admitted. To do so he evaluates the benefits and cost of the two alternatives. The two hospitals have a fixed location and are placed at the two extremes of a line of length one; $H_A$ is a public hospital while $H_B$ is a private firm:

---

3 The same approach is used by Chalkley and Malcolmson (1998).
The service is free at the point of use so that the patient’s utility depends on the quality and on travelling costs which are linear in the provider’s distance from the patient’s location. We assume that patients with high degree of severity (hence costs) have a bias towards health-related quality ($\tilde{q}$) whereas low severity patients are more interested in hotel services $\hat{q}$. The perceived level of quality by the two groups can be written as a weighted sum of hotel and health quality:

$$q_L = w\hat{q} + (1-w)\tilde{q}$$
$$q_H = (1-w)\hat{q} + w\tilde{q}$$

where $\frac{1}{2} < w < 1$

The utility function of the two groups of patients can be written as:

$$U_{i}^i = \begin{cases} 
\alpha q_A^i - \gamma d \\
\alpha q_B^i - \gamma (1-d) 
\end{cases} ; \quad i=L,H$$

which is linear in quality and the cost of travelling. $\alpha$ is a fixed parameter and $\gamma$ denotes the unit cost of travelling to the hospital. Patients are indifferent between hospital $A$ and hospital $B$ when $\alpha q_A^i - \gamma d = \alpha q_B^i - \gamma (1-d)$ ($i=L,H$). Solving for $d$ we get:

$$d^i = \frac{\alpha}{2\gamma} (q_A^i - q_B^i) + \frac{1}{2}$$

where $d^i$ represents the location of the marginal consumer. Substituting (3) in (5)

$$d^L = \frac{\alpha}{2\gamma} [w(\hat{q}_A - \hat{q}_B) + (1-w)(\tilde{q}_A - \tilde{q}_B)] + \frac{1}{2}$$
$$d^H = \frac{\alpha}{2\gamma} [(1-w)(\hat{q}_A - \hat{q}_B) + w(\tilde{q}_A - \tilde{q}_B)] + \frac{1}{2}$$

The demand for hospital $j$ is obtained by multiplying the distance by the density which, given the unit length of the line, is equal to the probability $p$ for low and to $(1-p)$ for high severity patients:

$$D_j^L = \left[ \frac{\alpha}{2\gamma} [w(\hat{q}_j - \hat{q}_A) + (1-w)(\tilde{q}_j - \tilde{q}_A)] + \frac{1}{2} \right] p$$

$$D_j^H = \left[ \frac{\alpha}{2\gamma} [(1-w)(\hat{q}_j - \hat{q}_B) + w(\tilde{q}_j - \tilde{q}_B)] + \frac{1}{2} \right] (1-p)$$
The demand for each hospital depends on the quality mix they offer with respect to what the other hospital provides. Such a mix depends on the objectives that both actors pursue.

The hospitals

In our model we assume that hospitals have asymmetric objectives. The private hospital aims to maximise its surplus; the public hospital pursues different goals (e.g. reputation, case mix or budget balance).

In our model we assume that reputation is the primary objective of the public hospital which can be translated into several alternative indices such as their market share or the severity of the case mix. In any case, given their non-profit attitude, they will pass on to the patient all the reimbursement the purchaser gives for quality. The difference in the objectives will only alter the mix of the two qualities.

The purchaser

The purchaser is assumed to be a government agency that contracts with hospitals for health care treatments. Through the contract terms implemented, the purchaser aims to induce the hospital to the desired behaviour in terms of trade-off between quality and cost for health care.

In health care a common assumption is that quality cannot be verified in court, i.e. a specific level of quality cannot be written in the contract since the clause cannot be enforced (Chalkley and Malcomson). For this reason, the quality of care delivered can be controlled indirectly through the reaction function of the hospital to a set payment $q^*$ for improving the quality of care. The purchaser sets the reimbursement $q^*$ in order to balance the trade-off between cost minimisation and quality enhancement. In this model we take it as a given parameter, but we assume $q^* > 0$. This is in fact the only condition that is necessary for cream skimming which is independent of the actual value of $q^*$. Given that the payment is uniform, but patients have a different attitude towards the quality mix, the purchaser associates the weight $\delta$ and $(1-\delta)$ respectively with health and hotel related quality, where $\delta=p+w-2pw$.

The payment scheme for quality offered by the provider will then take the following form:

$$q^* + \delta q^* + [(1-\delta)q^*]^2$$

Levaggi (2004) and Montefiori (2005) show how $q^*$ can be set by the provider in a general context.
The rules of the game

The game is developed from the standpoint of the private hospital which receives from the purchaser a PPS payment \( t = E(\beta) + q^* + [(\beta q^*)^2 + ((1 - \beta)q^*)^2] \) and competes with the public hospital for patients.

The use of PPS was first advocated by Ellis and McGuire (1986) and other authors who widely criticised cost reimbursement for its cost inflation properties. The most recent literature shows that prospective contracts have in fact a higher cost than cost reimbursement ones (Chalkley and Malcomson, 2002). In our model, since the reimbursement for a low and high cost patient is the same, but quality cannot be verified, the provider can implement some form of opportunistic behaviour in setting quality to choose patients with low severity.

2.1 Quality setting by the hospitals

The private hospital sets its quality mix to maximise its surplus, but in doing so it has to take account of the behaviour of the public hospital.

The minimum quality level that the hospital must provide to avoid malpractice is normalised to zero, i.e. \( \tilde{q}_i \geq 0 \), \( i = A; B \)

Public hospitals

Public hospitals are not interested in surplus maximisation, at least in a standard definition of the term. This is because in the public sector the reputation of the management and of the medical staff is based on indicators that abstract from economic efficiency. These objectives may range from the maximisation of their reputation (alternatively defined as their market share or an index of complexity of the case mix treated) to maximising common goals with the purchaser\(^5\). Under this assumption we can write the quality mix supplied by public hospitals as:

\[
\begin{align*}
\hat{q}_A &= (1 - \varphi)q^* \\
\tilde{q}_A &= \varphi q^*
\end{align*}
\]

where \( 0 \leq \varphi \leq 1 \)

and they set \( \varphi \) accordingly.

In pursuing their objectives, they should face a budget constraint. This is one of the crucial issues that we wish to analyse in our paper. We argue that, given the complexity of the internal market and the failure of specific regulations, the public hospital might perceive the constraint as soft, i.e. it might think that the purchaser (or a higher level of government) will bail it out by paying for its deficit. The problem of making budgets credible threats for public hospitals has long been

\(^5\) See Laffont and Tirole (1993) on this point.
recognized\textsuperscript{6} and is currently creating serious problems in the health care sector. In this paper we show that asymmetric behaviour and soft budget constraint are the main causes for cream skimming by private hospitals.

To show this, we start by assuming that the hospital takes its budget as hard; in this case to keep its current budgets balanced the following constraint has to hold\textsuperscript{7}:

\[
[q^* - \tilde{q}_b - \hat{q}_b + E(\beta) - \beta_L] D_A^L = [q^* - \tilde{q}_b - \hat{q}_b + E(\beta) - \beta_H] D_A^H
\]

Which can be written as:

\[
\frac{d_A^L}{d_A^H} = 1
\] (8)

Which means that the hospital is required to set \( \varphi \) according to the following rule:

\[
\varphi = \frac{1}{2} + \frac{\tilde{q}_b - \hat{q}_b}{2q^*}
\]

If the hospital does not perceive its budget as hard, it can pursue other objectives that become independent of its budget constraint. In this environment we consider two different cases.

In the first scenario we assume that the public hospital maximizes its reputation by turning all the reimbursements into health quality, i.e. it sets \( \varphi \) equal to 1.

\[
\tilde{q}_A = 0
\]

\[
\tilde{q}_A = q^*
\] (9)

In the second scenario the hospital is assumed to share the provider’s reimbursement according to the social welfare as defined by \( \delta \). The hospital’s behaviour perfectly matches the purchaser’s wish. Formally:

\[
\hat{q}_A = (1 - \delta)q^*
\]

\[
\tilde{q}_A = \delta q^*
\] (10)

Private hospital

The aim of the private hospital working for the public sector is much more simple to define. We assume a standard objective which is to maximise its surplus and this can be written as:

\textsuperscript{6} See Dawson and Howart (1993).

\textsuperscript{7} This constraint does not guarantee that hospitals have a balanced budget since it does not take account of the fixed cost part.
\[ \begin{align*}
\text{Max} \quad \Pi &= \left\{ \hat{q}q^* \right\}^2 + \left\{ (1 - \delta)q^* \right\}^2 - \tilde{q}_B^2 - \hat{q}_B^2 + \\
+ \left( q^* - \hat{q}_B - \hat{q}_B + E(\beta) - \beta_L \right)D_{B}^L + \left( q^* - \tilde{q}_B - \hat{q}_B + E(\beta) - \beta_H \right)D_{B}^H \\
\text{s.t} \quad \tilde{q}_B &\geq 0 \\
\hat{q}_B &\geq 0
\end{align*} \] 

\((11)\)

From the first order conditions of the maximization problem we obtain the private hospital reaction functions:

\[ \begin{align*}
\tilde{q}_B &= \frac{\alpha}{2(\alpha \delta + 2\gamma)} \left( q^*(1 - \delta) - \tilde{q}_B + \hat{q}_A(1 - \delta) + \hat{q}_A \delta - [\beta_H - \beta_L](2w - 1)p(1 - p) - \frac{\gamma}{\alpha} \right) \\
\hat{q}_B &= \frac{\alpha}{2(\alpha(1 - \delta) + 2\gamma)} \left( q^*(1 - \delta) - \tilde{q}_B + \hat{q}_A(1 - \delta) + \hat{q}_A \delta + [\beta_H - \beta_L](2w - 1)p(1 - p) - \frac{\gamma}{\alpha} \right)
\end{align*} \]

With

\[ \delta, (1 - \delta) \geq 0 \quad \forall p, w \in (0,1) \]

The private hospital’s reaction function, in terms of quality mix, can be written as:

\[ \begin{align*}
\tilde{q}_B &= \frac{\alpha}{2(\alpha \delta + 2\gamma)} \left( q^*[1 - \varphi + 2\delta \varphi] - \tilde{q}_B - [\beta_H - \beta_L](2w - 1)p(1 - p) - \frac{\gamma}{\alpha} \right) \\
\hat{q}_B &= \frac{\alpha}{2(\alpha(1 - \delta) + 2\gamma)} \left( q^*[2(1 - \delta) + \varphi(2\delta - 1)] - \tilde{q}_B + [\beta_H - \beta_L](2w - 1)p(1 - p) - \frac{\gamma}{\alpha} \right)
\end{align*} \] 

\((12)\)
3. Cream skimming

If the private hospital gets to know the patient type before the treatment, it will try to set $\hat{q}$ and $\tilde{q}$ strategically so that high-risk patients prefer to be treated by the public sector. If such a behaviour is implemented, given that the payment scheme is designed to break even on expected average costs, the private hospital will make a surplus while the public hospital will have a deficit.

However, this policy can be implemented only if the public hospital allows the private counterpart to do so and this mainly depends on the objective pursued by the former organisation and the enforceability of the budget constraint.

Given that hospitals compete for patients in a setting à la Hotelling, the first necessary condition for cream skimming is for there to be an asymmetry in their behaviour.\(^8\)

Let’s first assume that the public hospital is faced with a hard budget constraint so that the reimbursement share $\varphi$ has to be set according to eq. (10).\(^9\)

The private hospital’s reaction functions for health and hotel related quality are defined as:

\[
\begin{align*}
\hat{q}_{HBC}^* &= q^* \frac{\alpha}{2(2\gamma + \alpha)} - \frac{\gamma}{2(2\gamma + \alpha)} \\
\tilde{q}_{HBC}^* &= q^* \frac{\alpha}{2(2\gamma + \alpha)} - \frac{\gamma}{2(2\gamma + \alpha)}
\end{align*}
\]

If the public hospital can run into a deficit and sets its objectives according either to welfaristic rules or to pursue the reputation of its staff, the quality mix of the private hospital can be written as:

\[
\begin{align*}
\hat{q}_{SC}^* &= q^* \left[ 4\alpha\delta(1-\delta) + 8\gamma(1+\frac{2\gamma}{\alpha}) - \gamma(2\delta - 1) \right] - \frac{p(1-p)(2w-1)[1 + 2\delta + \frac{4\gamma}{\alpha}]}{V} + \frac{\gamma(2\delta - 1)}{V} - \frac{4\gamma^2}{aV} \\
\tilde{q}_{SC}^* &= q^* \left[ \frac{4\gamma}{V} + (\beta_h - \beta_l) \right] - \frac{p(1-p)(2w-1)[1 + 2\delta + \frac{4\gamma}{\alpha}]}{V} - \frac{\gamma(2\delta - 1)}{V} - \frac{4\gamma^2}{aV}
\end{align*}
\]

where

\[V = [4\alpha\delta(1-\delta) + 8\gamma(1+\frac{2\gamma}{\alpha}) - \gamma] > 0\]

When the hospital maximises the severity of its case mix and when the public hospital behaves strictly according to the purchaser’s wish:

\[
\begin{align*}
\hat{q}_{SC}^* &= q^* \left[ (4a\delta^2(1-\delta) + 4\gamma(1-\delta) + \delta(8\gamma\delta - \alpha)) \right] - \frac{p(1-p)(2w-1)[\alpha(3-\beta \delta) + 4\gamma]}{V} + \frac{\gamma(2\delta - 1)}{V} - \frac{4\gamma^2}{aV} \\
\tilde{q}_{SC}^* &= q^* \left[ (5\varepsilon\delta + 8\gamma) - [4\alpha\delta^2(2-\delta) + 4\gamma(3-2\delta) + \alpha] \right] + (\beta_h - \beta_l) \frac{p(1-p)(2w-1)[\alpha(1+2\delta) + 4\gamma]}{V} - \frac{\gamma(2\delta - 1)}{V} - \frac{4\gamma^2}{aV}
\end{align*}
\]

---

\(^8\) It is for this reason that maximising the share of patients has not been considered among the objectives pursued by the public hospital. It can be shown (Levaggi 2005) that this objective is symmetric to surplus maximisation by a private hospital.

\(^9\) The case mix imposed on the public hospital is even able to grant non-negative surplus to the public hospital. In fact the variable costs are fully covered and a surplus could be generated from the reimbursement devoted to fixed costs.
If the private hospital selects the patient type, the ex post probability of being treated by the private hospital is not the same for low and high cost patients and adverse selection seriously affects the public hospital.

Given that \( p \) is the share of low cost patients in the population, \( \frac{p}{1-p} \) defines the share of low to high cost treatments that should be offered. If the total number of cases is sufficiently high and hospitals do not choose their case mix, we should expect the private hospital to treat patients in this proportion. If they cream skim we will instead observe that:

\[
\frac{D^b_h}{D^H_B} > \frac{p}{1-p}
\]  

Condition (16) can be written as\(^{10}\):

\[ I < 1 \]

where

\[ I = \frac{(q_1 - \hat{q}_h)}{(q_1 - \hat{q}_B)} \]

is the cream skimming index.

The lower the index \( I \) is, the wider is the cream skimming practice in the market.

Let’s now examine the value of \( I \) according to the different strategies that can be implemented by the public hospital.

**Proposition 1:** if the public hospital interprets its budget as hard, the private hospital cannot cream skim.

In this scenario it is quite straightforward to show that \( I^{\text{SBC}} = 1 \), which means that asymmetry in the behaviour is a necessary but non-sufficient condition for cream skimming, in other words it takes three to tango.

When the public hospital interprets its budget as soft, cream skimming is likely to be detected and the extent of the application of this policy strictly depends on how soft the public hospital interprets its budget.

**Proposition 2:** If the public hospital turns all the reimbursement into health quality it can be shown that \( I^{\text{SBC}} < 0 \)

When the public hospital turns all the reimbursement into health quality (i.e., it maximizes its reputation), the private hospital’s unavoidable reaction is cream skimming. The health-related

\(^{10}\) The proof is presented in appendix 1
quality is discouraged because:

- it attracts high-cost patients;
- it is unrealistic and expensive to compete on it with the public hospital.

This pattern often emerges when the regulator is not able to impose a hard budget constraint and it might be one of the most important problems that the reformed competition-oriented public health care systems will have to face sooner or later.

When the public hospital shares the reimbursement received in both types of quality, the strategic space for cream skimming is considerably reduced.

*Proposition 3*: If the public hospital shares its objectives with the purchaser, cream skimming is always detected for \( p < 1/2 \), but its scope is reduced \( 0 < f^{B^C} < 1 \).

When the public hospital shares its objective with the provider, cream skimming is not always a possible alternative to the private hospital. Cream skimming is a viable solution if \( \delta > 1/2 \). In appendix 2 it is shown that this condition always holds if \( p < 1/2 \). When \( p > 1/2 \) \( \delta \) is lower than \( 1/2 \) and the public hospital invests most of the reimbursement in hotel quality. It attracts a wide share of low cost patients so that the conditions under which cream skimming is observed are unusual.

This result generates a welfare loss: the private hospital provides very low quality levels while the public hospital concentrates on hotel quality. This policy reduces the welfare of the patients facing high severity illness.
4. Numerical simulation

The model presented in this paper shows that in contracting for health care, opportunisti
c-behaviours play a fundamental role.

The extent of cream skimming depends on a range of parameters such as the distribution of
low and high cost cases ($p$), the preference bias for hotel quality of the low cost group ($w$), on the
behaviour of the other hospitals that compete on patients, and on how credible the regulator is in
imposing a hard budget constraint rule. In this section we present a numerical analysis of the cream
skimming index.

Table 1 shows the relationship between $I$ and $p$ for the three different assumptions on the
behaviour of the public hospital. $\beta_l$ and $\beta_h$ take the value of 1 and 1.4 respectively; $w$ is set to 0.6
and 0.9.

<table>
<thead>
<tr>
<th></th>
<th>$w=0.6$</th>
<th></th>
<th>$w=0.9$</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>I₂</td>
<td>I₃</td>
<td>I₁</td>
<td>I₂</td>
</tr>
<tr>
<td>p=0.1</td>
<td>-0.034</td>
<td>0.74</td>
<td>1.00</td>
<td>-0.027</td>
</tr>
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<td>p=0.2</td>
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<tr>
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<td>-0.035</td>
<td>0.92</td>
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<td>-0.037</td>
</tr>
<tr>
<td>p=0.5</td>
<td>-0.035</td>
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<td>1.00</td>
<td>-0.038</td>
</tr>
<tr>
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<td>1.36</td>
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If the public hospital perceives the budget as hard, no cream skimming occurs independently
of $p$ and $w$. If this is not the case, cream skimming is very high when the public hospital supplies
only medical care. This effect is amplified by $p$ and $w$.

If the public hospital shares the reimbursement according to the provider’s wishes, cream
skimming is detected only for $p<\frac{1}{2}$ as expected. In this case, it is interesting to note that $I$ is quite
sensitive to the variation in $p$ and $w$, while for the first case such a variance is quite small.

The cream skimming index affects the market share of each hospital and its expected profit.
We can then expect the surplus of the private hospital to be always positive and increasing in $I$. 14
For the public hospital, the first policy (hard budget constraint) allows it to have a small profit on fixed costs which depends on the value of $\delta$, but it is always rather small. If it supplies only medical care it will always have a budget loss and in the last case ($I_3$), a deficit occurs only if $p < \frac{1}{2}$. 
5. Conclusions

In this paper we have examined some of the possible reasons that lead hospitals to opportunistic behaviour in the choice of the patients to treat.

In particular we have concentrated on cream skimming which is an illegal behaviour that consists in offering health care only to the patients that have a low cost. It arises from the inability of the purchaser to observe the patient type and it might be solved through control and sanctions rather than incentives.

Cream skimming has important consequences: public hospitals will usually have a deficit since they will treat a higher proportion of patients with higher cost; some patients might not be treated and private hospitals have a surplus that is not related to a higher degree of efficiency.

These effects are self-inducing so that cream skimming might have perverse effects on the whole cost minimisation incentive structure of the reformed health care market. Prospective payments were mainly introduced to force hospitals to reduce slacks in the production process. If the payment is tailored to break even, a persistent deficit of the hospital can be interpreted as a sign of inefficiency. However, in the presence of cream skimming, this is no longer the case. The public hospital has a higher cost because of the patients it has to treat. While it might be reasonable in this case to grant extra funds to public hospitals, it should be recognised that the cost-minimising properties of the prospective payment scheme are completely undermined.

This behaviour is quite difficult to detect and curb. Lewis and Sappington (1999) propose a double payment system to avoid the problem: a prospective payment system for low-cost patients and a partial cost reimbursement for high-cost ones. This allows the hospital to choose the scheme that makes it better-off and ensures that both patient types are treated.

Chalkley and Khalil (2001) develop a framework to show that, with asymmetric information, the choice of the payment scheme may depend on the responsiveness of demand by consumers. The analysis indicates that there is an important role for the information that consumers have regarding the nature of medical interventions. They suggest payment based on treatment cost in order to contain costs in cases of emergency care and life threatening illness and payment schemes conditioned on health outcomes for elective procedures and less severe illness.

The model presented in this paper is the first step towards a comprehensive assessment of cream skimming. It needs to be developed in at least two directions: from a theoretical point of view, it is necessary to compare the properties of incentive systems such as the one described in Lewis and Sappington (1999) with control and penalty methods; from an empirical point of view it is necessary to determine the extent of the problem, something that so far almost no study has
attempted to estimate.
Appendix 1

\[
\frac{D^l_b}{D^m_b} > \frac{p}{(1-p)} \tag{A1}
\]

where

\[
D^l_b = \left\{ \frac{\alpha}{2\gamma} \left[ w(\hat{q}_b - \hat{q}_A) + (1-w)(\bar{q}_b - \bar{q}_A) \right] + \frac{1}{2} \right\} p
\]

\[
D^m_b = \left\{ \frac{\alpha}{2\gamma} \left[ (1-w)(\hat{q}_b - \hat{q}_A) + w(\bar{q}_b - \bar{q}_A) \right] + \frac{1}{2} \right\} (1-p)
\]

Thus eq.(A1) can be written as

\[
\frac{\alpha}{2\gamma} \left[ w(\hat{q}_b - \hat{q}_A) + (1-w)(\bar{q}_b - \bar{q}_A) \right] > \frac{\alpha}{2\gamma} \left[ (1-w)(\hat{q}_b - \hat{q}_A) + w(\bar{q}_b - \bar{q}_A) \right]
\]

then

\[
w(\hat{q}_b - \hat{q}_A) + (1-w)(\bar{q}_b - \bar{q}_A) > (1-w)(\hat{q}_b - \hat{q}_A) + w(\bar{q}_b - \bar{q}_A)
\]

and finally

\[(2w-1)(\hat{q}_b - \hat{q}_A) > (2w-1)(\bar{q}_b - \bar{q}_A)\]

considering that \(2w-1 \geq 0\) and assuming \(\bar{q}_b < \bar{q}_A\)

we obtain

\[
\frac{(\hat{q}_b - \hat{q}_A)}{(\bar{q}_b - \bar{q}_A)} < 1
\]

q.e.d.

Appendix 2

Proof of proposition 1:

Eq.(13) suggests that the private hospital sets the same quality level both for health and hotel related quality. But if this is the case, then also the two quality levels sets by the public hospital are equal. Therefore \(I = \frac{(\hat{q}_b - \hat{q}_A)}{(\bar{q}_b - \bar{q}_A)}\) cannot be anything different from 1 (since the private hospital’s quality levels are lower than those of the public hospital, given the private hospital monopolistic rent [spatial differentiation]).

Proof of proposition 2
From eq.(14) \( \tilde{q}_A > \tilde{q}_B \) and therefore the ratio \( \frac{(\tilde{q}_B - \tilde{q}_A)}{(\tilde{q}_B - \tilde{q}_A)} \) necessarily has to be negative. The cream skimming detectable in this scenario is substantial.

Proof of proposition 3

\[
\frac{(\tilde{q}_B - \tilde{q}_A)}{(\tilde{q}_B - \tilde{q}_A)} < 1 \rightarrow \frac{\tilde{q}_B - (1 - \delta)\tilde{q}_A}{\tilde{q}_B - \delta \tilde{q}_A} < 1
\]

after a few substitutions we obtain:

\[
4\gamma\left(\frac{4\gamma}{\alpha} + 1\right)q^+(1 - 2\delta) < (\beta_H - \beta_L)(1 - p)(2w - 1)[4\alpha + 8\gamma] + 2\gamma(1 - 2\delta)
\]

We note that only the sign of the element \((1 - 2\delta)\) is not defined. In fact it is positive for \(p>1/2\) and negative for \(p<1/2\).

In the case of \(p>1/2\), i.e. \((1 - 2\delta)>0\), we obtain a ratio between two positive values which have to be lower than 1 if we observe cream skimming. In detail:

\[
\frac{4\gamma\left(\frac{4\gamma}{\alpha} + 1\right)q^+(1 - 2\delta)}{(\beta_H - \beta_L)(1 - p)(2w - 1)[4\alpha + 8\gamma] + 2\gamma(1 - 2\delta)} < 1
\]

(A2)

In the case of \(p<1/2\), i.e. \((1 - 2\delta)<0\), we obtain a ratio between two negative values which yield a positive value:

\[
\frac{4\gamma\left(\frac{4\gamma}{\alpha} + 1\right)q^+(1 - 2\delta) - (\beta_H - \beta_L)(1 - p)(2w - 1)[4\alpha + 8\gamma]}{2\gamma(1 - 2\delta)} > 1
\]

(A3)

q.e.d.
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