Why Managed Care Now and not For All*

Marcos B. Lisboa[†] Humberto Moreira[‡]

July 10, 2015

Abstract

We propose an alternative model for insurance markets which is used to analyze managed care contracts. In our model, households would like to buy insurance for the possible need of a service. The distinctive aspect of our model is that providers of service have privileged information on the most appropriate procedure to be followed. In the managed care application of the model, doctors are the providers of the service and through a diagnosis have better information of the patient's health condition. Managed care capitation contracts provide monetary incentives for doctors to save medical costs while standard health insurance contracts do not.

Equilibrium in our model is always constrained efficient. A partial capitation contract arises when both the cost and net benefits of treatment are high enough. We show that a capitation contract provides incentives for doctors: i) to care about the likelihood households will obtain the good state of nature *(altruistic behavior)*; and ii) to save medical costs *(managed care behavior)*. Doctors, in this case, choose less medically efficient treatments as they would choose under a standard health insurance contract. Besides this, household' welfare is increased in comparison to the standard contract (*fee-for-service* contract). This increased welfare translates into a revealed preference for the capitation contract.

*Financial support from CNPq. We would like to thank Francisco Ferreira, Ilan Goldfajn, Marco Bonomo, Walter Novaes and Monica Viegas Andrade for many useful comments on an early version of the paper. Preliminary versions of this paper were presented at EPGE/FGV, PUC-Rio, LACEA, 2000 and LAMES, 2001. The usual disclaimers apply.

†Graduate School of Economics, Getúlio Vargas Foundation.

‡Department of Economics, Catholic University of Rio de Janeiro.

1 Introduction

1.1 Managed Care

The standard health economics model usually assumes the existence of asymmetric information between insurance companies and patients.[1] Patients may know more about their health than insurance companies do and may tend to use health services more intensively if they have access to a full coverage. These assumptions generate some of the stylized facts observed in health insurance contracts, such as the requirement for co-payment and the supply of partial insurance contracts, even though households typically are risk-averse, while insurance companies may be risk-neutral.

In the traditional health insurance contract, *indemnity plans*, doctors are usually paid per service performed *(fee-for-service)*. In a full insurance contract, however, patients do not have incentives account for the cost of service when deciding whether or not they should consult a doctor. Because of that, they tend to see a doctor more often than it would be optimal.

The moral hazard problem presented in the relation between insurance companies and patients is solved through a risk-sharing contract.[2] Patients are responsible for a share of the service cost each time they see a doctor. This share is usually non-linear, having a lump-sum amount, paid at each visit, plus a percentage of the total expenditure. Contracts may also set a total amount every year to be paid by the insuree before being able to make use of the insurance. On the other hand, contracts between insurance companies and health providers (doctors and hospitals) usually simply establish the payment for services provided. Providers have freedom to propose needed treatments and there are no monetary incentives to limit expenditures.

Since the early sixties a steady increase in private health insurance costs have been observed, going from 3.89 percent of GNP in 1960 to 7.22 in 1990.[3] This tendency was one of the motivations for the Health Maintenance Act of 1973 and some further legal changes in the early 1980s that overturned existing restrictions on specific health insurance contracts. A main motivation for these decisions was to increase competition in the provision of health insurance contracts by allowing a large set of contracts, especially

[1] For a survey on health economics literature, see Zweifel and Breyer (1997) and Newhouse (1996).

[2] Arrow (1963) discusses in detail several possible market failures in the provision of health insurance.

[3] See Health Care Financing Administration (1998).

in the relationship among insurance companies, patients and providers of health services.[4]

Since the Health Maintenance Act, the typical health insurance contract has been subject to several transformations not explained by the standard model.[5] A central aspect of these transformations, usually labeled as the *managed care revolution*, has been the introduction of risk-sharing contracts between doctors and insurance companies.[6] Since doctors are typically risk-averse, this introduction suggests the need to provide incentives for doctors to take into account treatment costs while considering patient health and choosing the appropriate treatment.

Managed care's main objective is to rationalize the use of health services and, with respect to contracts with doctors, is characterized by two central aspects. First, patients have to choose a primary care physician. In order to have access to any medical service, they must first see their primary care physician, who will then determine the need to further exams or treatment.

Second, insurance companies establish a risk-sharing contract with the primary care physician, who receives a fixed amount a month per patient, independently of services provided. Besides that, insurance companies also establish several funds to provide payments for specialists, hospitals and exams. These funds are common to a group of doctors, who use them to pay for their patients' treatment. Each time a doctor determines the need for a procedure, the payment is withdrawn from the appropriate fund. If at the end of the year there is a positive balance in these funds, this balance is distributed to the doctors in an inverse ratio to the expenditures made by each doctor. These contracts are usually referred to as *partial capitation*.[7]

There are several types of health insurance companies in the managed care system. They differ as to the contract offered and benefits provided. The most common ones are HMOs (Health Maintenance Organizations), PPOs (Preferred Provided Organizations) and POS (Point of Service). Besides specific differences, all types share the basic innovation of managed care, an insurance contract that shares the risk between the insurance com-

[4]For arguments in that direction, see Enthoven (1993).

[5]Brown (1983) summarizes government regulatory impacts on the development of managed care.

[6]Glied (1999) summarizes the empirical literature on managed care.

[7]Fee-for-service contracts and salary payments also exist under managed care in some circumstances (Glied, 1999). Capitation, however, is a major innovation of managed care and will be the focus of the paper. We later on provide sufficient conditions for either capitation or fee-for-service contracts to emerge as the equilibrium outcome. Moreover, full capitation means that doctors bear all the risk. In our model, capitation is *always* partial, and it will be labeled by capitation only.

pany and the doctor.[8]

Managed care has been successful in controlling expenses and increasing its market share, displaying not only lower average costs but also lower rate of cost growth. Luft (1981) estimates that in some cases managed care costs are 10 to 40% lower than standard health contract costs. Between 1996 and 1997, for example, the cost of a typical HMO contract increased 1.03% while the typical health insurance contract increased 2.9%.[9] Furthermore, between 1992 and 1997, the managed care market share increased from 51% to 73%.[10] All these results suggest that the risk-sharing contract between doctors and insurance companies has addressed an incentive problem in the relation between doctors and insurance companies which ends up reducing insurance costs and increasing patient' welfare.

There are several controversies whether or not managed care provides an adequate insurance contract for patients and if contracts are well specified or not. In several instances, patients complaint about services not covered or delays in getting treatment. Very often, patients complain that doctors under managed care do not provide the best medical treatment available in comparison to that provided by the standard indemnity plan.[11]

Despite these controversies, however, it remains true that managed care has reduced health insurance cost growth and provided a service preferred by households in the sense that its market share has displayed a steady increase and most patients who choose a managed care contract later on do not regret the choice, not returning to a fee-for-service contract.[12]

What are the reasons for the appearance of capitation contracts? Why do these risk-sharing contracts between doctors and insurance companies seemingly increase overall welfare, leading to this increase in market share? Why are these incentives to doctors needed? From standard economic theory models, these risk-sharing contracts tend not to be optimal. Why, then, has managed care introduced them and why have consumers increasingly preferred these contracts?

[8] See Glied (1999).

[9] There is a controversy on to whether managed care reduces total costs or only selects patients with smaller costs. However, independently of the health cost reduction, some houlseholds prefer capitation contracts even with complaints about the quality of treatment. See Glied (1999), Newhouse (1996) and Newhouse, Schwartz, Williams and Witsberger (1985) for a summary of this discussion.

[10] See Health Care Financing Administration (1998).

[11] On the quality of services under managed care, see Miller and Luft (1997). Glied (1999) summarizes the major findings of the literature on the quality of managed care services.

[12] See Newcomer, Preston and Harrington (1996).

We propose in this paper an alternative model that generates partial capitation. However, our model does not rely either on the existence of providers of medical service with different but unobserved cost technologies or on an ex-ante asymmetry of information on the patient's health condition. There is to say, capitation in our model arises even if (i) providers of medical service have all access to the same technology; (ii) providers of medical service care only for their income; (iii) both the insurance company and the provider have the same information on the patient's current health condition when the insurance contract is signed. Therefore, capitation arises in our model even in the absence of selection problems.[13]

There is an extensive theoretical literature that identifies some economic reasons for the appearance of capitation contracts. This literature usually relies on the existence of adverse selection problems in the relation of the insurance company with either patients, doctors or hospitals.[14] In this case, capitation may be used as a screening device to select lower risk, or cost, type reducing the efficiency of the equilibrium outcome.[15]

Suppose however that explicit discrimination of patients that need medical care is not allowed and hospitals have access to the same technology. Why would then a single individual choose a capitation contract? In principle, in this case, both the insurance company and the provider of medical service have access to the same information on patient's health condition at the time the contract is signed. What would be the reason for a risk-sharing contract between the insurance company and the provider of medical service in this case? If the provider is risk-averse this contract would cost more than a fee-for-service contract.

Furthermore, the adverse selection literature does not seem to address the problem of treatment choice. One motivation for capitation contracts seems to be to provide incentives for doctors to choose medical procedures different than the ones they would choose under a fee-for-service contract.

This question is addressed by Ellis and McGuire (1986) and Rogerson (1994). In both cases providers of medical services care to some extent for

[13]It is simple to see that the trade-off between efficiency and selection raised by Newhouse (1996) also appears in this model when there are several risk types. Somewhat surpriensinly, the existence of equilibrium in our model generalizes to the case of adverse selection in the providers of medical services. This result contrasts with Rothchild-Stiglitz model. We will deal with that in the sequel of the paper.

[14]The basic models used in this literature are variations either of Rothchild-Stiglitz model or Shleifer's yardstick competition model. See Newhouse (1996).

[15]See Ma (1994) and Newhouse (1996).

the patient's welfare. In the first paper it is assumed that doctors care simultaneously for the patient's welfare and hospital's profits. In the second, hospitals choose to maximize gross social output.[16] The appearance of capitation contracts in these models, therefore, is associated with a specific assumption about the provider of service utility function.

1.2 Asymmetry of information in the health insurance market

The paper's main objective is to provide a theoretical model to address the questions raised by the managed care revolution. The model essential assumption is the existence of an information asymmetry in the doctor-insurance company relationship that justifies the establishment of these contracts. Suppose, initially, that doctors care about their income and also about the likelihood of patients being healthy in the future (*good state of nature*). We refer to this as the *altruistic assumption*. Under this assumption, in a fee-for-service contract doctors always choose the treatment that maximizes the likelihood of the good state of nature. In many cases, however, the marginal gain from choosing a better treatment, from a medical point of view, may not offset its cost, from the patient welfare perspective. Indeed, the term "best" here has no economic meaning: the best treatment can actually be very costly and patients may prefer an alternative treatment, which is less effective but cheaper. This result is trivially consistent with the stylized facts from health insurance markets, in particular the overuse, from an economic perspective, of exams and treatments if patients are provided a full insurance system and doctors have a fee-for-service contract.

In order to maximize patient welfare, doctors must take into account not only the likelihood of the good state of nature but also their budget constraints. If doctors always choose the best medical treatment irrespective of its cost, insurance companies anticipate this behavior, including it in the contract's expected cost. Thus, patients end up paying the cost of doctors' behavior.

The capitation contract arises naturally in this framework, which provides doctor incentives to balance the likelihood of good state of nature and the cost of treatment, since their reward depends inversely on how much they spend. This simultaneously reduces the expected cost of treatment and increases the likelihood of the bad state of nature. In an optimal contract, this trade-off is chosen to maximize patient welfare, restricted to the

[16] We refer to the assumption of providers of medical service caring about patient's welfare as *altruistic assumption.*

required doctor's incentives. Therefore, in this framework the contract optimally generates three basic aspects of managed care: i) incentives for doctors to control costs; ii) the optimal behavior of doctors in some circumstances is not to choose the best medical treatment as they would choose under fee-for-service contracts; and iii) increased patient welfare, which translates into a revealed preference for that contract.

The altruistic assumption, however, is very strong. Why would doctors have direct preferences for patients achieving the good state of nature? We show in the paper that this assumption can be endogenously generated in many circumstances. First, we construct a simple example where doctors may be sued and punished in case bad state of nature happens. The existence of litigation costs leads almost immediately to the altruistic assumption *(defensive medicine)*.[17]

The most interesting case, however, which is the focus of the paper, arises when there is an additional moral hazard problem in the doctor-insurance company relationship.[18] Suppose the quality of the diagnoses performed by the doctor depends upon an effort level which is not directly observable. That effort level may be related with the doctor's effort in keeping up with the medical research literature or the attention he gives to the patient in his office. In any case, in order to provide incentives for the doctor to choose high effort, the optimal contract must offer better rewards in case patients achieve the good state of nature, which generates precisely the altruistic behavior. In doing so, it creates incentives to use the best medical treatment independently of its cost. In order to compensate for that behavior, the optimal contract must also provide incentives for the doctor to take into account total costs: the doctor's payment must be inversely related to the expenditures on the patient treatment.

1.3 Insurance markets for specialized service

The model proposed here is quite general and seems to apply to a variety of circumstances. We consider a model with providers of a service and households who would like to buy insurance against the chance of having to use such a service. Providers have access to privileged information on the

[17]For the evidence that doctors practice defensive medicine, see McClelan and Kessler (1996).

[18]Equilibrium in our model exists even if there are different types of doctors and each doctor's type is private information (adverse selection model). As we show later, contrary to the Rothschild and Stiglitz (1976) model, in our framework the equilibrium outcome can be obtained as a solution of a planner's problem, which always has a solution.

most appropriate procedure to be followed. There is always a chance, however, that providing the service may not be successful. Suppose households have access to a full insurance contract that pays for whatever procedure providers find necessary. If providers may be sued in case the procedure is not successful, or if they are concerned about their reputation, they have incentives to always propose the procedure most likely to be successful irrespective to its cost. In equilibrium, however, insurance companies anticipate this behavior, which results in higher insurance premiums.

We propose that this asymmetry of information lies at the core of the managed care revolution. The model's basic features, however, may also be used to understand several insurance for service arrangements, such as possible repair of durable goods or fixed assets. A central property of the model is that a risk-sharing contract between an insurance company and providers of service may arise every time a household would like to buy insurance for possible services needed and the provider has privileged information. *The rationale of this contract is to make providers internalize not only households ' desire for a successful outcome, but also the cost of alternative procedures.* In some cases, a procedure with a lower likelihood of success may be chosen over one with higher likelihood that nevertheless costs more.

The paper provides sufficient conditions for the existence of equilibrium. In order to induce providers to make effort, the optimal contract must specify higher payments in the good state of nature and thus induce them to care about the outcome for the household. This last equilibrium property result is equivalent to the *altruistic assumption.* The equilibrium outcome is characterized by a loss of welfare for the household, in comparison with the first-best outcome, due to the need to encourage providers to choose, on one hand, effort, and the least expensive treatment for some signals on the other. However, the equilibrium outcome is still constrained optimal: given the asymmetry of information, the market outcome is the most efficient one. Risk-sharing contracts do not always produce an equilibrium outcome in our model. We show, however, that they do if costs and net benefits from procedures get very high. This result seems to fit particularly well in the health insurance case, where the growth of managed care has been increasing precisely while new medical technologies have become available, new technologies that are simultaneously more expensive and more effective in treating diseases.[19]

The next section provides a precise description of the model. Section

[19] On the increasing cost of new medical technologies, see Glied (1999) and the references there summarized.

3 focuses on two leading examples: defensive medicine and risk-neutral providers. Section 4 describes the optimal contract and summarizes our central results. In order to simplify the model's interpretation and convey the central message as a proposal to understand theoretically managed care, we stick to the health insurance market interpretation of the model where service providers are labelled as *doctors* and households are often referred to as *patients*.

In the sequel to this paper we will extend the model to a dynamic setting where insurance companies are restricted in introducing contracts with monetary payments independent of the state of nature. This generalization seems natural since in several instances one does not observe providers's payments to be contingent upon the state of nature. In particular, providers of medical service payments do not seem to depend on whether or not patients get better after being treated. We show that by allowing companies to threaten not to renew the contracts, they may still be able to induce providers to make an effort. In this case, however, providers' expected utility must be higher than their reservation level.

2 The general framework

We consider a model with three types of parties: households, providers of a service and insurance companies. Households have uncertainty about the future need for a service, which affects their level of health.[20] Providers, if hired by a household, perform a diagnosis which provides a signal about which service may reduce the likelihood of a loss of income due, for example, to the need to buy another good or a worse health condition. This signal is observed only by the provider of the service. For each signal there is a procedure that maximizes the likelihood of households obtaining the good state of nature in the final period. Before providing the diagnosis, however, providers have to choose an effort level. High effort levels increase the probability of the good state of nature for every signal and procedure chosen. There are risk-neutral insurance companies that offer contracts to both the providers and households.[21]

[20]From the formal point of view, in our model patients have uncertainty on future utility levels. Therefore, the bad state of nature can be interpreted as a loss in welfare due to any other motive, including a health condition.

[21]We abstain in the paper from the moral hazard problem in the relationship between patient and insurance company. Such a problem is well treated by the standard model and it could be easily added in our model without any additional cost, except making the notation even more complex.

Consider a partial equilibrium model with a single commodity, two periods and three stages in each period - *ex-ante, interim, ex-post* - and three types of individuals: *patients, doctors*[22] *and insurance companies.*

In each period patients face uncertainty about the health condition in the ex-post stage: there are two individual states of nature: $j \in \{B, G\}$ and preferences regarding consumption bundles are represented by a state-dependent utility function $u^j : \Re_+ \to \Re \in C^2$, strictly increasing and concave such that

Condition 1 (H1) *The utility of the good at the good state is* $1 + \delta^u$ *times the utility at the bad state, i.e.,* $\gamma u^G = u^B$, $\gamma > 1$.

Let us denote u^B simply by u. Notice that from the formal point of view, uncertainty is concerned on future utility levels. Therefore, a bad state of nature can be interpreted as a bad health condition that reduces the patient utility. Without loss of generality, with assume that patients have the same endowment in both states of nature, ω. Let the status quo probability of the good state of nature be π_0.

Let $v : \Re_+ \to \Re \in C^2$ be the doctor's utility function, strictly increasing and strictly concave.

Doctors have an uncertain demand represented by an exogenous probability $p \in (0, 1)$ of having a patient outside the contractual relation with insurance companies in each period. A doctor has an expected reservation utility denoted by $\bar{v}$, where if $\bar{r}$ satisfies $v(\bar{r}) = \bar{v}$ then $\bar{r} > 0$.

There are $I > 1$ principals, or *insurance companies*, that provide insurance for the patients and intermediate their relation with the doctors. We suppose that these principals are risk-neutral.

The model proposed here departs from the standard literature by assuming the existence of a third type of individual, whom we refer to as *doctor*. A doctor examines a patient and chooses an action, or treatment, in the interim stage that affects the patient's probability of the good state of nature. This action is supposed to be perfectly observable, but its effectiveness depends upon a signal privately observed by the doctor.

The time line of the model in each period can be summarized as follows.

[22] There is no change in the results that follow if the service provider is a doctor or as an hospital.

Contracts offered	Signal	Choice of treatment	State realized Contracts enforced
------- |	------- |	------- |	------- |
ex-ante	interim 1	interim 2	ex-post

In the ex-ante stage in each period, contracts are proposed and chosen. The interim stage is divided into two sub-stages. In the first doctors observe a signal concerning patients health and, in the second, a treatment is proposed and implemented. Finally, in the ex-post stage the state of nature is revealed and contracts are enforced.

To make the argument precise, suppose that in the interim stage the doctor observes a private signal s that may assume the following discrete values in $S = \{s_j;\ j = 0, 1, ..., N\}$, with cumulative probability function given by $F(s_j) = j/N$. With some abuse of notation, we use s_j for both the j-th signal and the probability of a signal occurrence below it. Moreover, higher signal means bad news in terms of patients health.

There are 2 types of actions available for the doctor: $A := \{a_0, a_1\}$. Action i costs a_i to be implemented in addition to the doctors' payments, $0 = a_0 < a_1 = a$. Action a_0 should be interpreted as the doctor choosing *no action.*

Given this signal, the probability of the good state of nature for a patient depends on the action chosen and it is given by $\pi(a, s)$ for every a. Denoting $\Delta\pi(s) = \pi(a_1, s) - \pi(a_0, s)$, we assume that:

Condition 2 (H2) *$\pi(a_i, s)$ is decreasing, for $i = 0, 1$, and $\Delta\pi(s)$ is increasing in s. Moreover, there exists a critical $s_c \in S$ such that $\Delta\pi(s_c) = 0$. To avoid the result being trivial, $1 < c < N$.*[23]

Therefore, the higher the signal the lower is the probability of the good state. Moreover, the gain of using treatment increases with the signal and there exists a critical signal s^c such that for signals below it action a_0 generates a higher probability of the good state of nature, while for signals above it the reverse happens.

If doctors change from no treatment to treatment at s, then

$$g(s) = \left(\sum_{s_k \leq s} \pi(s_k, a_0) + \sum_{s_k > s} \pi(s_k, a_1) \right) \Delta s$$

[23] For simplicity we assume that there exist s^c satisfying the equality.

is the ex-ante probability of the good state. Since s^c maximizes this ex-ante probability of the good state of nature, we refer to it as the *best action* or *the best medical treatment*.

Let r_j be the doctor payment in case he chooses treatment j, i.e., $r := (r_j)$ is the contract. Let $v_j := v(r_j)$ be the doctor indirect utility. We also define the *power* of the contract: $\Delta r := r_1 - r_0$, which gives the incentives for the choice of treatment. Analogously, we can define the powers in units of doctor's utility: Δv. Denote also d the premium paid by patients to insurance companies in each period.

3 On the cost of altruism and capitation contracts

In this section we consider a reduced version of the model that provides the basic intuition of our results. Supose that doctors care about the likelihood of patient´s achieving the good state of nature *(altruistic assumption)*. This care may result either from some exogenous reason (e.g., litigation costs in case bad state happens), or, as we will see later on from an endogenous one (reputation or asymmetric information on doctors' effort or type).

Given the altruistic assumption, in the absense of further incentives, doctors will always choose the treatment that maximizes the likelihood of patient´s achieving the good state of nature *(best medical treatment),* regards its cost, wich will lead to high insurance primium for such a contract.

A welfare improvment, however, may be obtained in case doctor´s payments are contingent upon the choice of treatment, which will partially offset the altruistic behaviour, with doctors receiving larger payments in case they choose no treatment *(capitation contracts)*. The expected cost of such incentives schemes will depend on doctors´risk aversion. An welfare improvement will be obtained either if cost of treatment is high enough or the cost of the bad state of nature is small enough.

In the second part of the paper we will show that this seemingly *ad hoc* altruistic assumption actually arises for several types of further uncertainty. Presence of moral hazard - doctors choose an unobservable efort level; adverse selection - there are several doctors' type with unobservable characteristics; or demand uncertainty in a dynamic model; all of these induce doctors to care about patients' achieving the good state of nature. Therefore, altruistic behaviour is an endogenous feature of doctors-patients realtionship in the presence of uncertaity. This, in turn, leads, in a three party model of unsurance to capitation as the optimal contracts for some types of patients.

3.1 A simple example

To concentrate ourselves in the doctors' incentive schemes, let us assume for these examples that the consumer is risk neutral. In the example, doctors may be punished in case they do not choose the best medical treatment *(defensive medicine)*. It is shown that in this case, even without the reputation effect, the basic results of the paper carry over. Punishment, in this case, makes doctors care about the likelihood of patients achieving the good state of nature and, in the absence of any other incentive, always to choose the best treatment. The efficient outcome, however, may require doctors not always to choose the best treatment, since its cost may not compensate the marginal benefit of increasing the probability of the good state of nature. The optimal contract, in this case, will offset the punishment cost, providing larger payments in case doctors choose no treatment.

Now we consider the leading example of defensive medicine. In this case, doctors may be sued if they do not choose the best medical treatment and the patient does not obtain the good state of nature. We assume that doctors' loss in income due to not choosing the best medical treatment is proportional to the patient loss in the likelihood of the good state of nature.

The doctor's utility level given a contract r, signal s and choice of treatment a is given by

$$\pi(a,s)v + (1-\pi(a,s))\, v\left(r - \alpha\left(\pi(s) - \pi(a,s)\right)\right)$$

where $\alpha > 0$ is the parameter that gives the letigation cost of doctors and $\pi(s) := \max_a \pi(a,s)$ is the probability associated with the best medical treatment. Therefore, if the doctor's payments are not contingent on the choice of treatment, he always chooses the best medical treatment, that is to say a so that $\pi(a,s) = \pi(s)$ for every s.

In the case where payments are contingent on the treatment choice and s is a signal where doctors where indifferent between using treatment or not, then

$$\pi(a_0,s)v(r_0) + (1-\pi(a_0,s))\, v\left(r_0 - \alpha\Delta\pi(s)\right) = v_1 = v(r_1).$$

This implies that $r_0 > r_1$. Since we are interested in contracts least costly and make the doctor participate, $r_1 = \bar{r}$ in the optimal contract.

Consider a contract that maximizes patient welfare given the needed incentives for the doctors. If in this contract payments are not contingent upon the treatment chosen, the expected social benefit is

$$[1 + \delta^u g(s^c)]u$$

and its cost is given by $\bar{r} + (1 - s^c)a$. Thus, s^c is the optimal change of treatment if and only if

$$\delta^u \Delta\pi(s^c + \Delta s)u \geq a\Delta s \geq \delta^u \Delta\pi(s^c)u = 0.$$

If a is sufficiently large or δ^u sufficiently small, then s^c cannot be optimal. This means that an efficient contract must necessarily have payments contingent upon the treatment chosen.

3.2 The one-period model

Since doctors are risk averse and insurance companies are risk neutral, we will show that contracts between insurance companies and doctors must be non-contingent on the choice of treatment. As we will see later, in the dynamic equilibrium it may be optimal to make the doctor's payments contingent upon the action chosen.

We refer to a contract that specifies a payment of $\overline{r}$ independently of the use of treatment as a *fee-for-service* one. Moreover, under this contract doctors are indifferent when they must use treatment or not.

Given contracts $r = (r_0, r_1)$ between insurance companies and doctors and d the premium paid by patients to insurance companies, the ex-ante expected profit of insurance companies and utility of patients are respectively:

$$\begin{aligned} L(r,d) &= d - sr_0 - (1-s)(r_1 + a) \\ U(r,d) &= [1 + \delta^u g(s)]u(w - d) \end{aligned}$$

where s is the induced change of treatment induced by the contract to the doctors.

Let R be the set of contracts r between insurance companies and doctors that satisfy the following ex-ante participation constraint of doctors:

$$V(r) = v_1 - s\Delta v \geq \overline{v}$$

where s is the induced change of treatment induced by the contract.

Now let us define the concept of equilibrium that we are going to use:

Definition 3 *An* ***equilibrium*** *is a collection of strategies* $(r_i, d_i)_i$ *where for each* i *the contract* (r_i, d_i) *solves the problem*

$$\begin{gathered} \max L(r,d) \\ s.t.\ U(r,d) \geq U(0,0) \\ r \in R \end{gathered}$$

where $U(0,0) = [1 + \delta\pi_0]u(w)$.

Consider an alternative model with the same primitives, except that the doctor's signal is observable. In this case one can easily verify that at equilibrium doctors receive a fixed payment independently of the treatment chosen, which provides them the reservation utility. Insurance companies, due to competition, make zero profits and the optimal signal is chosen to maximize patient welfare. As usual, this outcome is referred as *Pareto optimal or first best.*

In our model, on the other hand, in some cases insurance companies have to induce doctors to choose a high effort level by offering more rewards in case the good state of nature occurs. These incentives induce doctors to choose the most expensive treatment when that choice maximizes the probability of the good state of nature. However, this behavior may not be optimal from the patient perspective since he also takes into account the effect on the expected cost of treatment and, therefore, the expected cost of insurance. Therefore, the optimal contract may also have to provide incentives for doctors to choose the least expensive treatment in some cases by reducing their payment in case they choose the more expensive (and more effective) one from the health perspective.

We will show later, however, that the market outcome is always constrained optimal, in the sense provided below. Let R^0 denote the set of feasible contracts which can be contingent upon the signal observed by the doctor and R is the set of non-contingent contracts. The set R^0 corresponds to the model with perfect, symmetric information and R corresponds to the set of asymmetric information one.

Definition 4 *We say that an equilibrium* $(r_i, d_i)_i$ *is* ***first-best*** *if there is no other contract* (r, d) *satisfying*

$$r \in R^0,\ L(r,d) \geq 0 \text{ and } U(r,d) > \max_i U(r_i, d_i).$$

We say that an equilibrium $(r_i, d_i)_i$ *is* ***constrained optimal,*** *if there is no other contract* (r, d) *satisfying*

$$r \in R,\ L(r,d) \geq 0 \text{ and } U(r,d) > \max_i U(r_i, d_i).$$

The equilibrium maximizes the patients' welfare. Since insurance companies break even, the contract premium must be equal to the ex-ante expected cost, i.e.,

$$d = sr_0 + (1-s)(r_1 + a).$$

Therefore, the optimal change of treatment must solve the following program:

$$\max_{r,s}\ [1+\delta^u g(s)]u(w-d)$$
$$\text{s.t.}\quad v_1 - s\Delta v \geq \overline{v}$$
$$d = sr_0 + (1-s)(r_1+a).$$

Let us denote s^* the solution of the program above. We say that there is a delay in the change of treatment if $s^* > s^c$. The following proposition resumes our first result:

Proposition 5 *The one period model has a fee-for-service first-best equilibrium where doctors receive their certainty equivalent of the outside opportunity cost. Moreover: (i) the optimal treatment may involve some delay ($s^* \geq s^c$), it is nonincreasing with δ^u and nondecreaing with a; (ii) if a is sufficiently low, then the optimal change of treatment is the best one.*

4 Endogenizing altruism

4.1 Two-periods model

Now we will introduce dynamics in the model. Suppose that there are two periods and there is no commitment, that is, contracts are short run and patients may not return to same doctor. Patients decide in end of the first period if they will come back in the next to the current doctor. Let ρ^j be the probability that patients will return to the same doctor in the second period given the state realized at the first period is j. If a patient returns to the same doctor, he improves his likelihood of surviving by a multiplicative factor $\delta^g > 0$. This is exactly the reputation effect which can be justified by the fact that the long run relation with a doctor has a value for the patient (for instance, when patients return to the same doctor, they benefits from the superior knowledge on health conditions that this doctor has about them). Formally:

Definition 6 *We denote $G = (1+\delta^g)g$ the ex-ante probability of the good state of nature due to reputation effect.*

We use the perfect equilibrium concept to solve the game in two periods. As we saw in the last subsection, the solution in one-period model is the fee-for-service contract. However, since patients may threaten doctors not coming back in the second period and doctors demand is uncertain, the first period contract may have power on choice of treatment in equilibrium which characterizes the capitation aspect of the contract. In this case, doctors have an incentive to anticipate the change of treatment in order to raise the likelihood of the good state of nature.

We start the analysis investigating the principal's offers to the doctor which specify how much he receives in the interim stage. Now contracts depend upon the choice of treatment. Suppose that a doctor has accepted a contract (r_j). His optimal behavior is to choose treatment $a_j(s)$ for a given signal s. Anticipating a return probability ρ^j of the current patient under the the insurance contract given the realization of the state of nature j in the end of the first period. His expected utility in the interim stage of the first period is then given by[24]

$$V_j(s) = [p + (1-p)(\rho^B + \pi(s, a_j(s))\Delta\rho)]\overline{v} + v_j$$

where $\Delta\rho = \rho^G - \rho^B$.

Therefore, doctors choose treatment at s if and only if

$$(1-p)\Delta\pi(s)\Delta\rho\overline{v} \geq -\Delta v.$$

In the ex-ante stage insurance companies offer contracts for the doctors and patients. If an insurance company offers a contingent contract on the treatment choice, $r = (r_j)$, to the doctor and charge d to the patient and both accept the contract, then its expected profit will be

$$L(r, d) = 2d - \{r_1 - s\Delta r + (1-s)a + [p + (1-p)(\rho^B + g(s)\Delta\rho)]\overline{R}\}$$

where $\overline{R} = \overline{r} + (1-s^*)a$ and s is the induced change by the contract.

If the patient accepts this offer, his utility is then given by

$$U(r, d) = [2 + \delta^u g^* + \delta^g g(s) + (\rho^B + g(s)\Delta\rho)\delta^u\delta^g g^*]u(w-d)$$

where the star means that the respective variable is calculated at s^*.

As in the previous section, the efficient allocation for the two-periods model is the one that maximizes the insurance company expected profit given the patients acceptance restricted to the first period contracts be in R. In the next subsection we will characterize it.

4.1.1 Efficient allocation

The efficient allocation is equivalent to maximize the patient welfare subject to the participation of doctors, break-even of insurance companies and the

[24] In the Appendix we give the total expression of this utilities and the others below.

induced change of treatment. Thus, the efficient allocation of the economy is the solution of the following problem when there is a change of treatment at s:

$$\begin{array}{ll} \max\limits_{\rho^j, v_i, d} & [2 + \delta^u g^* + \delta^g g(s) + (\rho^B + g(s)\Delta\rho)\delta^u \delta^g g^*] u(w - d) \\ \text{s.t.} & v_1 - s\Delta v \geq \overline{v} \quad (1) \\ & 2d \geq r_1 - s\Delta r + (1 - s)a + [p + (1 - p)(\rho^B + g\Delta\rho)]\overline{R} \quad (2) \\ & (1 - p)\Delta\pi(s)\Delta\rho\overline{v} \geq -\Delta v \quad (3) \end{array}$$

We have the following result:

Proposition 7 *The efficient allocation of the two-periods economy is the fee-for-service contract in each period.*

Proof. See the Appendix. ■

4.1.2 Equilibrium allocation

Differently from the efficient solution, the patients may not be committed to return to the doctor of the first period. This means patients may threaten doctors in the first period not returning with positive probability. In this case doctors will be incited to anticipate the change to treatment earlier than in the fee-for-service case (capitation effect). On the order hand, patients have a gain in continuing with the same doctor (reputation effect). As we will see below contracts may involve some power on the contract between insurance companies and doctors (capitation contract) due to the nocommitment of patients.

First let us establish the threat of patients. Given implementable contracts (v_0, v_1), d and the change of treatment at s, the patient's decision problem is given by:

$$\begin{array}{ll} \max\limits_{\rho^j} & [2 + \delta^u g^* + \delta^g g(s) + (\rho^B + g(s)\Delta\rho)\delta^u \delta^g g^*] u(w - d) \\ \text{s.t.} & (1 - p)\Delta\pi(s)\Delta\rho\overline{v} \geq -\Delta v \end{array}$$

Finally, the equilibrium is determined by maximizing the patients welfare in the doctors payments and patients premium given the reputation power (ρ^B and ρ^G) and the induced change of treatment (an analogous maximization problem of the efficient allocation determination, but fixing ρ^B and ρ^G). The equilibrium must best perfect in the sense that patients have no incentive to deviate from their pre-determined probability of return to doctors in the end of the first period.

Thus, fee-for-service will be an equilibrium if and only if there is no delay. That is, if s^{**} is the optimal change of treatment in the first period, then $s^{**} \geq s^c$ and: (i) if $s^{**} = s^c$, then the equilibrium will be fee-for-service in both periods without any delay in the first period; (ii) if $s^{**} > s^c$, then the equilibrium contract will have capitation in the first period with delay. The following proposition resumes our finding:

Proposition 8 *The two period model has a fee-for-service first-best equilibrium in the first period if and only if the optimal change of treatment is the best one. This will be the case if a is sufficiently low. Otherwise, capitation in the first period is always present with delay. Moreover, the optimal treatment in the first period may involve some delay ($s^* \geq s^c$) and it is nonincreasing with δ^u and δ^g and nondecreaing with a.*

Proof. See the Appendix. ■

4.2 Introducing hidden information

There are two classical ways to introduce asymmetric information in the relation between doctors and insurance companies: hidden effort of doctors or doctors are heterogenous with respect to their types. Since the conclusions of the second case are analogous, we will only do the analysis of the first case.

4.2.1 Moral hazard

Suppose that, before observing the signal, doctors have to choose an *effort level,* $e = 0$ and $e = 1$, with the respective costs: $0 = c_0 < c_1 = c$. Let

$$\begin{cases} \pi(a, s), \text{ if } e = 0 \\ \Pi(a, s), \text{ if } e = 1 \end{cases}$$

be the probability of the good state given a, s. We assume that $(H2)$ holds for π and effort always increases the likelihood of the good state of nature in the following way: making effort ($e = 1$) is equivalent to observing a more favorable signal on the patient's health condition. That is, let us assume:

Condition 9 (H3) $\pi(a_j, \gamma s) = \Pi(a_j, s)$, *where* $\gamma \in (0, 1)$, *for all* j *and* s.

The assumption $(H3)$ says that the doctor's effort improves the signal by a factor of γ, i.e., a doctor that makes effort and observes a signal s

is equivalent, with respect to the consumer's welfare, to one that makes no effort and observes a better signal γs.

Now, the insurance company should guarantee the participation of the doctor and induce the doctor's optimal effort.[25] A doctor who decides to make an effort i will accept this contract if the participation constraint is satisfied:

$$v_1 - (1 - s^i)\Delta v - c_i \geq \bar{v} \quad (IR)$$

where s^i is the change of treatment and it induces effort i if it satisfies the incentive constraint:

$$v_1 - (1 - s^i)\Delta v - c_i \geq v_1 - (1 - s^{-i})\Delta v - c_{-i} \quad (IC_i)$$

$-i \neq i$ is the alternative effort. The insurance company may also decide not to hire a doctor, in which case it can simply offer $r = 0$ and the probability of the good state of nature is given by π_0 (null contract). In this case, the household just buys a full insurance contract that transfers income from the bad to the good state of nature and does not go to see a doctor. Let R be the set of contracts that satisfy the incentive and participation constraints and the null contract.

Let R^0 be now the set of contracts in R that can be contingent on the signal observed and the effort made by the doctors; R^s be the set of feasible contracts which can be contingent only upon the signal observed.

Thus, we have analogous definition of first-best and constrained optimal, but we add the following

Definition 10 *We say that an equilibrium* $\{(r_i, d_i)_i\}$ *is* ***second-best*** *if there is no other contract* (r, d) *satisfying*

$$r \in R^s, \; L(r, d) \geq 0 \textit{ and } U(r, d) > \max_i U(r_i, d_i)$$

Therefore, besides the participation constraint on the doctor, there will also be incentive constraints that must be satisfied. In the next subsections we deal with this problem. What is important here is that the decision for effort is taken after he signs the contract and before the doctor sees the signal in the interim stage in each period.

[25] If the service provider is an hospital, the utility function is linear and the (IR) constraint is the break-even condition and everything is the same.

The equilibrium allocation of the economy under moral hazard of the doctor's choice of effort must solve the following problem:

$$\max_{v_i,d,s}[2+\delta^u g^* + \delta^g g(s) + (1-\Delta\rho + g(s)\Delta\rho)\delta^u\delta^g g^*]u(w-d)$$
$$\text{s.t.} \quad v_1 - s\Delta v \geq p\overline{v} \quad (1)$$
$$2d \geq r_1 - s\Delta r + (1-s)a + [(1-g)p+g]\overline{R} \quad (2)$$
$$(1-p)\Delta\pi(s)\overline{v} \geq -\Delta v \quad (3)$$
$$-(1-\gamma)\Delta v \geq c \quad (4)$$

Proposition 11 *Let s be the optimal change of treatment under symmetric information on effort. Then, the equilibrium is second-best if and only if $(1-\gamma)(1-p)\Delta\pi(s)\overline{v} < c$.*

5 Comparative statics

6 Concluding remarks

The paper proposed a contract model to analyze managed care and, specifically, capitation contracts. The model's basic feature is the existence of an asymmetry of information between insurance companies and patients, on one side, and the providers of service, doctors, on the other. Doctors know more about patients' health than insurance companies or even patients do. Moreover, doctors success in treating patients may depend on a non-observable effort level. In order to induce doctors to make an effort, optimal contracts have to provide larger payoffs in case patients achieve the good state of nature. However, this induces doctors to disregard treatment costs, leading to high insurance premiums and reducing patients' expected welfare. Therefore, in equilibrium, it may be optimal to provide incentives to doctors to save medical costs through capitation contracts.

We have shown that fee-for-service contracts might be first-best. This happens when the gains from providing incentives for doctors to choose effort are not high enough. However, in many cases the first-best is not attainable and, in particular, capitation contracts may provide larger patient expected utility than fee-for-service contracts. Capitation contracts arise precisely when both the benefits and costs from treatment are high enough: in this case, patients benefit from high effort but also from doctors not always using the best medical treatment. This equilibrium property seems to fit the stylized facts from the growth of managed care and capitation contracts in the US.

Since capitation contracts are not first best, the transition from fee-for-service to capitation contracts, due for example, to a change in the treatment technology, may generate a sense of loss in efficiency. However, every time the optimal contract is capitation, it welfare dominates a fee-for-service contract. Even though they are not first-best, capitation contracts, whenever they arise, are the best possible outcome, maximizing patient welfare subject to the given information asymmetry.

7 Appendix

Let us first give the expressions of the expected utilities of doctors, insurance companies and patients:

$$\begin{aligned}
V_j(s) &= \{(1-\pi(s,a_j(s)))[\rho^B+(1-\rho^B)p]+\pi(s,a_j(s))[\rho^G+(1-\rho^G)p]\}\overline{v}+v_j \\
L(r,d) &= 2d-\{sr_0+(1-s)(r_1+a) \\
&\quad +[(1-g)(\rho^B+(1-\rho^B)p)+g(\rho^G+(1-\rho^G)p)]\overline{R}\} \\
U(r,d) &= (1-g)\{u^B+(1-\rho^B)[(1-g^*)u^B+g^*u^G]+\rho^B[(1-G^*)u^B+G^*u^G]\} \\
&\quad +g\{u^G+(1-\rho^G)[(1-g^*)u^B+g^*u^G]+\rho^G[(1-G^*)u^B+G^*u^G]\}
\end{aligned}$$

Proof. (Proposition 5) Since patients and doctors are risk averse, it is easy to see that in the optimal $r_0 = r_1 = \overline{r}$. Moreover, the optimal change of treatment is s if and only if

$$[1+\delta^u g^-]\Delta u \geq [\delta^u \Delta\pi\Delta s]u \text{ and } [\delta^u\Delta\pi^+\Delta s]u^+ \geq [1+\delta^u g]\Delta u^+$$

where $d = \overline{r}+(1-s)a$, $u = u(w-d)$, $\Delta u = u(w-d)-u(w-d-a\Delta s)$, $g = g(s)$, $\Delta\pi = \Delta\pi(s)$ and the index + (resp. $-$) means that respective function is calculated at $s+\Delta s$ (resp. $s-\Delta s$). These conditions can written equivalently as

$$[(\delta^u)^{-1}+g^-]\frac{\Delta u}{u} \geq \Delta\pi\Delta s \text{ and } \Delta\pi^+\Delta s \geq [(\delta^u)^{-1}+g]\frac{\Delta u^+}{u^+}.$$

Then, from H2 and these inequalities, $s \geq s^c$. From the concavity of u, the left hand side of the first inequality and the right hand side of second inequality above are nonincreasing in a and δ^u. Thus, this implies that $\Delta\pi$ must not increase when a and δ^u increases. By H2 and the fact that $s \geq s^c$, (i) follows. Observe that if a is sufficiently low (close to zero), then $s = s^c$, i.e., (ii) is true. ■

Proof. (Proposition 7) Writing down the Lagrangian L and deriving its first order condition we have:

$$\begin{aligned}
0 &= \partial_d L \Leftrightarrow\ 0 = -[2+\delta^u g^* + \delta^g g + (\rho^B + g\Delta\rho)\delta^u\delta^g g^*]\partial u + 2\lambda_2 \quad (4)\\
0 &= \partial_{v_0} L \Leftrightarrow 0 = (\lambda_1 - \lambda_2 h'(v_0))s - \lambda_3 \quad (5)\\
0 &= \partial_{v_1} L \Leftrightarrow 0 = (\lambda_1 - \lambda_2 h'(v_1))(1-s) + \lambda_3 \quad (6)\\
0 &\geq \partial_{\rho^B} L \Leftrightarrow 0 \geq [\delta^u\delta^g g^* u - (1-p)\lambda_2 \overline{R}\ ](1-g) - (1-p)\Delta\pi(s)\lambda_3\overline{v} \quad (7)\\
0 &\leq \partial_{\rho^G} L \Leftrightarrow 0 \leq [\delta^u\delta^g g^* u - (1-p)\lambda_2 \overline{R}\ ]g + (1-p)\Delta\pi(s)\lambda_3\overline{v} \quad (8)
\end{aligned}$$

From (4)

$$\left[1 + \frac{\delta^u g^* + \delta^g g + (\rho^B + g\Delta\rho)\delta^u\delta^g g^*}{2}\right]\partial u = \lambda_2 > 0$$

which implies that (2) is an equality: $2d = r_1 - s\Delta r + (1-s)a + [p + (1-p)(\rho^B + g\Delta\rho)]\overline{R}$.

From (5) and (6)

$$\begin{aligned}
h'(v_0) &= \frac{\lambda_1 - \lambda_3/s}{\lambda_2}\\
h'(v_1) &= \frac{\lambda_1 + \lambda_3/(1-s)}{\lambda_2}
\end{aligned}$$

Thus, if $\lambda_3 = 0$, then $\Delta v = 0$ which, from (3), implies that $\Delta\pi(s) = 0$ or $\Delta\rho = 0$. Now we will show that λ_3 cannot be positive or negative.

If $\lambda_3 > 0$, then, from (5) and (6), $\Delta v > 0$ which from (3) implies that (i) $\Delta\pi(s) < 0$ and $\Delta\rho > 0$ or (ii) $\Delta\pi(s) > 0$ and $\Delta\rho < 0$. Suppose that (i) holds. There exists two possibilities for the sign of $\delta^u\delta^g g^* u - (1-p)\lambda_2\overline{R}$. If it is non-negative, from (7) $\partial_{\rho^B} L > 0$ and then $\rho^B = 1$. If it is negative, from (8) $\partial_{\rho^G} L < 0$ and then $\rho^G = 0$. However, in both cases this implies that $\Delta\rho \leq 0$ which is a contradiction. For (ii), a similar contradiction occurs.

If $\lambda_3 < 0$, then, from (5) and (6), $\Delta v < 0$ which, from (3), implies that: (i) $\Delta\pi(s) > 0$ and $\Delta\rho > 0$ or (ii) $\Delta\pi(s) < 0$ and $\Delta\rho < 0$. Again, a similar contradiction occurs.

There are the following possibilities:

i. $\delta^u\delta^g g^* u < (1-p)\overline{R}\partial u$ which implies that $\rho^B = \rho^G = 0$;

ii. $\delta^u\delta^g g^* u > (1-p)\overline{R}\partial u$ which implies that $\rho^B = \rho^G = 1$;

where u and its derivative ∂u are calculated at $w - .5(\overline{r} + (1-s)a + pR$.

iii. otherwise, $\delta^u\delta^g g^* u = (1-p)\overline{R}\partial u$;

where u and its derivative ∂u are calculated at $w - .5(\overline{r} + (1-s)a + pR + (1-p)\pi\overline{R}$ and $\pi = (1-g)\rho^B + g\rho^G$ is such that the equality is true. In particular, we can choose $\rho^B = \rho^G = \pi$.

Therefore, the efficient contract is fee-for-service. ■

Proof. (Proposition 8) Let us analyze two possible cases:

(i) $\Delta v \geq 0$. In this case, it is easy to see that the optimal patients choices are $\rho^B = \rho^G = 1$. Thus, the equilibrium allocation of the economy must solve the following program:

$$\begin{aligned} &\max_{v_i,d,s}[2 + \delta^u g^* + \delta^g g(s) + \delta^u \delta^g g^*]u(w-d) \\ &\text{s.t.} \quad v_1 - s\Delta v \geq p\overline{v} \quad (1) \\ &\qquad 2d \geq r_1 - s\Delta r + (1-s)a + [(1-g)p + g]\overline{R} \quad (2) \end{aligned}$$

and, therefore, the equilibrium contract will be fee-for-service such that

$$v_0 = v_1 = p\overline{v}$$

Moreover, s is the optimal change of treatment if and only if

$$\begin{aligned} [2 + \delta^u(1+\delta^g)g^* + \delta^g g^-]\Delta u &\geq [\delta^g \Delta\pi\Delta s]u \text{ and} \\ [\delta^g \Delta\pi^+ \Delta s]u^+ &\geq [2 + \delta^u(1+\delta^g)g^* + \delta^g g]\Delta u^+ \end{aligned}$$

where

$$2d = r_1 + (1-s)a + [(1-g)p + g]\overline{R}$$

and we are using the same notation of the proof of Proposition 5. We refer to this signal as s^{**}.

Now we have to check the consistency of equilibrium (perfection), i.e., the incentives of patients to deviate from $\rho^B = 1$ in order to incite doctors to choose the best medical treatment. Indeed, if patients choose $\rho^B < 1$, then $\Delta\rho > 0$ which implies that doctors will choose the best change of treatment s^c whenever $\Delta v = 0$. Therefore, patients have an incentive to deviate if and only if their payoff following $\rho^B = 1$ is worse than deviating to $\rho^B < 1$, i.e.,

$$2 + \delta^u(1+\delta^g)g^* + \delta^g g^{**} < 2 + \delta^u g^* + \delta^g g^c + (\rho^B + g^c\Delta\rho)\delta^u\delta^g g^*$$

or equivalently,

$$(1 - \rho^B - \Delta\rho g^c)\delta^u g^* < g^c - g^{**}$$

where $g^c = g(s^c)$. If $s^{**} > s^c$, then $g^c - g^{**} > 0$ and for $\rho^B < 1$ sufficiently close to 1 the inequality above is true. Otherwise, there is no incentive to deviate.

(ii) $\Delta v < 0$. In this case $\Delta\rho > 0$ and the optimal patients choices are $\rho^B = 1 - \Delta\rho$ and $\rho^G = 1$ (for a given $\Delta\rho > 0$). Thus, the equilibrium allocation of the economy must solve the following program:

$$\begin{aligned}
&\max_{v_i,d,s}[2 + \delta^u g^* + \delta^g g(s) + (1 - \Delta\rho + g(s)\Delta\rho)\delta^u\delta^g g^*]u(w - d) \\
&\text{s.t.} \quad v_1 - s\Delta v \geq p\overline{v} \quad (1) \\
&\qquad 2d \geq r_1 - s\Delta r + (1 - s)a + [(1 - g)p + g]\overline{R} \quad (2) \\
&\qquad (1 - p)\Delta\pi(s)\Delta\rho\overline{v} = -\Delta v \quad (3)
\end{aligned}$$

Fix $s > s^c$. Thus (3) determines Δv from s and $\Delta\rho$. Moreover, (1) and (2) are binding and determines v_1 and d. It is easy to see that v_1 increases and d decreases with s (because $s > s^c$).

Proceeding in analogous form of Proposition 5 proof and using the same notation, s is the optimal change of treatment in the first period if and only if

$$[2 + \delta^u(1 + (1 - \Delta\rho)\delta^g)g^* + \delta^g(1 + \delta^u\Delta\rho g^*)g^-]\Delta u \geq [\delta^g(1 + \delta^u\Delta\rho g^*)\Delta\pi\Delta s]u \text{ and}$$
$$[\delta^g(1 + \delta^u\Delta\rho g^*)\Delta\pi^+\Delta s]u^+ \geq [2 + \delta^u(1 + (1 - \Delta\rho)\delta^g)g^* + \delta^g(1 + \delta^u\Delta\rho g^*)g]\Delta u^+.$$

The remaining of the proof follows the same steps of the proof of Proposition 5. ■

Proof. (Proposition 9) The first order condition gives:

$$\begin{aligned}
0 &= \partial_P L \Leftrightarrow \; 0 = -[2 + \delta^u g^* + \delta^g g + (\rho^B + g\Delta\rho)\delta^u\delta^g g^*]\partial u(w - d) + 2\lambda_2 \quad (5) \\
0 &= \partial_{v_0} L \Leftrightarrow 0 = (\lambda_1 - \lambda_2 h'(v_0))s - \lambda_3 \; + \lambda_4 \quad (6) \\
0 &= \partial_{v_1} L \Leftrightarrow 0 = (\lambda_1 - \lambda_2 h'(v_1))(1 - s) + \lambda_3 - \lambda_4 \quad (7)
\end{aligned}$$

The solution under moral hazard may involve more distortion ($\lambda_4 > 0$) if the solution without the incentive constraint (4) (i.e., the solution of the previous section) does not satisfy it, i.e.,

$$(1 - \gamma)(1 - p)\Delta\pi(s)\overline{v} < c$$

■

8 References

Arrow, K. J. (1963): "Uncertainty and the welfare economics of medical care"; *American Economic Review*; **53:941-973.**

Brown, L. D. (1983): "Exceptionalism as the rule? US health policy innovation and cross-national learning"; *Journal of Health Politics, Policy, and Law;* **23:35-51.**

Ethhoven, A. (1993): "The history and principles of managed competition"; in: *Health Affairs*, Supplement: **24-48.**

Glied, S. (1999): "Managed Care"; NBER working paper #7205.

Health Care Financing Administration (1998): "Brief Summaries of Medicare and Medicaid" and "National Health Expenditures". Available: http://www.hcfa.gov/Medicare (accessed August 1998).

Luft, H. S. (1981): *Health Maintenance Organizations: dimensions of performance*; John Wiley and Sons, New York.

Mc Clelan, M. and D. Kessler (1996): "Do Doctors Practice Defensive Medicine?" *Quarterly Journal of Economics*; Cambridge; **CXI:353-390**.

Miller, R. H. and H. S. Luft (1997): "Does Managed care lead to better or worse quality of care?"; *Health Affairs*; **16:7-25.**

Newcomer, R.; S. Preston. and C. Harrington (1996): "Health Plan Satisfaction and Risk of Disenrollment Among Social/HMO and Fee-for- Service Recipients"; *Inquiry : a journal of medical care organization, provision and financing*; **33:144-154**.

Newhouse, J. (1996): "Reimbursing health plans and health providers: efficiency in production versus selection"; *Journal of Economic Literature*; **7:285-288.**

Newhouse, J., W. Schwartz, A. Williams and C. Witsberger (1985): "Are fee-for-service costs increasing faster than HMO costs?"; *Medical Care;* **23:960-66.**

Pauly, M. (1986): "Taxation, Health Insurance, and Market Failure in Medical Care"; *Journal of Economic Literature*; **24(3):629-75.**

Rothschild, M. and J. Stiglitz (1976): "Equilibrium in competitive insurance markets"; *Quarterly Journal of Economics*; **90:629-650**.

Zweifel, P. and F. Breyer (1997): *Health Economics;* Oxford University Press.