

Remunerating health care providers in low-income countries: an analytical assessment of prevailing contractual schemes

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Abstract

Little effort has been put in so far to analytically assess alternative policy options for health care financing in rural setting of low-income countries. We use microeconomic modelling to highlight incentives that various compensation mechanisms set to providers. A principal-agent model is used to assess some policy instruments available to a government for influencing the prescription behaviour of the health care providers. Three different approaches for charging fees to patients are reviewed: lump sum payment, universal free health care and prescription charges. Links with available empirical results are made. A key finding from the model is that a similar variation in one policy instrument can have opposite consequences under different institutional configurations. In addition, it is shown that a government faced with a shortage of funds might have the ability to enhance the effectiveness of its remuneration scheme. This policy option avoids further charging the patient.

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Introduction

These last decades, health economists have extensively used microeconomic models to explore the pros and cons of different ways to remunerate providers of curative health care (Zweifel and Breyer, 1997). Yet, most of these efforts went to arrangements that echo problems, market trends and reform agendas of high-income countries (Chalkley and Malcomson, 2000; Ma and McGuire, 1997).

Surprisingly enough, less effort was put into the analytical assessment of remuneration contracts prevailing in low-income countries (Hammer and Jack, 2002; Leonard and Zivin, 2005). This lack of interest for incentives is worrying. Results achieved so far by many public health systems are far from satisfactory (WHO 2000). While insufficient financing has been and is still a major constraint, inappropriate institutional arrangements could be part of the explanation as well (Filmer et al. 2000; World Bank 2003). In an era of rising global commitment towards the public health sector in poor countries, one might wonder whether the supplementary financial resources will bring the improvement that is so needed.

An explanation for the paucity of analytical work could be that institutional arrangements in these countries are seen as ‘standard’ and that there is no need to go further than the major insights that one finds in textbooks. But is this view correct? On close scrutiny, one may notice some particularities in terms of health service organisation. For example, while for ambulatory care, the tasks of prescribing and dispensing drugs are delivered by two different actors in high-income countries, it is standard public policy in many low-income countries, especially in rural areas, to bundle the two services. Obviously, this is not neutral in terms of incentives (Trap et al., 2002). There is another observation that may encourage us to do more analytical work: some assumptions upon knowledge, preferences or behaviour that would be perceived as unrealistic in high-income countries may be valid in order to describe situations in some traditional or transitional societies. This observation goes further than what could be perceived as anthropological oddities (Leonard, 2003). In many contexts, limited education and the lack of some key institutions (especially those that took centuries to mature in the West) are constraints that deserve due consideration, including in models.

This paper will explore what microeconomic formalisation could offer in terms of assessment of policy options for health care financing in low-income countries. As an illustration we consider the case of how a government can establish user fees in its health facilities; within the unifying framework of a classical principal-agent model, we review what impact a change in some contract parameters has on health care provider's prescription. Three tariff forms observable in low-income countries are considered: (1) a lump sum payment (flat fee), (2) no payment and (3) a lump sum payment + prescription charge. In order to demonstrate that analytical models can both inspire empirical research and guide policy-making we then make a link with some existing empirical literature (mainly published in public health journals). It comes out that as far as low-income countries are concerned, incentives set to providers by compensation mechanisms have received too little attention so far. Models are particularly useful to disclose risks and phenomena that remain unnoticed in real life. For example, our model alerts policy makers to the fact that a similar variation in a policy instrument can have opposite consequences under different institutional configurations. This highlights the need for a more holistic view of institutional arrangements establishing health provision in low-income countries.

The structure of the paper is the following. In the first section, we provide an overview of health care financing in low-income countries. A historical perspective on the user fee debate is adopted. In the second section, the principal-agent framework is laid down and we review its appropriateness to address the situation of public health care provision in rural areas. The third section introduces our different assumptions, including our formalisation of the demand for health care. In the fourth section, we carry out comparative statics to assess for each of the three different tariff forms, the impact of different policy instruments on prescription behaviour. Impact on access is discussed as well. In the fifth section, we produce a normative assessment of the 'lump sum + prescription charges' arrangement; we demonstrate that allowing the provider to charge a profit margin on medical items is a source of inefficiency. The sixth section establishes the link between our analytical results and the empirical literature. It summarises the key insights and identifies possible ways forward.

1. Health care financing in low-income countries: 20 years of debate and reform

Since the mid-eighties, health care financing has received considerable attention in low-income countries (World Bank, 1987). The impetus came from the major budgetary crisis experienced by governments in the wake of the oil shocks and degradation of international terms of trade. Governments were not able anymore to cover financially the free health services they operated since independence. The introduction of user fees in the public health facilities was perceived as the only alternative to a full collapse of the rural health system. Under the leadership of UNICEF and WHO, most of the sub-Saharan African governments endorsed the so-called 'Bamako Initiative' in 1987 and adopted the strategy first for their health centres (Jarret and Ofosu-Amaah, 1992). They later extended the logic of payment by the user to hospital services. Within a decade, most other low-income countries followed suit.

Different forms of user charges have been adopted across countries and sometimes, within countries (Nolan and Turbat, 1995; Singh, 2003). A didactic literature was developed to identify pros and cons of different ways to charge patients (Goodman and Waddington, 1993; Shaw and Griffin, 1995). Yet, this did not prevent design oddities in some places (e.g., the obligation for the health facilities to retrocede their income to the tax department). In many countries, the implementation of the policy was flawed (Gilson et al., 2001). As a matter of fact, results of the Bamako Initiative have had mixed reviews (Gilson, 1997; James et al., 2006; Levy-Bruhl et al., 1997; Singh, 2003). Several studies have shown a problem of inaccessibility by the poor.

The response of the international community and governments took two faces. In the late nineties, considering the fact that user fees were there to stay, many actors (including the World Health Organization, the World Bank and the International Labour Office) turned to community health insurance as a way to circumvent the accessibility problems generated by the user fees (Ndiaye et al., 2007; Preker and Carrin, 2004). More recently, another group of actors advocated more radically the downright removal of the user fees (Save the Children, 2005). As a result, the situation today is less homogeneous than 10 years ago. For example, while Uganda

abolished user fees in 2001, neighbouring Rwanda is building its rural health system on community health insurance (Musango et al., 2006; Tashobya et al., 2006).

A remarkable trait of the debate on user fees during these last twenty years is their analysis without paying much attention to other sources of funding. Yet, some early researches revealed that user fees often contributed little to the total funding of public health systems (Gilson et al., 1995). While this finding has been used to conclude that the limited benefits in terms of revenue generation weren't worth the social cost (exclusion of the poorest), nearly no one picked up the other conclusion: scientists should widen their attention to other funding sources of public health services as well.

Whereas some governments may have seized the opportunity of the user fee introduction to reduce their commitments to the health sector, many have continued to commit quite considerable amounts of resources to their health systems, if only for the salaries. Furthermore, the public health system is a major beneficiary of external aid. In fact, in many countries, thanks to a stronger commitment to reduce poverty, both governments and donors are increasing the amount of resources allocated to the health sector.

Yet, the best way for the governments, and possibly donors, to organise their financial support to health facilities hasn't been studied extensively. This neglect is at odds with the fact that compensation mechanisms set incentives that are not neutral on providers' performance (Barnum et al., 1995), but surely is in line with a general inattention to provider incentives. In fact, even in the very active debate on user fees, provider incentives have not received the attention they deserve (Meessen et al., 2006b). Most of the focus has been on equity considerations and, to a lesser extent, on resource mobilisation and incentives to users.

The view developed in this paper is that the discussion of user fees requires a more comprehensive view of the institutional arrangements determining the health care providers' behaviour. In particular, the complementary contribution of the government in the funding and the way this affects the incentives must be brought into the analysis.

2. A Principal-Agent framework

As any organisation, a health facility can be seen as a nexus of contracts (Jensen and Meckling, 1976). The government, in its role of steward of the health system, has some authority to affect key parameters of these contracts. This holds even more for the health facilities that are owned by the government. First of all, there are all the contracts underlying the transactions between the health facility and the government: many governments pay indeed the staff salaries, provide drugs and finance some running costs of their own health facilities. Secondly, via its regulatory authority, the government has also some leverage to change parameters of the contracts between the health facility and other stakeholders (drug providers, users...). Any parameter of a contract can then be seen as a given *policy instrument*.

The ambition of this paper is not to review the full array of policy instruments available to a government. We will focus only on a couple of contracts, moreover in a partial way: (1) the contracts linking the government with the health facility for the provision of drugs and staff bonus; and (2) the treatment contract between the health facility and the patient. For the latter, three contractual set-ups will be considered: (1) a lump sum payment, (2) no payment and (3) a lump sum payment + prescription charge.

For our purpose, the model does not need to compare the three ways to charge patients and identify the ‘best’ one for a given metric (e.g., efficiency). The lack of a benchmark is not seen as a weakness in a realm where ‘big bang reforms’ are exceptional and incremental changes often the only available option. The key then is to make policy makers aware of the direct or indirect consequences of institutional changes that they (or other stakeholders) may perceive as minor. Highlighting the incentives that a given institutional set-up establishes for the health care provider can then be a sufficient advocacy tool. By permitting to foresee the impact of a variation brought to one of the contract parameters (e.g., a fee-per-patient paid by the government) upon provider’s behaviour, comparative statics fulfil this objective.

The relevant economic framework to deal with those issues seems to be the Principal-Agent model. The problem can be stated as follows: there is a principal¹, who has to remunerate an agent², the health care provider, for the curative services he delivers to a given population. Because of the inherent character of the job in the health care facility, there is an asymmetry of information between the Ministry of Health and its agent. One can reasonably assume that only the agent observes the pathology that a patient suffers from. Since the Ministry of Health only knows total drug consumption (through delivery records), the health care provider can justify any prescription (of drugs, but more generally of any medical item) by unverifiable local epidemiological conditions. This gives him a de facto discretion over the prescription pattern.³ Under incomplete contracting, the prescription pattern is not monitorable and hence not contractible, the principal has to cope with the rationality of the agent who behaves according to his preferences.

There are good reasons to believe that the principal and the agent have different objectives. Consequently the issue at stake for the Ministry of Health is to find the contractual arrangement aligning incentives for its health care provider with its own objectives.

Regarding the health care provider's objectives, we will assume throughout the paper the extreme case of selfish preferences: the health care provider just cares about maximising his own well-being. We acknowledge that this assumption strongly contrasts with the widespread picture of the altruistic and professional doctor abiding by medical ethics and public service ethos. Our goal is certainly not to pass judgement on the actual behavioural norms in low-income countries or to undermine the view that medical ethics and public service ethos are indeed crucial. Our point is merely to show what happens if our assumption is valid, or put differently, to highlight situations in which ethical commitment may be in contradiction to self-interest. The outcome then depends on the respective utility weights of the psychological cost of 'bad' practice, on the one hand, and of the gains in terms of money or leisure, on the other hand. With respect to this, moral heterogeneity is going to matter. However, the distribution of morality being given, the stronger the incentives, the higher the probability of bad practice, or equivalently the proportion of bad practice.

In our model, the agent is in charge of both consultation and drug dispensing. As already mentioned, this is quite a standard situation for public health care providers in low-income countries.⁴ The health care provider is supposed to be in a monopolistic position for both tasks. People familiar with health service organisation in low-income countries, will note that this assumption fits quite well the policy developed for rural areas. It echoes for example the situation of countries implementing the *health district model*⁵, especially as far as the hospital is concerned. While in many countries, the monopoly of the public health centre has been eroded by private health competitors such as informal drug retailers or unregulated private practice, this fact does not undermine the key message the paper delivers to the government as far as its own health care providers are concerned. Indeed, technically, the only requirement for our developments to be valid is that the right hand side of inequality (1) is exogenously given.⁶

In our model, a contractual scheme has three components: the reward function, the payment modality for the patient and the drug supply rules. For each component, one can imagine varying formulas. For example, as far as the payment modality is concerned, it can be a flat fee or strictly increasing according to the amount of drugs prescribed. Drug supply conditions can also vary. In some countries, the government bears the responsibility to provide these drugs for free to its public health facilities.⁷ In others, the health care provider has to cover their costs.

As already mentioned, this paper reviews various existing institutional settings and raises positive considerations with respect to the policy instruments. Table 1 summarises the different settings covered in the paper. This selection is intended to reflect some arrangements that prevail in low-income countries. For each combination, we suggest a country or situation of reference.

Table 1: Three different institutional settings

	Lump Sum	Free health care	Lump sum + prescription charge
Illustration in 2007	Cambodia	Uganda (and most low-income countries before the mid-80ies; Burundi (2006 – today); refugee camps)	China (and Rwanda)
Fee-per-patient paid by a third-party payer (w)	Yes in some areas, but not in most facilities.	No, only fixed salary.	China: probably in some areas through the New Cooperative Medical Scheme. Rwanda: in areas with performance-based contracting.
Consultation Fee (c)	>0	0	>0
Retail price of drugs (p_s)	0	0	>0 , real cost + mark-up (but partly reimbursed by the New Cooperative Medical Scheme in China).
Purchase price of drugs (p_p)	0 – drugs provided for free by the Ministry of Health's central medical store.	0 – drugs provided for free by the Ministry of Health's central medical store.	>0 , drugs are purchased from suppliers.

Before turning to the review of some combinations of contractual parameters and the resulting optimisation problem for the health care provider, let us first introduce the assumptions of the model.

3. Assumptions

3.1. The patients

While endowments in terms of income (y) and health status (h) are unequally distributed, preferences are supposed to be homogeneous among the whole population and are defined over bundles of state of health and disposable income.

$$(h, y) \in [0,1] \times [0,1]$$

Value 1 is arbitrarily attributed to perfect health, while $h = 0$ corresponds to death.

The income y (or wealth, the distinction is not needed) of the richest individual will be

normalised at unity. Utility of a patient is an increasing function of both its arguments:

$$u(h, y); u_1 > 0, u_2 > 0$$

People have their own ex ante perception of recovery after a treatment. They perceive this probability as being a function of m , the amount of medical items prescribed by the health care provider. In this model, a medical item is any item (1) that is costly to the health care provider; (2) whose unit cost is under the influence of the principal; (3) whose quantity per patient is a health care provider's decision; (4) that is chargeable at a piece rate; (5) that is valued by the users as a recovery enhancer. This certainly includes medicines, X-rays or lab test, but can also be extended to all the services whose consumption is depending on the hospital length of stay (e.g., laundry, patient food...). Note that the amount of medical items is measured in monetary terms. Henceforth, a higher m does not necessarily mean more physical units (e.g., tablets), but it can also be an upgrade in the perceived quality of medical items (e.g., third generation cephalosporin instead of ampicillin, trade-mark drugs instead of generic ones, injections instead of tablets, comfort in the hospital rooms).

The subjective probability $\pi(m)$ is assumed binary in its outcome (perfect recovery versus no change at all) with

$$\pi'(m) > 0, \pi''(m) < 0$$

Notice that these expectations do not need to be medically valid. The information structure between the doctor and the patient is not further specified. It does not matter whether it represents the true process or a wrong perception. As a layman in the medical field, the patient will probably positively value any additional medical item whatever the initial level. This does not seem to be an invalid assumption, especially in low-income countries. It must also be emphasized that the asymmetry of information between the patient and the health care provider gives additional discretion to the latter in terms of prescription choices.

In addition, the patient knows her disease and, at equilibrium, correctly anticipates the agent's prescription behaviour (i.e. the standard of care she will receive for this disease).

An individual, characterised by an initial state of health h and an income y chooses to come to the health centre and to pay the tariff t if and only if

$$\pi(m)u(1, y - t) + (1 - \pi(m))u(h, y - t) \geq u(h, y) \quad (1)$$

The expected utility of coming to the health centre is computed on the left hand side and compared with the utility that corresponds to the status quo: with probability $\pi(m)$ the patient recovers, she does not with probability $(1 - \pi(m))$. In either case, a tariff t has to be paid. There exists a tariff, let's call it $\tilde{t}$, such that condition (1) holds with equality. This willingness to pay increases with the probability to recover and, therefore, with the prescription level. Under a suitable additional assumption on the preferences⁸, namely $u_{12} \geq 0$, the partial derivative of $\tilde{t}$ with respect to h is negative: the worse the health endowment, the higher the willingness to pay. The assumption is rather intuitive. It states that the marginal utility of income must grow as health gets better. If, in addition, we exclude risk lovers ($u_{22} \leq 0$), then $\tilde{t}$ is an increasing function of income.

Alternatively, for a given tariff and prescription, among people suffering from disease h , we can focus on the indifferent individual whose income is $\tilde{y}(m, t, h)$. Patients earning more than this threshold decide to seek care to the health centre, the others do not. We have

$$\frac{\partial \tilde{y}}{\partial m} < 0, \frac{\partial \tilde{y}}{\partial t} > 0 \quad (2)$$

which indicates that the income threshold is a decreasing function of prescription and increases with the tariff. Stated in other words, the higher the amount of medical items received and the lower the tariff, the higher the demand.

According to the description made so far, each individual is endowed with a state of health and some income or wealth. Regarding the initial joint distribution of this twofold endowment that characterises the population, we assume that there exists a discrete number of heterogeneous illnesses. Since the principal does not observe the disease type of the patients, prescription is not monitorable and hence not enforceable. Under the stated assumptions, we can focus on any pathology h and write the corresponding demand function as

$$d_h(m_h, t_h) = \int_{\tilde{y}(m_h, t_h, h)}^1 dF(y) = (1 - \tilde{y}(m_h, t_h, h))$$

Any patient earning more than the income threshold $\tilde{y}$ is going to demand one unit of health care. Therefore, this unit is integrated against the income density function in the relevant part of its support. The second equality holds if we let income be uniformly distributed and the number of people suffering from disease h be 1. The latter statement is unrealistic but is made for the sake of tractability as it does not impact on our results.⁹

In the subsequent developments we do not use the h subscript. The following sections introduce the optimisation behaviour of the health care provider. The doctor chooses the complete prescription pattern, but we only consider the optimisation with respect to a given pathology. All results apply to any of them.

3.2. The health care provider

We specify the utility function of the agent as

$$U(Y, e) = Y - v(e) \text{ with } v' > 0, v'' > 0$$

where Y is the monetary payoff¹⁰ and e the effort level. Y will be the key variable affected by the variations in our contract schemes; e is the sum of consultations and is supposed to be observable by the principal. It is assumed that any disease generates the same disutility in terms of work effort for the health care provider. Notice also that e is a continuous variable since the size of the population has been normalised at 1.

3.3. The contractual scheme

Our inquiry pursues a twofold objective. First, recalling that the agent has discretion over the prescription pattern, we want to highlight what drives his choice. How does a given instrument (i.e. contract parameter) serve his objective? Second, we examine the impact of changes in the contractual parameter values on the equilibrium prescription behaviour.

Let us introduce the contractual arrangements in terms of algebraic notation. The health care provider raises resources from two sources: his principal and the users. The principal may contribute in two ways: in cash or in-kind (drugs). The principal sets all the compensation rules and related prices.

Between the principal and the agent, we assume that there is a monetary reward function linear in the number of consultations. Fee-for-service is a long-established remuneration model for curative care at the first line in high-income countries (Groenewegen et al., 1991). The development of community-based health insurance makes it more prevalent in low-income countries.¹¹ Some recent contracting experiments have also adopted such an approach with donor or public budget (Meessen et al., 2006a; Soeters and Griffiths, 2003). This assumption does not exclude that the health care provider receives a fixed salary. Yet, as we have assumed that the health care provider's utility is linear in income, we can omit the fixed wage component of the income from our developments.

The other monetary relationship is between the individual user and the health care provider. We will examine two different non-exclusive ways for charging the users: through a fee or by setting prices on the medical items. As a reminder, these parameters are a decision of the principal.

In its generic form, the total payment by the user is henceforth linear in prescription:

$$t(m) = c + p_s m$$

where c stands for a lump sum fee and p_s for the unit sale price of drugs charged to the patient. Since m is measured in money, p_s represents the share of market price that is paid by the patient, depending on the extent of the subsidy. It is by varying values for c and p_s that we will be able to explore different models such as flat fee ($p_s = 0$), free health care (c and $p_s = 0$), or prescription charges (c and $p_s > 0$).

Readers familiar with user charges in low-income countries will notice that our assumption that the health care provider retains the full income he raises from his principal and his patients diverges from the actual situation in several countries (the

health care provider has often only limited decision rights on the allocation of these revenues, see also footnote 4). Together with the assumption that the principal has the capacity to enforce the different parameters of the contracts, it allows the model to exclude situations such as under-table-payment charged by the providers.

As already mentioned, it is assumed that the principal has some influence on p_p , the cost incurred by the health care provider when he prescribes one unit of medical item to a patient. The idea of ‘influence’ includes the extreme case in which the principal is actually the supplier of the health care provider; as far as drugs and laboratory reagents are concerned, this is a quite a standard model of supply in the public sector of low-income countries (Nazerali et al., 2006).

4. A positive assessment of the prescription behaviour

As already suggested, the institutional setting is not neutral in terms of incentive provision. The health care provider is therefore expected to adapt his prescription behaviour to changes in the contractual arrangement. Intuitively, the prescription level should be influenced by the terms of drugs provision and possibly by the reward function. However, it also critically depends on the tariff structure as is shown in this section.

As a preliminary step, let us first examine the shape of the demand for treatment under two alternative tariff structures: flat fee ($p_s = 0$) and prescription charges ($p_s > 0$).

In the former case, since the tariff is lump sum, prescription does not impact on the final price charged to the patient. Hence, additional medical items always decrease the income threshold and demand monotonically increases with m .

In the latter case, however, since the bill increases with the quantity of medical items, the effect of additional prescription is twofold. On the one hand, it has a positive impact on the perceived probability to recover, thereby raising demand (reducing the income threshold). On the other hand, the cost charged to the user grows linearly,

with the opposite effect on demand by the users. Intuitively, given that the latter effect is linear while the former decreases at the margin, the income threshold is U-shaped with respect to prescription. In other words and as can be seen in figure 1b, aggregate demand first increases with prescription and, after a maximum, decreases under the weigh of the bill. This is shown analytically in appendix 1.

Figure 1 illustrates the point and draws the comparison with the lump sum setting (flat fee).

Insert here Fig 1a and 1b

Figure 1a: The income threshold as a function of prescription under the lump sum system

Figure 1b: The income threshold as a function of prescription under the prescription charge system

Turning back to the provider's incentives, let us describe his optimisation program. According to our assumptions, the objective of the provider can be written as follows:

$$\begin{aligned} \underset{\{e, m\}}{\text{Max}} \quad & U = [w + (p_s - p_p)m]e - v(e) \\ \text{s.t.} \quad & e \leq d(m) = (1 - \tilde{y}(m, t(m))) \end{aligned}$$

The doctor maximises utility with respect to the number of consultations and the prescription pattern subject to the demand constraint. He can not consult more than this “pool of available patients”, the right hand side of the constraint.

The aim of the developments that follow is to prove that the constraint always binds except in one particular case which is first discussed.

Let us examine this first trivial case. Suppose $p_s = p_p$.

The desired effort level is then an increasing function of the bonus:

$$e^* = v'^{-1}(w)$$

where v'^{-1} denotes the reciprocal function of v' .

It appears that, in this case, the provider is insensitive to the social costs and benefits of drug use. The only aim of the prescription behaviour is to drive demand and adapt it to the desired effort level.

For example, consider the prescription charge setting. If medical items are charged to the user, to any given tariff (c, p_s) corresponds an inverted U-shaped demand function. Let us describe the provider's prescription behaviour starting from high bonus levels. If w is very high, the demand constraint may be binding. Therefore, the provider chooses the prescription level that maximises the demand for treatment $\left(m^* = \arg \min_m \tilde{y}\right)$. Actually, there exists a bonus w such that the optimal number of patients from the provider's viewpoint is equal to $\text{Max}_m (1 - \tilde{y}(m))$, that is the largest demand. For bonuses that are below this threshold, the provider only ensures that his willingness to consult will be satisfied. For this purpose, he selects any prescription level that attracts at least e^* . Mathematically, as can be seen in figure 2, there exists an interval of intermediate prescriptions $[m_1, m_2]$ that fulfil this requirement. The provider is indifferent and draws arbitrarily or randomly within this set. Prescription is hence indeterminate. The number of treated patients is known but the number and the proportion of rationed patients depends on the selected prescription level. Indeed, demand potentially exceeds the supply of health care.

Insert here figure 2

Figure 2: The interval of prescription levels attracting at least e^* patients

But as soon as the purchase price (p_p) is slightly lower or larger than the sale price (p_s) , the provider selects either the upper bound m_2 or the lower bound m_1 , respectively. In the former case, the principal grants him a thin profit margin while, in the latter case, drug use is taxed at the margin. In both situations, there is no rationing on the demand side. In other words, at equilibrium, the agent examines all the patients. If we denote by λ the Lagrangean multiplier associated with the demand constraint, formally, $\lambda > 0$. This can be shown by contradiction.

Suppose first that the health care provider makes some profit on medical item sales ($p_s > p_p$) and that the demand constraint is not yet binding. The agent can increase prescription, thereby making more money and, depending on the initial level, either raising or reducing the extent of excess demand. For initially light treatments, additional prescription enlarges the pool of excess health care demand, as can be seen from figure 1.b. The health care provider keeps extending the treatment until this pool vanishes. It follows that the equilibrium prescription is located in the ascending portion of the income threshold curve, where the tariff component outweighs the “perceived health effect” in the decision of the patient.

The opposite reasoning holds for $p_s < p_p$, in which case the selected amount of medical items corresponds to a point where the curve is downward sloping. In words, suppose the “pool of patients” constraint is not binding. Would it happen, the doctor can reduce the amount of medical items, thereby economising on the purchase price p_p and tightening excess demand until the waiting room is empty. Therefore, in the general case where the purchase price differs from the sale price and in the development that follows, the demand constraint is binding at equilibrium.

Having substituted the demand for health care for the number of consultations in the objective function, the first order condition with respect to prescription can be written as

$$(p_s - p_p)(1 - \tilde{y}(m^*)) = [w + (p_s - p_p)m^* - v'(1 - \tilde{y}(m^*))] \left[\frac{\partial \tilde{y}}{\partial m} + \frac{\partial \tilde{y}}{\partial t} p_s \right] \quad (3)$$

where the last term in brackets is $d\tilde{y}/dm$.

Condition (3) gives m^* , the amount of medical items that the provider assesses as optimal from his perspective. Pursuing the objective of assessing the impact of marginal changes in the contractual setting on the provider’s behaviour, we apply the implicit function theorem on condition (3) under the two broad tariff schemes: flat fee and prescription charges. The free health care model will be briefly considered as a trivial and particular case of the lump sum setting.

Since between both schemes the provider is faced with contrasting demand behaviours, the impact of a given policy measure on the equilibrium prescription is shown to depend on the tariff structure.

The lump sum setting (flat fee)

Under the simplifying assumption that $p_s = 0$, condition (3) can be re-written as

$$\left[w - p_p m^* - v'(1 - \tilde{y}(m^*)) \right] \left| \frac{\partial \tilde{y}}{\partial m} \right| = p_p (1 - \tilde{y}(m^*))$$

This condition states that the net benefit from any extra consultation, that is the bonus from which the monetary cost of medical item and the marginal disutility of labour are deducted, must exactly offset the infra-marginal cost of extended treatment.

In this first tariff setting, how does the selected prescription level react to changes in the parameters of the reward function (w, p_p)?

First, with respect to the bonus,

$$\frac{\partial^2 U}{\partial w \cdot \partial m} = \left| \frac{\partial \tilde{y}}{\partial m} \right| > 0 \Rightarrow \frac{\partial m^*}{\partial w} > 0$$

This result is very intuitive: if the principal provides stronger incentives to consult, then it makes the agent willing to relax the demand constraint by prescribing a higher amount of medical items.

Second, an increase in the medical item purchase price has the intended effect of reducing the prescription level:

$$\frac{\partial^2 U}{\partial p_p \cdot \partial m} = (-1) \left(m \left| \frac{\partial \tilde{y}}{\partial m} \right| + (1 - \tilde{y}) \right) < 0 \Rightarrow \frac{\partial m^*}{\partial p_p} < 0$$

Indeed, a higher cost of medical item simultaneously decreases the marginal net benefit from additional patients and raises the monetary cost of attracting them.

Finally, as a remark on the accessibility to the poor, we wonder whether a reduced tariff improves the participation level. The cross derivative with respect to the fee is¹²

$$\frac{\partial^2 U}{\partial c \partial m} = v''(e) \frac{\partial \tilde{y}}{\partial t} \left| \frac{\partial \tilde{y}}{\partial m} \right| + p_p \frac{\partial \tilde{y}}{\partial t} > 0 \Rightarrow \frac{\partial m^*}{\partial c} > 0$$

From the provider's point of view, if the lump sum tariff increases, total demand is lower and the doctor has to attract it at the cost of higher medical item consumption. But the converse is true in the sense that a lower tariff will be associated with less medical services. It follows that the effect of a policy measure primarily intended at extending participation towards poor patients is not obvious since the net impact on the income threshold is indeterminate: on the one hand, a lower c attracts more patients, but, on the other hand, the partial effect of the reduction in the prescription level is positive on the income threshold. However, due to the latter effect, a higher bonus indirectly attracts poorer patients through an improved medical service. The opposite is true if p_p gets higher¹³.

The free health care model

The free health care model is just a particular case of the lump sum model: one just has to set c equal to 0. The main aim of such a strategy has traditionally been to improve the access to health care by the poor (James et al., 2006). With our model, we can take into account the provider's behaviour which is often neglected and raise the issue of the effectiveness of such a policy.

First, one can notice that as total tariff is zero, the whole population participates whatever the prescription level ($\tilde{y} = 0$). An arbitrarily small positive amount of medical item makes everyone willing to come, provided there is no private participation cost (e.g., transportation). As a consequence, the prescription behaviour of the health care provider does not impact on the utilization. The pool of patients is the largest possible. It follows that the agent does not need to use more medical resources to attract patients. In order to get effort from the health care provider, the government has to set the purchase price for the medical items of course to zero. The prescription does not serve any purpose in the maximisation program of the provider, as it does not even appear in his objective function. Two polar cases may be encountered: either the doctor is altruistic towards his patient or he is purely selfish and ready to seize the opportunity to resell the medical items on the black market. The

welfare of the population is therefore highly dependent on intangible factors, namely the moral values of the medical staff. But in both cases, the principal should expect excessively high medical item consumption (i.e. overprescription or pilfering). The point is that prescription is not channelled at all by the contract. Such a system seems in fact to be sustainable by the principal's budget only at the cost of close monitoring.

Secondly, as far as labour provision is concerned, marginal disutility of effort will be equal to the bonus at equilibrium. If the latter is not high enough, rationing might occur on the demand side, as already mentioned.

To conclude, we see that free health care is indeed a model giving full access to health care for the poor, provided that they do not face other participation costs nor suffer from rationing due to too low incentives to effort on the provider's side. Yet, free health care may be extremely costly in terms of medical items consumption; this can only be prevented by (costly) monitoring.

Prescription charges

Let us assume now that the user pays some strictly positive price p_s per monetary unit of medical item prescribed; it is also assumed that $p_s > p_p$. Suppose also that this amount is retained by the health care provider.

Under this scheme, $d\tilde{y}/dm$ is positive in condition (3). It measures the number of lost patients following a marginal increase in the prescription level and the corresponding growth of total bill. Condition (3) states that the monetary gain from marginal treatment extension must equal its opportunity cost, that is the forgone net benefit on the indifferent patient.

How does the chosen treatment react to changes in the reward function?

First, with respect to the per patient bonus,

$$\frac{\partial^2 U}{\partial w \partial m} = - \left[\frac{\partial \tilde{y}}{\partial m} + \frac{\partial \tilde{y}}{\partial t} p_s \right] < 0 \Rightarrow \frac{\partial m^*}{\partial w} < 0$$

The sign is opposite under the lump sum scheme, for the following reason. A higher bonus remains an incentive to work more, but, if the tariff is piece rate, in order to attract more patients, the agent has to reduce prescription since, at equilibrium, the burden of the tariff is the critical factor.

Second, let us have a look at the impact of p_p on the selected prescription:

$$\frac{\partial^2 U}{\partial p_p \cdot \partial m} = (-1)(1 - \tilde{y}) + m \frac{d\tilde{y}}{dm}$$

The sign of this expression is indeterminate. The reduction in the profit margin on medical item sales has the intended effect of reducing prescription. However, the opportunity cost of extended treatment also declines. But intuition suggests that the former effect dominates the latter.

As far as accessibility is concerned, we examine the impact of marginal changes in the tariff structure on the provider's equilibrium behaviour.

On the one hand, what is the impact of an increase in the fixed component of the tariff charged to the user?

$$\frac{\partial^2 U}{\partial c \cdot \partial m} = (-1)(p_s - p_p) \frac{\partial \tilde{y}}{\partial t} - v''(e) \frac{\partial \tilde{y}}{\partial t} \frac{d\tilde{y}}{dm} - (w + (p_s - p_p)m - v'(e)) \frac{\partial^2 \tilde{y}}{\partial t^2} p_s$$

where we have made use of the fact that $\partial^2 \tilde{y} / \partial t \cdot \partial m = 0$ (see footnote 12).

The first term on the right hand side is negative. The monetary gain from extending the treatment is smaller with a higher c , because of a lower initial demand. The second term also discourages high prescription levels since it shows a rise in the opportunity cost per lost patient. Indeed, due to the reduction in initial demand, the marginal disutility of effort gets lower, this, in turn, expands the forgone utility gain made on a given number of lost patients.

The third and last term indicates how c impacts on the number of lost patients. It can be shown that $\tilde{y}$ is concave with respect to the bill¹⁴ (demand is convex in the tariff), hence this number decreases with c . As a conclusion, since the opportunity cost of a marginal increase in prescription declines with the latter effect, the global sign remains unknown. It is not obvious that, in order to compensate the health care consumer for a higher consultation fee, the doctor is going to reduce the weight of the treatment on total bill.

Finally, does an increase in the sale price of medical item drive the health care provider to prescribe more?

Using the fact that $\frac{\partial^2 \tilde{y}}{\partial t \cdot \partial m} = 0$, the derivative is as follows

$$\frac{\partial^2 U}{\partial p_s \cdot \partial m} = (1 - \tilde{y}) - (p_s - p_p) \frac{\partial \tilde{y}}{\partial t} m - \frac{d\tilde{y}}{dm} \left[m + v''(e) \cdot \frac{\partial \tilde{y}}{\partial t} m \right] - (w + (p_s - p_p)m - v'(e)) \frac{\partial^2 \tilde{y}}{\partial t^2} p_s m$$

The first term translates the intuitive effect of a higher profit margin on medical item sales, driving the agent to extend the treatment. However, the second and third ones restrain medical prescription. As can be seen from the fourth term and following a same line of argument as above regarding the number of lost patients, since $\tilde{y}$ is concave in the tariff, the last partial effect tends to reduce the opportunity cost of additional prescription.

As far as access for the poor is concerned, the link between prescription and participation is inverted compared with the lump sum setting. Other things being equal, an extension of the treatment results in an increase of the participation threshold. A striking result is the potential ineffectiveness of reducing the consultation fee (c) in attracting the poor. Indeed, the agent's response might be a higher prescription level. For egalitarian purposes, the government had better raised the fee-per-patient to drive the doctor to reduce prescription and hence the participation threshold.

5. The optimal reward contract

Making use of the above calculations, it can be shown by contradiction that in the optimal reward contract $p_p = p_s$.

The first step of the proof consists in evaluating the public budget at a given health care situation, that is a vector of participation and treatment $(\tilde{y}, m)$:

$$C(\tilde{y}, m) = [w(p_p; \tilde{y}, m) - c + (1 - p_p)m](1 - \tilde{y}) \quad (4)$$

where

$$w(p_p; \tilde{y}, m) = \frac{(p_s - p_p)(1 - \tilde{y})}{d\tilde{y}/dm} - (p_s - p_p)m + v'(1 - \tilde{y}) \quad (5)$$

The total cost of $(\tilde{y}, m)$ in a given contract setting (4) is the per patient cost multiplied by the number of consultations. The unit cost includes the bonus and the share of subsidies in the market price of medical items. Function (5) comes from (3) and is the incentive compatibility constraint. The partial derivative of the right hand side of (5) with respect to p_p measures the change in the bonus that leaves the prescription level unchanged following a marginal variation in p_p .

As a second step, we show that it is possible to strictly reduce the total cost through simultaneous changes in w and p_p without altering the initial health care situation.

$$\frac{dC}{dp_p} = -\frac{(1 - \tilde{y})^2}{d\tilde{y}/dm} < 0 \Leftrightarrow \frac{d\tilde{y}}{dm} > 0$$

which is precisely the case when $p_p < p_s$. As a consequence, it would be profitable for the principal to increase the purchase price and to adapt the bonus accordingly. The converse is true if in the initial contract $p_p > p_s$.

In particular, remunerating the health care provider through benefits on medical items prescription is sub-optimal. The intuition is as follows: the profit margin on medical items is an incentive to over-prescribe. As shown above, at equilibrium, an additional treatment extension would reduce demand. As a consequence, in order to mitigate this effect, the principal simultaneously grants the provider with a high bonus as an incentive to consult more and hence to prescribe less. However, an increase in the purchase price tends to restrain drug use, thereby economising on drug subsidies. The latter effect is twofold since it implies a simultaneous reduction in the subsidy per unit of medical item and in total drug consumption. In addition, from a reduced prescription follows a decreased participation threshold. Hence, in order to restore its initial level, the principal can even lower the bonus w . This is a second source of cost reduction.

To restate the proposition, the principal has the ability to improve the effectiveness of the public budget by making use of the knowledge of the provider's decision rule. The optimal remuneration contract makes use of per patient bonuses and the provider should be made financially insensitive to medical item prescription. Put differently, medical item prescription should not be biased by monetary incentives.

Two technical concluding remarks seemed worth mentioning.

On the one hand, for completeness, one should ensure that the provider's participation constraint remains fulfilled. Indeed, following the improvement of the cost effectiveness of the health policy, the agent is worse off. Either, his outside option is bad enough, or not. In the latter case, an increase in the fix wage component of the remuneration is the best suited strategy since it has no behavioural consequence. On the other hand, as is shown in appendix 2, our result is robust to a multiple pathologies setting.

6. Discussion

The main objective of the paper was to explore whether microeconomic modelling could enlighten policy making and empirical research with regard to health care organisation in low-income countries. We believe that our paper reaches its goal to some extent. We intend to show that by linking each of the three models with one ongoing debate: rational drug use (lump sum model), abolition of user fees in Uganda (free health care model) and control of cost escalation in China (lump sum + prescription charges model). Each time, we illustrate how the model echoes with the existing empirical literature; this allows identifying key policy insights brought forward and possible tracks for further empirical studies. We conclude our discussion with lessons valid across the different contractual set-ups.

6.1. Rational drug use in subsidised public health facilities

Irrational drug use – here defined, as deviation from evidence-based medical art for a given ill-health condition – is a major source of welfare loss in the health sector: it leads to ineffective treatment, adverse effects, development of drug resistance and unnecessary costs (le Grand et al., 1999). While patients, by poor compliance or self-medication, are undoubtedly major contributors to this state of affairs, more and more attention is being paid to the role of professionals (Trostle, 1996). There is a large body of evidence that irrational dispensing of medicine is particularly high in low-income countries. The fact that the medicine retail sector is very accessible and loosely regulated is a key factor (Chalker et al., 2005; Goodman et al., 2004). However, many studies have shown that physicians and other personnel involved in consultancies were also a source of irrational drug use (Hogerzeil et al., 1993). Field studies have shown that a multiplicity of factors determine the providers' behaviours. Obviously, therapeutic knowledge is one of them; yet, there is growing evidence that it does not predict practice (Das and Hammer, 2007). A key question is the relationship between remuneration contracts and providers' prescriptions. Several studies have compared public and private practitioners (Bojalil et al., 1998; Siddiqi et al., 2002). Fewer have looked at prescription patterns under different remuneration systems within the public sector (Holloway et al., 2001). An even more neglected

field is the impact of public health sector reform – including changes in the parameters of contracts – on medicine prescription (Laing et al., 2001).

Our model allows to discuss this problem for the three contractual schemes, but the lump sum model is the most illustrative in this respect. It shows indeed an unequivocal impact upon the amount of medicines prescribed by the providers, of an increase of the fee-per-patient paid by the principal (positive), the lump sum fee paid by the user (positive) and the medicine purchase prices (negative). These findings have direct policy implications. First, they invite ministries of health and stakeholders to have a much broader understanding of the available instruments to affect drug utilisation. Too often, irrational drug use (for a given list of available essential drugs) is mainly tackled through ‘soft’ approaches such as information, training and supervision. In line with other authors, we would advocate a much more holistic view of determinants (Goel et al., 1996). Programme managers must be less myopic on incentives in place.

The case of Cambodia, which fits the lump sum model (cf. Table 1), offers a nice illustration. While irrational drug use is particularly problematic in the private sector, it is also an issue in the public sector (Chareonkul et al., 2002). To monitor and tackle this problem, the hospital service bureau collects each year drug indicators from public health centers and hospitals (Ministry of Health, 2002). While the recommendations made by the bureau are certainly relevant (eg, continuous training of doctors and nurses), they are totally silent on the possible influence of remuneration contracts. Yet, in some districts, there have been quite some important changes in the ways health care providers are remunerated. In several places, some principals (eg, a NGO) have for example introduced a fee-per-patient (Soeters and Griffiths, 2003; Van Damme et al., 2001). Such factors would deserve more scrutiny. The model conveys also some more positive messages. For example, it indicates that if the Cambodian government wants to curb overprescription, a first step could be to charge the medicines it provides today for free to its health facilities. The best way to control the following impact in terms of access by the poor (the higher $\tilde{y}$ threshold in our model) could be to establish a complementary waiver scheme targeting the poorest (Hardeman et al., 2004).

6.2. Abolition of user fees

Readers may be interested to know whether this microeconomic model offers any new insights with respect to the current debate on the abolition of user fees. We believe that the answer is affirmative. As far as accessibility by the poor is concerned, our model shows that only the free health care model is compatible with access by the poorest individual. Yet, this result is quite trivial: in the familiar graphic representation of demand for health care, it corresponds to the extremity of the demand curve at price equal to 0. The fact that our model does not integrate the principal's budget constraint implies that it does not allow for assessing the actual societal impact of removing any price rationing on the health care market. In practice, as public budget is quite limited in low-income countries, one can suspect that some de facto rationing will take place. In Uganda, the tight budget constraint has been put forward to explain the recurrence of drug stock-outs since the abolition of user fees (Nabyonga et al., 2005).

Yet, our model shows that drug shortages in Uganda may have their source elsewhere. Indeed, under the free health care system, providers are enticed away from a careful utilisation of inputs other than their own labour effort. Many may be tempted to respond positively to users' frivolous demand¹⁵ or requests to receive extra medicines (e.g., for refilling the family medicine chest); some may even pilfer medical items for reselling them on the market (including through their private practice).

Operationally speaking, the recommendation is clear: close monitoring is necessary. Quite interestingly, this is standard practice during a humanitarian crisis, a specific context in which free access to health care is crucial. In its "Refugee Health" – a textbook for medical humanitarian volunteers – *Médecins Sans Frontières* reckons that in a refugee camp setting, drug monitoring may keep an expatriate nurse full-time busy (Médecins Sans Frontières, 1997).

The model conveys another lesson for the smooth operation of a free health care system: a tight relationship between individual remuneration and effort can be useful.

In our model, this message is conveyed by the fact that rationing will reappear if the fee-per-patient does not compensate the marginal effort required for the last patient in the queue. One can think of two ways for transposing this into ‘real world’ policy. A conservative scenario is this one: when health staff earn only a fixed salary, the principal, its constituency or its representative will have to invest sufficiently in monitoring health care provider’s *effort* (e.g., presence at work). The other option would be to replace the fixed salaries by a fee-per-patient system. Practically, it requires the principal to focus its monitoring on health care provider’s *outputs*. Recent experiments have confirmed the feasibility of this strategy in low-income countries (Meessen et al., 2006a; Soeters and Griffiths, 2003). We acknowledge that this approach clashes with the traditional behavioural assumption underlying, at least in rhetoric, a free health care system: the altruistic and professional health staff, who are inspired by ethics and public service ethos and consequently deserve trust and a fixed salary from their principals.

Yet, we believe that this traditional behavioural assumption deserves some scrutiny. It is well known that for several reasons, civil servant medical staff have suffered great hardship these last twenty years in most low-income countries (Lindelov and Serneels, 2006). Studies have shown that morale has been affected and staff have developed coping mechanisms to survive (Ferrinho and Van Lerberghe, 2000). Most of these strategies (eg, absenteeism, drug pilfering, bribe) go against the interests of the population. A key question is whether the staff have interiorized these strategies departing from traditional civil servant deontology as new norms (Ferrinho et al., 2004). If so, a mere increase of the fixed salary may be insufficient to roll back the ‘bad habits’. We would contend that if there exists no more widespread commitment among civil servants to subordinate their own interests to the benefit of the population, institutional arrangements deserve thorough re-examination (Le Grand, 2003).

The case of Uganda is interesting to illustrate how the insights brought by the model can guide future empirical work. Obviously, the above discussion backs up recommendations made by others to assess the possible factors behind the current drug stock-outs in Uganda (Nazerali et al., 2006). Smart methodologies will have to

be developed to test possible explanations such as drug leakage and overprescription by the staff.

The question we raise on reversibility of ‘bad habits’ is also relevant for this country. The Ugandan health system went through very difficult times during more than two decades (Macrae et al., 1996). Several authors depicted the appalling status of health staff in the nineties and their coping mechanism, including the widespread practice of drug pilfering (Kyaddondo and Whyte, 2003; McPake et al., 1999). The blurred situation in terms of institutions – formal and informal, private and public – was highlighted (Birungi et al., 2001). It would be useful to study to what extent inappropriate coping mechanisms are contained today and if so, document, as multiple reforms have been implemented, what made the difference. Staff satisfaction with the current mode of remuneration would also deserve documentation (Kipp et al., 2001).

6.3. Curbing cost escalation and enhancing access in China

Some other possible policy insights from our model can be provided for the Chinese case. Over the last 25 years, the Chinese society has experienced a dramatic transformation. While the transition to a market economy has instigated major societal progresses, there is a large consensus that achievements in the health sector are much less satisfactory (World Bank, 1997). The analysis made by many experts is that market mechanisms have taken too much precedence over other mechanisms in the co-ordination of the health sector (Liu, 2004). Part of the explanation is that health has not been a priority, at least till recently, for central and local governments. Direct government budgetary support to public health care facilities has shrunk to insignificant amounts. Official government salaries have not kept pace with the rapid economic growth. To survive, public health facilities have turned to users to raise their income. Because of quite tight price control by the price bureaus on the consultation fees chargeable to patients, health care providers gain most of their income on the quantity of medicines and tests that they prescribe to patients. The incentives to overprescribe are strong: while health facilities are still formally owned by the government, health staff are the main residual claimants on revenue raised

from patients (Liu and Mills, 2003). This leaves the population at the mercy of quite powerful health care providers. As health insurance benefit package remains quite limited for the rural population, treatment can mean a major economic burden for the households. Poverty is sometimes the outcome (Liu et al., 2003; Meessen et al., 2003).

Interestingly enough, our last model, lump sum + prescription charges, is a quite good representation of the current institutional configurations of public health facilities in China, for rural hospitals in particular. In this third contractual set-up, any overprescription equates to overcharging to the individual user. It may then be interesting to check whether the model sends any message with respect to the current problems of cost escalation and inaccessibility by the poor. We think so.

As far as access is concerned, our model does not corroborate the intuitive solution of cutting the consultation fee charged to the patient. Indeed, providers may adapt by increasing their prescription levels. A much better approach would be to introduce / increase a fee-per-patient paid by the principal. The reason is very straightforward: in order to seize the possible increase of revenue from the fee-per-patient, the health care provider must attract more users; it can do so only by lowering the bill charged to the patient, which requires reducing the amount of prescribed medical items. As far as efficiency is concerned, our model highlights also the loss stemming from the fact that providers are allowed to charge a profit margin on the medical items they prescribe.

For sure, the Chinese health system's crisis requires quite a wide and sophisticated set of policy measures. Obviously we don't mean to underestimate the height of the challenge, especially in terms of the actual range of manoeuvre for health authorities (Meessen and Bloom 2007). These caveats formulated, we believe that modelling is not useless. For example, our model confirms that establishing purchasing bodies is a way forward. The ongoing roll-out of health insurance schemes in rural areas (the so-called New Cooperative Medical Scheme) may create the perception that this is the route currently taken, but a key feature of these schemes must temper our enthusiasm: in too many places, the schemes are not acting as real purchasing bodies, they are just reimbursing part of their hospital bill to patients. A real 'purchasing body' should have a direct contractual relationship with the health care provider. Our model shows

that the way such a principal remunerates the providers is strategic (Eggleson et al., 2006). While complex payment systems are probably the future, we show that even a basic approach such as a fee-per-patient could already have an impact. Given the great variety of approaches developed today in ‘decentralised’ China (Wagstaff et al. 2007), it is unclear to us whether this track has been taken so far; our model seems at least to indicate that it deserves consideration. Our normative assessment of the prescription charge arrangement indicates to the Chinese health authorities a second track for decisive action: there is a need for much stricter action towards health care providers charging a mark-up on the medical items that they prescribe. For drugs, organising and enforcing a ‘prescriber – dispenser split’ (including by the punishment of the too frequent practice of kickbacks by pharmacies) seems the best way forward. Legislation and practices in high-income countries are probable sources of inspiration.

6.4. General lessons

Modelling has its own limits: it rests on assumptions that may be seen as simplistic and betraying the complexity of reality. It should certainly not be the only source of knowledge for guiding health policymaking. Yet, as far as health systems of low-income countries are concerned, the current state of affairs in the scientific community embodies more a situation of too little analytical modelling than an excess of it. A testimony of that is the little attention being paid to incentives to providers in the user fee debate – a scientific question that one could have expected to have benefited over and over from the dialectic exchange of arguments and counter-arguments by respective camps.

Models help to discuss specific cases, but they convey also general lessons. In this paper, we see at least two lessons for health policy makers. The first one is about the possible causes of some phenomena observable in health care systems. A pattern quite extensively shared across countries is the low quality of services delivered by public health care providers. For tackling these problems, it is tempting to point at strategies such as capacity building or quality assurance mechanisms. Our model suggests another track for action: incentives. The quality of services (e.g., prescription of medicines, cleanliness of the buildings, tastiness of the patient meals, comfort in the

hospital rooms) is to a large extent determined by the health staff. If a health facility is dirty, a lack of economic interests may be a better explanation than a lack of expertise.

The second key finding of this scrutiny of three contractual set-ups is the demonstration that policy instruments cannot be considered in isolation from the contractual arrangements in place. Our model shows for example that while a rise in the fee-per-patient paid by the principal induces providers to prescribe less in the lump sum + prescription charges setting, it entices the providers to prescribe more in the lump sum one. A same policy can have opposite effects under two different regimes.

This observation has two main scientific implications. The first one is mainly of a descriptive nature: there is a need to develop a more holistic and detailed view of institutional arrangements establishing health provision in low-income countries. Current dichotomist concepts (public versus private, free health care versus ‘user charges’) are much too gross to capture the complexity of the institutional reality. The second one is that one must acknowledge that there is today an insufficient knowledge both analytically and empirically of the consequences of variations in some policy instruments. This observation is not an argument for a policy status quo: needs are so huge that decisive actions are required. It just reminds us that caution with reforms of the public sector and good measurement of their impact are required.

Appendix 1: The income threshold is U-shaped with respect to prescription if the tariff is piece rate.

The marginal impact of prescription on the income threshold is:

$$\frac{d\tilde{y}(m, t(m))}{dm} = \frac{\partial \tilde{y}}{\partial m} + \frac{\partial \tilde{y}}{\partial t} \cdot p_s \quad (\text{A.1})$$

The net effect can be shown to be negative for initially low prescriptions. For higher ones, the positive “bill effect” outweighs the negative “perceived health effect”. Let us define a function $F(y, m, t)$ as the expected utility gain from coming to the health centre rather than keeping suffering from a given disease. By definition, $F(\tilde{y}, m, t) = 0$, that is condition (1) holds with equality. Then, (A.1) can be written as

$$\frac{d\tilde{y}}{dm} = (-1) \frac{\partial F / \partial m}{\partial F / \partial \tilde{y}} + (-1) \frac{\partial F / \partial t}{\partial F / \partial \tilde{y}} p_s$$

which has the same sign as

$$(-1) \left(\frac{\partial F}{\partial m} + \frac{\partial F}{\partial t} p_s \right) < 0 \Leftrightarrow \frac{\partial F}{\partial m} > \left| \frac{\partial F}{\partial t} \right| p_s$$

Using (1), we work out the derivatives of $F(y, m, t)$ with respect to m and t . Making use of these calculations,

$$\begin{aligned} & \frac{d\tilde{y}}{dm} < 0 \\ \Leftrightarrow & \pi'(m)[u(1, \tilde{y} - t) - u(h, \tilde{y} - t)] > \pi(m)u_2(1, \tilde{y} - t) \cdot p_s + (1 - \pi(m))u_2(h, \tilde{y} - t) \cdot p_s \quad (\text{A.2}) \end{aligned}$$

Because the recovery function is concave in prescription, the left hand side of (A.2) decreases with m . Since, in addition, under the assumption that $u_{12} \geq 0$ the right hand side is an increasing function of m , we have completed the proof of the above statement that the income threshold is U-shaped with respect to prescription.

Appendix 2: The optimal reward contract in a multiple pathologies setting

For the purpose of extending the result of section 5 to a multiple pathologies setting, we only need to show that, following a change in p_p , there exists a change in w that allows to restore the initial prescription level for all pathology h . As a second step, it is shown that total cost is not minimised for any reward contract in which $p_p \neq p_s$.

Suppose that total population size is H . For simplicity, let us assume that H is also the discrete number of pathologies and that patients are uniformly distributed between these categories. First, the decision rule of the health care provider can be extended in the following way:

$$\underset{\{m_1, \dots, m_H\}}{\text{Max}} \sum_{h=1}^H [w + (p_s - p_p)m_h] (1 - \tilde{y}_h(m_h)) - v \left(H - \sum_{h=1}^H \tilde{y}_h(m_h) \right)$$

There is a set of H first order conditions:

$$\left\{ \begin{array}{l} w = \frac{(p_s - p_p)(1 - \tilde{y}_1(m_1^*))}{d\tilde{y}_1/dm_1} - (p_s - p_p)m_1^* + v' \left(H - \sum_{h=1}^H \tilde{y}_h(m_h^*) \right) \\ (...) \\ w = \frac{(p_s - p_p)(1 - \tilde{y}_H(m_H^*))}{d\tilde{y}_H/dm_H} - (p_s - p_p)m_H^* + v' \left(H - \sum_{h=1}^H \tilde{y}_h(m_h^*) \right) \end{array} \right.$$

We can isolate any pair of equations and show that

$$-\frac{(1 - \tilde{y}_i(m_i^*))}{d\tilde{y}_i/dm_i} + m_i^* = -\frac{(1 - \tilde{y}_j(m_j^*))}{d\tilde{y}_j/dm_j} + m_j^* \quad \forall i, j \in \{1, \dots, H\}$$

Since, for any equation h ,

$$\frac{\partial w}{\partial p_p} = -\frac{(1 - \tilde{y}_h(m_h^*))}{d\tilde{y}_h/dm_h} + m_h^*,$$

There exists a simultaneous change in w and p_p such that the vector of equilibrium prescriptions remains constant.

Second, in this extended setting, total cost is the same expression as (4) summed over all pathologies, hence,

$$\frac{dC}{dp_p} = -\sum_{h=1}^H \frac{(1 - \tilde{y}_h(m_h^*))^2}{d\tilde{y}_h/dm_h}$$

And the argument of section 5 applies.

Notes

¹ Throughout the paper, we will use two other terms for this single principal: the government or the Ministry of Health. Yet, it should be clear that also any third-party payer fits the role. One could imagine for example that the principal is a humanitarian NGO or a community health insurance. We refer to these cases, when relevant.

² Throughout the paper, the health care provider is assumed to act as a single practitioner or as a team with no internal conflict of interest. Such a simplification allows the economic analysis to focus on the incentive problems of interest. For a more sophisticated view, see for example (Boadway et al., 2004).

³ This assumption is a bit extreme. There are methods to assess the relevance of medicine prescription and identify the causes of variations between providers; yet, they are costly and as a matter of fact, quite loosely implemented in practice. Some of the research questions about ‘irrelevant prescriptions’ are covered in our discussion.

⁴ The Bamako Initiative foresaw that a community health committee would play a part in the governance of drug management and would have some residual claim on any profit from it. This community model has been adopted to various extents at health centre level, but not in all countries and to our knowledge, never at hospital level.

⁵ The health district model aims at ensuring to all a good access to health services. It allocates governmental resources – buildings, equipment and workforce – in such a way that every rural household has a health centre in close vicinity (e.g., 1-hour walk) and a hospital in a reasonable distance (e.g., 1-hour drive). The two levels of health facilities have to deliver a different – usually nationally defined – package of activities to their respective target populations. In practice, scarcity of resources makes that each household faces a monopoly for both levels of care. This policy has been endorsed by most sub-Saharan African countries in Harare in 1987 (WHO, 1987).

⁶ The right hand side of (1) measures the utility level obtained from the best alternative to visiting the public health facility. Under the monopolistic position of the latter, this best alternative equates with keeping suffering, while under competition, it would be visiting the nearest or cheapest alternative practitioner.

⁷ In this paper, we will consider only the case of a drug supply system without rationing. The model can easily be adapted to incorporate drug quotas (e.g., the ‘essential drug kits’).

⁸ This is a sufficient condition.

⁹ Indeed, our model is aimed at predicting the marginal impact of slight policy changes on the provider's behaviour. For that purpose, the reaction of demand just needs to be computed at the margin. Therefore, it is unimportant to take account of a potential correlation between income and health status.

¹⁰ Notice that the provider is risk neutral with respect to income. As a consequence, the fix part of its remuneration can be omitted in the analytical developments.

¹¹ Yet, it must be noticed that community-based health insurance can opt also for other models such as capitation payment or reimbursement to patients of drug prescription charges.

¹² The first equality holds because $\frac{\partial^2 \tilde{y}}{\partial t \partial m} = 0$. Indeed, $\tilde{y}(m, t)$ is implicitly defined by condition (1)

under strict equality:

$$\pi(m)u(1, \tilde{y} - t) + (1 - \pi(m))u(h, \tilde{y} - t) - u(h, \tilde{y}) = 0 \Leftrightarrow \frac{u(h, \tilde{y}) - u(h, \tilde{y} - t)}{u(1, \tilde{y} - t) - u(h, \tilde{y} - t)} - \pi(m) = 0$$

Using the latter equation and the implicit function theorem to find $\partial \tilde{y} / \partial t$, we notice that it does not depend on m . We conclude that the cross derivative is zero.

¹³ You could easily check that the above results apply to the more general case where $p_p > p_s$.

Indeed, in this situation, the equilibrium prescription is located in the downward sloping part of the income threshold curve. It follows that the results of the comparative statics have the same sign as those in the lump sum setting. The provider's marginal behaviour is hence similar in direction even if not in magnitude.

¹⁴ Using the previously defined function $F(y, m, t)$,

$$\begin{aligned} \frac{\partial^2 \tilde{y}}{\partial t^2} &= \frac{\partial}{\partial t} \cdot \left[(-1) \frac{\partial F / \partial t}{\partial F / \partial \tilde{y}} \right], \text{ which has the same sign as } \left[\frac{\partial F}{\partial t} \frac{\partial^2 F}{\partial \tilde{y} \partial t} - \frac{\partial^2 F}{\partial t^2} \frac{\partial F}{\partial \tilde{y}} \right] \text{ that is equal to} \\ &= (\pi.u_2(1, \tilde{y} - t) + (1 - \pi).u_2(h, \tilde{y} - t)).(\pi.u_{22}(1, \tilde{y} - t) + (1 - \pi).u_{22}(h, \tilde{y} - t)) \\ &\quad - (\pi.u_{22}(1, \tilde{y} - t) + (1 - \pi).u_{22}(h, \tilde{y} - t)).(\pi.u_2(1, \tilde{y} - t) + (1 - \pi).u_2(h, \tilde{y} - t) - u_2(h, \tilde{y})) \\ &= (\pi.u_{22}(1, \tilde{y} - t) + (1 - \pi).u_{22}(h, \tilde{y} - t)).u_2(h, \tilde{y}) \leq 0 \end{aligned}$$

¹⁵ As others, we doubt that frivolous demand is a major issue today in rural areas of low-income countries: in practice, there are participation costs (e.g., transportation, time loss) that limit its

occurrence.

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Figure 1a (on the left); **Figure 1b** (on the right)

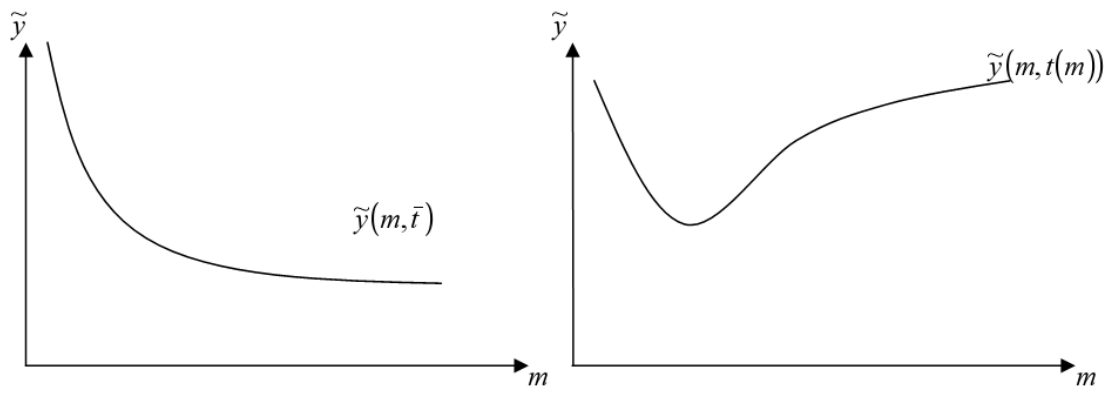


Figure 2

