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Designing incentives for rural health care providers in developing countries

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Abstract

In many developing country settings, and particularly in rural areas, the implementation of anything more than very rudimentary contracts for medical care providers, including public employees, is virtually impossible. In this paper, we examine the kinds of policy levers that governments might conceivably have available to induce physicians to serve in rural areas. Using simple models of screening and spatial competition, we investigate how the government can sort between physicians with low and high opportunity costs of relocation, and how the quality of existing providers (e.g., traditional healers) might affect the government's training policies.

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1. Introduction

Since 1977, the international health community has put a great deal of emphasis on ensuring universal access to basic primary care as a high priority for public action. While the rationale for this emphasis is questionable,² we take this goal as given. In practice, attempts at universal provision have often been disappointing. Reliance on the private sector to put trained professionals in such areas is not warranted as demand for the services

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² See Filmer et al. (2000) for a critique of this approach to health care policy.

at the true opportunity cost of the professionals' time is simply too low. State intervention is obviously needed. On the other hand, public performance has met with, at best, variable success. Disappointment stems from several sources but a common problem is the inability to staff and supply medical posts in rural areas. High vacancy rates, rates of absenteeism, simple lack of conscientious or courteous care, and frequent lack of supplies such as essential drugs are common in many public facilities.

A vast literature examines how to optimally pay physicians, in the context of the principal-agent model.³ These models are applicable to institutionally rich environments, such as exist in urban areas of industrialized countries. However, sophisticated performance-based contracts are difficult to enforce in poorer countries, so we restrict ourselves to simple mechanisms. The first is a menu of rural service options that specifies alternative rewards for different lengths of rural service. If the state provides medical training, these rewards might be implemented through adjustments to tuition fees or repayments of student loans, conditional on the length of service.

The second model builds on the first, and examines the endogenous behavior of physicians who operate in rural areas. We assume that explicit incentives cannot be provided by the central authorities, and that performance responds only to competition with local alternative providers (e.g., traditional healers). Consistent with virtually all studies of physician behavior in developing countries, we assume that both providers charge fees. We use a differentiated goods model of competition that allows us to ask how well a rural physician who locates in a rural village should be trained. The level of training affects both the average quality of service provided in the village, but also the income of the physician. This feeds back into the optimal rewards that must be offered to induce relocation in the first place.

In this paper, we do not address the public/private issue: that is, we make no distinction between public servants and private providers contracted by the government. These issues, related to the question of asset ownership, have been dealt with elsewhere (e.g., [Hart et al., 1997](#); [Glaeser and Shleifer, 1998](#); [Besley and Ghatak, 2000](#)). Instead, we simply ask how physicians should be compensated and trained, when explicit incentive mechanisms are infeasible. The next section models the design of rural service options, taking the performance of the physician at village level as fixed. Following this, Section 3 incorporates competition at the village level to endogenize physicians' market incomes, under the assumption that explicit incentives cannot be provided from the center.⁴ Section 4 briefly concludes.

2. Satisfying the participation constraint: getting doctors to serve in rural areas

This section examines how a government might pay physicians to serve in rural areas when some physicians are more willing to move than others. This heterogeneity could

³ See, e.g., [Ma \(1994\)](#), [Ma and McGuire \(1997\)](#), [McGuire \(2000\)](#), and [Newhouse \(1996\)](#).

⁴ The underlying models are familiar to students of basic microeconomics, so are not presented in any detail here. The interested reader is referred to the working paper version of this paper, [Hammer and Jack \(2001\)](#).

derive, for example, from differences in underlying preferences or opportunity costs. The only variable upon which payment can be conditioned is length of service, denoted q . We assume for simplicity that the quality of service is independent of the time spent on the job,⁵ that it is independent of the physicians' willingness to move,⁶ and that the social value of rural service per unit time is constant, b .⁷ The total payment received by the physician from the government is P , and the cost of staying in the rural area can be high or low, and is increasing and convex in the time spent. Denote the cost by $c_i(q)$, where $i=L,H$, $c_L(q) < c_H(q)$, and $c'_L(q) < c'_H(q)$, for $q > 0$. A proportion ϕ of physicians have low opportunity costs, and a proportion $(1 - \phi)$ have high costs. A physician's net utility is simply $P - c_i(q)$.

The government's objective is to maximize the social benefit of medical care less the financial costs of delivery (i.e., the costs of paying physicians). If both types of physician are employed, welfare is

$$W = \phi(bq_L - P_L) + (1 - \phi)(bq_H - P_H), \quad (1)$$

where q_i is the quantity of services provided by, and P_i the payment made to, a physician of type i . Note that we do not include the utility of the physicians in this measure of welfare, motivated by the assumption that public income is more valuable than (private) physician income due to the existence of tax distortions. The welfare of physicians is important however, as their pursuit of it generates incentive effects.

Rural medical care could be efficiently procured by simply paying all physicians b per unit time of service, i.e., $P_i = bq_i$. However, social welfare is zero in this case, while physicians earn surplus $S_i(b) = \max_q bq - c_i(q)$, for $i=L,H$. Welfare would be maximized by a perfectly discriminating government (which could observe physician types), by requiring i -type physicians to make a lump-sum payment $S_i(b)$ in return for being paid b per unit time of rural service. When such differential fees are infeasible, a simple two-part tariff can be employed, in which physicians are charged a uniform fee F , and are paid a constant wage per unit time w .⁸ F can be interpreted as the amount of medical school expenses that are required to be repaid to the government before a rural appointment is granted.

This two-part tariff is neither fully optimal, nor likely to be observed in practice. Not only does it require a potentially large up-front payment from the physician to the government, but it also requires that the physician trust the government to pay the (high)

⁵ One can imagine the effects in both directions, determined by a mix of increased experience and rural fatigue.

⁶ The simple idea here is that the government is trying to procure basic health care services, which can be provided equally well by a range of physicians. These physicians might be of differing quality in urban areas, and thus have different opportunity costs, while all being able to provide the same quality of basic service.

⁷ Of course, the marginal value of additional doctor time could fall as services expand. The constant marginal social value is supported by the realistic assumption that services are sufficiently thinly spread that any expansion is on the extensive margin, and increases access to previously unserved populations.

⁸ When costs are quadratic, $c_i(q) = \theta_i q^2 / 2$, for $\theta_L < \theta_H$, it can be shown (e.g., Tirole, 1988) that the parameters in the optimal two-part tariff are $w = b / (2 - \bar{\theta} / \theta_H)$, and $F = w^2 / 2\theta_H$, where $\bar{\theta}$ is the harmonic mean, satisfying $1/\bar{\theta} = \phi/\theta_L + (1 - \phi)/\theta_H$.

wage rate w for as long as services are provided. Instead, the government can offer a menu of (two) rural service options, (q_L, P_L) and (q_H, P_H) , that stipulate the length of service required and the total payment to be paid to the physician. Standard techniques can be used (see [Hammer and Jack, 2001](#)) to show that, as long as the costs of high-cost types are not too high, the optimal menu includes two periods of service, $q_L > q_H$, satisfying

$$\begin{aligned} c'_L(q_L) &= b \\ c'_H(q_H) &= b - \frac{\phi}{1-\phi} [c'_H(q_H) - c'_L(q_H)], \end{aligned} \quad (2)$$

and that these are coupled with payments $P_L = c_L(q_L) + [c_H(q_H) - c_L(q_H)]$ and $P_H = c_H(q_H)$. Clearly, the total payment to low-cost physicians is less than that paid to high-cost physicians, $P_L > P_H$ (although the average annual salaries paid may not have the same pattern). Physicians with lower opportunity costs are induced to spend longer in rural areas (which makes sense), but they are paid more than their opportunity cost to do so. If the opportunity cost of high-cost physicians is too high, it becomes optimal for the government to send only low-cost types to rural areas. This would be particularly the case if public services were well-targeted to the poor, so that, contrary to our simplifying assumption, the social benefit of extensive expansion of coverage (to the non-poor) was small. Otherwise, universal coverage may be simply unattainable at an acceptable cost.

Many countries have schemes for increasing the number of doctors accepting rural assignments. Extra pay for “hardship posts” is common but often ineffectual. In one of the few studies on the subject, [Chomitz et al. \(1998\)](#) examined the “willingness to accept” remote assignments in Indonesia. For doctors originally from these areas, the extra cost to induce acceptance was modest but for others, the necessary wage was well outside any realistic range. However, preferential admission to specialist education (severely rationed by less-than-transparent means) did have some effect.

Several countries, including the United States, offer subsidized medical education under the proviso of a period of service in remote locations. An alternative is illustrated by Bangladesh which uses a point system, wherein the acceptance of unattractive postings earns a physician points, which increase the chances of future postings to particularly appealing locations. Explicit differences in the cash terms of contracts are not generally used. The ability of governments to effectively use such indirect means rather than wage differentials depends on the ability to exploit either a market failure (capital markets in the U.S. that make medical education expensive) or a government-induced constraint in medical education or labor markets. Nonetheless, these instruments can be understood in terms of differential payment mechanisms.

3. Competition as an incentive for performance

The previous section examined the design of mechanisms to induce physicians to move to rural areas, under the assumption that when there they would produce output of a certain social value (b). Inducing the physician to work also requires that incentives be given,

unless the provider's altruism is sufficiently strong.⁹ We assume here that the government cannot provide any explicit performance-based incentives, and can at best pay a monthly wage (as in the previous section). Incentives then must come from the market. Even when services are officially free to consumers, informal payments abound (see, e.g., Lewis, 2001). It is important then to understand the nature of market equilibrium, and the implications for the kinds of physicians that should be assigned to rural areas.

Studies on the substitution of demand between providers of different levels of quality are common in the literature, and consumers are often found to actively search between alternative providers (Leonard et al., 2001; Filmer et al., 2000). An alternative local source of supply, for example in the form of a traditional healer, affords individuals an "exit" option, and might improve the performance of physicians. In the simple model we employ in this section, this is manifest in price competition, assuming the quality of services, as determined by the physician's level of training, is fixed by the government.¹⁰ As long as local competition is imperfect, the physician will earn some current profit, which represents a component of the overall compensation earned as a result of her decision to relocate.

To formally model the interaction of a traditional healer and a city-trained physician, we employ a spatial competition model. Individuals within a community have a range of tastes, some preferring to visit a traditional healer, others favoring a physician. Individuals choose between the two given tastes, on the basis of the quality of service provided, and the price charged, by each. To model this, we assume individuals are uniformly distributed along the unit interval $[0,1]$, with the traditional healer located at 0 and the physician at 1. An individual located at position x gains net surplus $\sigma_0 = u_0 - p_0 - tx$ by purchasing care from the traditional healer, compared with $\sigma_1 = u_1 - p_1 - t(1-x)$ by purchasing care from the physician. u_i is the utility of care received from provider i (which depends on its quality), p_i is the price charged by provider i , and t represents the consumer's unit travel cost, which parameterizes the extent to which the traditional healer and the physician differ.¹¹ \underline{u} is an individual's utility from self care, that is, her outside option. We assume for simplicity that the healer and the physician have no alternative opportunities in the village, so their costs of provision are zero.

Under the assumption that travel costs are small enough, so that all consumers visit either the healer or the physician, equilibrium prices charged by the traditional healer and the physician are

$$\begin{aligned} p_0 &= t + \frac{\Delta u}{3} \\ p_1 &= t - \frac{\Delta u}{3}, \end{aligned} \tag{3}$$

where $\Delta u = u_1 - u_0$ is the quality differential. The physician's equilibrium profit is $t/2 + \Delta u/3 + \Delta u^2/18t$, which is increasing in Δu for $\Delta u > -3t$. Therefore, as long as the physician's

⁹ Even altruistic physicians might provide less than the socially optimal level of services. On the other hand, poorly trained altruists could do more harm than good. Our model abstracts from these concerns.

¹⁰ We could also use a model in which costly physician effort affected demand. Here, price reductions, which are costly to the physician, have the same effect.

¹¹ Leonard et al. (2001) have examined the importance of travel costs to choice of provider in rural Tanzania.

quality is not too far below that of the healer (or if it is above it), an increase in healer quality reduces the physician's profit.

On the other hand, higher quality traditional healers could indicate less need for high-quality city-trained physicians. To examine this issue let us consider the optimal training level of a physician, when the costs of training, $K(u_1)$ are increasing and convex in quality. The social surplus from the provision of care, net of travel costs, is

$$S(u_1) = \int_0^{\hat{x}} (u_0 - p_0 - tx)dx + \int_{\hat{x}}^1 (u_1 - p_1 - (1-t)x)dx, \quad (4)$$

where \hat{x} is the position of the individual who is indifferent between seeking care from the traditional healer and the physician. It is straightforward to show that $S'(u_1) = 1/2 + \Delta u/18t$, and the optimal physician quality satisfies

$$\frac{1}{2} + \frac{\Delta u}{18t} = K'(u_1). \quad (5)$$

The second-order condition for a maximum is $1 - 18tK'' < 0$, which we assume is satisfied. In this case, an increase in healer quality reduces the optimal training level of physicians (i.e., they are strategic substitutes), further reducing the profits that can be earned by physicians who relocate.¹²

As the potential profits earned by city-trained physicians fall, it is necessary to draw more on general budgetary resources to satisfy the participation constraint (i.e., to pay fixed fees and monthly salaries high enough to induce physicians to relocate). If the costs of tapping these resources (measured by the shadow cost of public income relative to private village consumption) are large, then the reduction in training could be mitigated. Indeed, if these costs are large enough, optimal physician quality could in fact increase. In this scenario, healer and physician quality would be strategic complements.

One implication is that, when the shadow cost of public funds is high, it might not be optimal to equalize medical resources across regions: instead, localities with better local healers should attract better-trained physicians. This policy conclusion is clearly not robust to the introduction of other variables that are likely to be correlated with the quality of local healers. For example, if the government is inequality averse, and if healer quality is correlated with local incomes, the efficient allocation of physicians may be rejected on equity grounds.

4. Conclusions

A great deal of literature examines how medical care providers should be paid. However, in many developing country settings, and particularly in rural areas, the implementation of anything more than very rudimentary contracts is virtually impossible.

¹² It can be easily shown that $d\pi_1/du_0 = \partial\pi_1/\partial u_0[1 - \partial u_1^*/\partial u_0]$, where $u_1^*(u_0)$ is the socially optimal choice of physician quality. As $\partial u_1^*/\partial u_0 < 0$, the negative partial effect of healer quality on physician profits is augmented by the government's adjustment.

In this paper, we have therefore examined the kinds of policy levers that governments might conceivably have available to induce physicians to serve in rural areas. Using simple models of screening and spatial competition, we have investigated how the government can sort between physicians with low and high opportunity costs of relocation, and how the quality of existing providers (e.g., traditional healers) might affect the government's training policies.

5. Uncited reference

Jack, 2000

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