

A Supplementary Appendix: Health Insurance and Consumer Choice

A.1 HMO Consumers

Typically, however, consumers do not bear the cost of their hospitalization directly, as either all or most of the cost is borne by an insurer. Similarly, consumers' choices of both which hospital to patronize and what care to consume are determined substantially by their insurer through selective contracting and utilization review.¹ This is especially true of HMO patients who often pay little or nothing when they consume care and whose utilization is often heavily managed by the HMO.² Hence, we model the HMO's choices.

We posit a very simple model of HMO behavior. HMOs sell policies to consumers, consisting of a premium, M , and decision rules specifying the hospital to which a consumer will be sent and the quantity of care he will be provided, depending on his characteristics, R_i . We will denote the hospital-choice decision rule by a J -vector of indicator functions $\chi(R_i)$, where a 1 in the j th place indicates that a consumer with characteristics R_i is sent to hospital j . We will write the j th function in this vector for the i th consumer in the mnemonically convenient notation, $\chi_{i \rightarrow j}$. The decision rule for quantity of care consumed is $q(R_i)$. We assume that R_i is unobservable ex ante, so that the consumer evaluates the desirability of the HMO by its premium and its average quality, $\bar{v} = \int_{R_i} \sum_{j=1}^J \chi_j(R_i) v(q(R_i), R_i, S_j) dF_{R_i}$, i.e., the average utility across consumers from consuming hospital care.

Thus each HMO contract is characterized, for the consumers' purposes, by a pair, (M, \bar{v}) . Different consumers choose different policies since their incomes differ. We are agnostic about the insurance market — by some means, (M, \bar{v}) are chosen for each insurer and consumers are allocated among them.³

The HMO must choose rules to assign consumers to hospitals, $\chi(R_i)$ and rules to assign quan-

¹Consumers are also influenced by the advice of their doctors, who in turn are also often influenced by incentives from the insurer. We do not model the doctor-patient interaction here.

²HMOs seek to limit medical expenditures by selectively contracting with health care providers, and most also attempt to control care via financial incentives for doctors.

³We are assuming that the allocation is independent of consumer characteristics observable to the market participants but unobservable to the econometrician. We have not specified ex ante observable consumer characteristics in our model, however there certainly are such factors that affect M and \bar{v} , e.g., age and sex. Therefore this analysis should be thought of as conditional on ex ante observables. When we discuss the solution below, it will also be conditional on ex ante observables. We are assuming, therefore, that HMOs can “price discriminate” among consumers with different observables and that they can offer them, either implicitly or explicitly, different decision rules in their benefits.

tities, $q(R_i)$. It does this to minimize costs subject to producing its chosen level of quality:

$$\begin{aligned} \min_{\chi(\bullet), q(\bullet)} \int_{R_i} \sum_j \chi_j(R_i) p_j q(R_i) dF_{R_i} \\ \text{s.t.} \quad \int \sum_j v(q_i, R_i, S_j) dF_{R_i} \geq \bar{v}. \end{aligned} \quad (1)$$

Assuming that a solution exists, this problem is equivalent to solving the following problem for each consumer individually (where λ is chosen such that the constraint is satisfied at the solution):

$$\min_{\chi, q} \sum_j p_j q - \lambda v(q, R_i, S_j) \quad (2)$$

Assertion:

The problem:

$$\begin{aligned} \min_{\chi(\bullet), q(\bullet)} \int_{R_i} \sum_j \chi_j(R_i) p_j q(R_i) dF_{R_i} \\ \text{s.t.} \quad \int \sum_j v(q_i, R_i, S_j) dF_{R_i} \geq \bar{v} \end{aligned}$$

is equivalent to solving

$$\min_{\chi, q} \sum_j p_j q - \lambda v(q, R_i, S_j)$$

for each consumer individually, where λ is chosen such that the constraint is satisfied at the solution.

Proof:

Consider a set of $\chi^*(R_i)$ and a $q^*(R_i)$ satisfying the above problem for each R_i for a λ which causes the constraint to be satisfied. Now consider any $\chi(R_i)$ and $q(R_i)$ satisfying the constraint.

By the optimality:

$$\sum_j \chi_j^* (p_j q_i^* - \lambda v(q_i^*, R_i, S_j)) \leq \sum_j \chi_j (p_j q_i - \lambda v(q_i, R_i, S_j))$$

Now, integrating both sides over R_i and imposing the constraint:

$$\begin{aligned} \int_{R_i} \sum_j \chi_j^* (p_j q_i^*) - \lambda \bar{v} &\leq \int_{R_i} \sum_j \chi_j (p_j q_i) - \lambda \bar{v} \\ \int_{R_i} \sum_j \chi_j^* (p_j q_i^*) &\leq \int_{R_i} \sum_j \chi_j (p_j q_i) \end{aligned}$$

This proves the result. \square

Naturally, λ will vary among health plans and on consumer ex ante observables, as different plans will choose to offer different levels of quality depending on local market conditions and the niche they wish to target.

We might just as well think of this problem as one of maximizing an “effective” utility function:

$$\max_{\chi, q_{ij}} -\frac{1}{\lambda} p_j q_{ij} + v(q_{ij}, R_i, S_j). \quad (3)$$

This problem is a discrete-continuous choice problem (Anderson et al., 1992; Dubin and McFadden, 1984). The solution can be thought of in two stages. After the choice of hospital, there is a choice of the optimal quantity:

$$\max_{q_{ij}} -\frac{1}{\lambda} p_j q_{ij} + v(q_{ij}, R_i, S_j) \quad (4)$$

Substituting the optimal quantity, q_{ij}^* into the above yields an indirect utility function:

$$V_{ij}^*(R_i, p_j, S_j) = -\frac{1}{\lambda} p_j q_{ij}^* + v(q_{ij}^*, R_i, S_j) \quad (5)$$

The insurer then chooses the hospital with the greatest V_{ij} . So, the probability of a randomly selected consumer going to hospital j is:

$$P\{i \rightarrow j\} = \int_{V_{ij}^* \geq \max_j \{V_{ij}^*\}} dF_{R_i} \quad (6)$$

This leads to total expected demand for hospital j :

$$D_j(p) = \int_{V_{ij}^* \geq \max_j \{V_{ij}^*\}} q_{ij}^* dF_{R_i}. \quad (7)$$

We have characterized consumers with HMO insurance and the attendant demand facing hospitals from these consumers. We now turn to consumers with “traditional” insurance.

A.2 Traditional Insurance Consumers

We also model traditional insurance in a simple way. With traditional insurance (also referred to as “conventional,” “fee-for-service,” or “indemnity”) consumers pay a premium and agree to pay a proportion of expenses (called “coinsurance”). The consumer is then free to choose where to obtain medical care when they fall ill.

A traditional insurance contract is thus a premium, M , and a coinsurance rate, τ . The consumer chooses his own hospital and pays $\tau p_j q_{ij}$ for his care. The insurer then picks up the remaining $(1 - \tau) p_j q_{ij}$.

In traditional insurance the consumer makes his treatment decisions to maximize utility over χ and q :

$$\max_{\chi, q} U_{ij} = u(I - M - \tau p_j q_{ij}) + v(q_{ij}, R_i, S_j) \quad (8)$$

We assume that this utility is well-approximated by:

$$U_{ij} \approx u(I - M) - u'(I - M) \tau p_j q_{ij} + v(q_{ij}, R_i, S_j) \quad (9)$$

Thus, we are effectively assuming either that marginal utility is constant in C or that $\tau p_j q_{ij}$ is small relative to $I - M$. Either way, we still permit the marginal utility of income to vary among

consumers. This assumption serves the purpose of leading the effective utility function to have the same structure as in the HMO case for our purposes (i.e. $u'\tau = 1/\lambda$) — although from the perspective of the consumer, there is a difference. This then leads to a hospital's expected demand in the same way as in the previous section.

References

- Anderson, S. P., dePalma, A., and Thisse, J. F. (1992). *Discrete choice theory of product differentiation*. MIT Press.
- Dubin, J. A. and McFadden, D. L. (1984). An econometric analysis of residential electric appliance holdings and consumption. *Econometrica*, 52(2):345–62.