

Chapter 4

Demand for Health Care: Modified Model and Theoretical Results

GLS 87 is a pioneering study, which tried to model an individual's health care seeking behaviour in a discrete choice framework by incorporating both individual and provider characteristics. A number of studies which appeared after GLS 87 followed almost the same structural and reduced form model with minor modifications and changes. This chapter briefly presents GLS 87 and the modifications and improvement made later. Then, it attempts to incorporate the concepts of quality and price of health care developed in the previous chapter to extend the basic structural model of GLS 87. Finally, it draws some theoretical insights about an individual's sensitivity to quality and price of health care from the theoretical model.

The chapter is organised in the following way: Section 4.1 presents the structural model of GLS 87 including the modifications and improvements made in the later studies. Section 4.2 extends the structural model by including our conceptualisation of quality and price of health care (developed in the previous chapter). Section 4.3 and 4.4 draw some theoretical insights about an individual's sensitivity to quality and price of health care from the model. Section 4.5 highlights some important inferences made in the discussions.

4.1 GLS 87: The Structural Model and Modifications

Although there were similarities, the framework used by GLS 87 was substantially different from the theoretical framework developed by Grossman (1978). In GLS 87 framework, an individual's decision to go for health care (or treatment) and choice of health care providers are considered in a static discrete choice set-up which assumes that the individual has access to a limited number of health care providers and she is concerned only with short-run utility maximisation. In the first stage, the individual decides whether or not to go for health care and once decided to go for health care, in the second stage she decides which health care provider to select from a set of finite number of alternative health care providers.

To discuss the basic structure of these models, we shall now briefly describe the structural model of GLS 87. The model assumes that utility of an individual depends upon health status and consumption of goods other than health care. When an individual falls sick, she, in the first stage, decides whether to seek health care or not. If she decides to seek health care, then in the second stage, she has to choose a particular health care provider. Consumption of health

care implies both benefits and costs. It benefits the individual because health care is expected to improve her health status. It entails cost (both monetary and non-monetary) because money and time spent for consuming health care is not available for any other purpose. The individual chooses a particular health care provider from a set of health care providers, each of which has a potential impact on her health. The potential impact depends on health care provider's skills and individual's characteristics (e.g. health status, health problems, ability to implement the recommended health care, and so on).

The utility function of individual i conditional on receiving health care from provider j is expressed as

$$U_j = U(H_j, C_j, T_j) \quad (4.1)$$

Where H_j = expected health status of the individual after receiving health care from provider j ; C_j = expenditure on consumption after paying provider j ; and T_j = non-monetary cost of accessing health care.

The perceived quality or marginal product of provider j 's health care is defined as the ratio between H_j and H_0 , where H_0 is expected health status without (professional) health care (i.e. 'no care' or 'self care'). Therefore,

$$Q_j = H_j/H_0,$$

$$\text{Or, } H_j = H_0 Q_j. \quad ^1$$

For 'no care' or 'self care', quality production function takes a simple form. Since for 'no care' / 'self care' $H_j = H_0$, this implies $Q_0 = 1$. This means, the proportionality factor is unity for the 'no care' / 'self care' alternative. In effect, this normalises the health care production function so that the quality of a particular provider's care is measured relative to efficacy of 'no care' or 'self care'. The quality parameters are assumed to depend upon provider characteristics (e.g. training and facilities) and individual characteristics (type and severity of illness).

Let P_j be the price of provider j 's care and Y be the income, then

$$C_j = Y - P_j \quad ^2 \quad (4.2)$$

The constraining level of income depends on the length of time over which individuals are able to budget.

¹ Gertler, Locay and Sanderson (1987) assumed this simple linear relationship, which seems to be too simplistic. A better approach would have been to assume a general functional form.

² Feasibility condition requires that individual's income has to be at least as large as the price of the alternative, that is, $C_j \geq 0$.

Combining (4.1) and (4.2) we get

$$U_j = U(H_j, Y - P_j, T_j) \quad (4.3)$$

Now if the individual has $J + 1$ feasible alternatives (with $j = 0$ being no care or self-care), then the unconditional utility maximisation problem is

$$U^* = \max(U_0, U_1, \dots, U_J) \quad (4.4)$$

Most of the studies which followed the basic structural model of GLS 87 made some minor changes and modifications. For example, Dor, Gertler and van der Gaag (1987), Gertler and van der Gaag (1990), Mwabu, Ainsworth and Nyamete (1993), Gupta and Dasgupta (2000), Sahn, Younger and Genicot (2003) included the non-monetary costs (value of time spent in seeking health care) into the budget constraint, since it was argued that time spent to utilise health care was done at the expense of work in market place, production work at home or leisure.³ Therefore, the budget line, in those studies, takes the following form: $C_j + P_j^* = Y$; where P_j^* is the total price of health care which includes direct payment to the health care provider and indirect cost of accessing health care (e.g. value of time expressed in monetary terms). Dor, Gertler and Gaag (1987) and Gertler and van der Gaag (1990) defined the quality of health care in the structural model in the following subtractive form: $Q_j = H_j - H_0$. Or $H_j = H_0 + Q_j$. Akin, Guilkey, Hutchinson and McIntosh (1998) included individual's leisure time as an argument in the utility function along with health status and consumption of non-health care goods.

Once the structural equations are specified, the estimation of demand functions requires choice of suitable functional form for the utility and quality functions. The functional form of the demand functions would necessarily depend on the functional forms of the utility and quality functions and on the assumption about the distribution of disturbance terms.⁴ The demand function for provider shows the probability that its utility is greater than utility from other provider, given the individual's characteristics. In GLS 87, these estimated demand functions were used to project the impact of user fees on demand. In particular, these demand functions were used to compute the welfare costs of user fees - where welfare costs were measured by compensating variations. The demand functions were also used to estimate the

³ According to Gertler and van der Gaag (1990) adding to the value of leisure would greatly complicate the model. Therefore, they implicitly assume that lost time comes at the expense of work or home production and not at the expense of leisure.

⁴ McFadden (1981) has shown that given the reasonable distribution assumptions for the disturbance terms of utility and quality functions, demand takes a nested multinomial logit form, where it is first decided whether to seek care and then conditional on seeking care it is decided from which provider to seek care.

compensating variations for non-price changes (such as travel time). The estimated demand functions were used to calculate elasticity and to see the scope for increase in user fees and reduction in welfare of the individuals.

4.2 The Structural Model and Extension

Now we shall try to incorporate our conceptualisation of quality and price of health care into the structural model of GLS 87. We assume that the utility of an ill individual conditional on health care from provider j depends on expected improvement in health outcome, functional quality of health care and consumption of non-health care goods. Although functional quality of care does not contribute to health outcome, we include it in the utility function since it is a source of satisfaction for the ill individual. The utility function of the ill individual, conditional on health care from provider j can be expressed as

$$U_j = U(H_j, Q_j^f, C_j) \quad (4.5)$$

Where H_j = perceived health outcome due to health care from provider j , Q_j^f = functional quality of health care from provider j as perceived by the individual; and C_j = consumption of non-health care goods.

The health outcome is determined only by the technical quality of health care (Q_j^t). Better the technical quality of health care, higher is the health outcome. Therefore, health outcome and technical quality of health care (both perceived by the individual) are positively related. Symbolically, the relationship between expected improvement in health outcome and technical quality of health care can be represented as

$$H_j = f(Q_j^t); f(0) \leq 0^5 \text{ and } f'(\cdot) > 0 \quad (4.6)$$

The technical quality of health care (Q_j^t) and the functional quality of health care (Q_j^f) are not observable to the individual, but the individual may have some prior information about the technical and functional objects of provider j .⁶ Let the vectors of technical and functional objects of the health care be represented by Z_j^t and Z_j^f respectively. Technical quality of health care (Q_j^t) is then nothing but the individual's evaluation of Z_j^t .⁷ Similarly, functional quality of health care (Q_j^f) is her evaluation of Z_j^f . Since they are individual's evaluation, they

⁵ This allows for the possibility that when there is no health care (i.e. $Q_j^t = 0$), perceived health outcome can be negative too.

⁶ Irrespective of how much information an individual has about the technical and functional objects of a health care provider, she might consider higher direct price or higher access (due to long waiting) as indicators of better quality.

⁷ Perceived technical quality may be highly influenced by (perceived) past health outcome.

must be influenced by the individual's characteristics (X). In this context, Sen's distinction between positional and trans-positional objectivity can be illuminating (see Sen 1993).⁸ Following Sen, we argue that it does not serve any meaningful purpose to neglect Q_j^t , and Q_j^f just because they are subjective, rather it is meaningful to consider Q_j^t and Q_j^f as individual's positional objective assessment. If we take a full deterministic view of causation, the individual's evaluation of Z_j^t (i.e. Q_j^t) can be entirely accounted for by an adequate specification of individual's positional parameter (X) and vector of technical objects (i.e. Z_j^t). Similarly individual's evaluation of Z_j^f (i.e. Q_j^f) can be entirely accounted for by an adequate specification of individual's positional parameter (X) and vector of functional objects (i.e. Z_j^f). If these parameters are all specified as part of the positional identification, then observation based on those parameters will be potentially fully explainable to others. Therefore,

$$Q_j^t = g(Z_j^t, X); \text{ and } Q_j^f = h(Z_j^f, X) \quad (4.7)$$

The overall quality of provider j as perceived by the individual can be expressed as

$$Q_j = k(Q_j^t, Q_j^f) = k(g(Z_j^t, X), h(Z_j^f, X)) = Q(Z_j^t, Z_j^f, X) \quad (4.8)$$

Combining equations (4.5), (4.6), (4.7) and (4.8), we get

$$U_j = U(f(g(Z_j^t, X)), h(Z_j^f, X), C_j) \quad (4.9)$$

The individual incurs two types of costs in utilising health care, namely, the direct price (P_j^D) and the access costs (P_j^A). The budget constraint of the individual can be expressed as

$$C_j + (P_j^D + P_j^A) = Y \quad (4.10)$$

Y = sum of permanent income⁹ and the value of time.

Substituting (4.10) in (4.9) we get the indirect utility function

$$V_j = U(f(g(Z_j^t, X)), h(Z_j^f, X), Y - (P_j^D + P_j^A)) \quad (4.11)$$

If there are n number of health care providers, the individual can choose any option from $(n+1)$ alternatives ($j = 0, 1, \dots, n$; where $j = 0$ stands for no care/self-care depending upon which of V_0, V_1, \dots, V_n gives her maximum value.

Choosing appropriate empirical specifications for equations (4.5) to (4.8) followed by econometric estimation can give us estimated demand functions. The estimated demand functions will show the probability of an individual with characteristics X choosing a health care provider characterised by the vector $(Z^t, Z^f; P^D, P^A)$. As in the case of GLS87, these

⁸ Trans-positional objectivity implies assessment of an object which goes beyond the positional influence (See Sen 1993).

⁹ Individual's permanent income depends on the length of time over which she is able to budget.

demand functions will show the demand for provider j in comparison to 'no care'/self care'. The demand functions estimated in this way can be used to project the impact of change in utilisation where there is a change in any combination of the following factors: (1) changes in technical objects vector (Z^t); (2) changes in functional objects vector (Z^f); (3) changes in direct price (P^D); and (4) changes in access costs (P^A).

The indirect utility function presented in equation (4.11) can also be expressed as $V_j = V(Z_j^t, Z_j^f, P_j^A, P_j^D, X)$. Suppose the ill individual has three possible choices: no care (i.e. $j = 0$), care from a government provider (i.e. $j = G$) and care from a private provider (i.e. $j = P$). She will choose no-care if $V_0 > \text{Max} \{V_G, V_P\}$, otherwise she will choose care from government or private provider. In other words, the individual will not go for health care if the expected improvement in health is not enough to compensate for the sacrifice of the consumption of non-health care goods. It is easy to understand that an individual will not go for health care either when she perceives the illness as not severe or the economic status of individual is very poor. In case $V_0 < \text{Max} \{V_G, V_P\}$, the individual chooses government provider if $V_G > V_P$, otherwise she chooses private provider.¹⁰

Let us consider the case when the individual is comparing two situations 1 and 2. Two situations could be two different providers or same provider at two different points in time. Suppose vectors of technical and functional objects in two situations 1 and 2 are characterised by (Z_1^t, Z_1^f) and (Z_2^t, Z_2^f) respectively. The individual will consider quality of health care in situation 2 as better than that in situation 1 if $Q(Z_2^t, Z_2^f; X) > Q(Z_1^t, Z_1^f; X)$, individual characteristics (X) remaining the same. Therefore, quality of care in situation 2 is better than in situation 1, in this framework, implies $U(Z_2^t, Z_2^f, .) > U(Z_1^t, Z_1^f, .)$ keeping other things constant.

Now the important question arises if quality of health care is better as well as price is higher in situation 2 compared to situation 1, will such a change be acceptable to the individual? Suppose $Q(Z_2^t, Z_2^f; X) > Q(Z_1^t, Z_1^f; X)$ and the price vector (P_2^D, P_2^A) at least weakly dominates the price vector (P_1^D, P_1^A) ¹¹, then situation 2 will be preferable to situation 1 if

¹⁰ If $V_G = V_P$, the individual is expected to be indifferent between government and private health care providers.

¹¹ This means at least one of the price components is higher in situation 2 compared to situation 1.

$V(Z_2^t, Z_2^f, P_2^D, P_2^A, X) > V(Z_1^t, Z_1^f, P_1^D, P_1^A, X)$. Therefore, the final choice will depend on the individual's trade-off between quality and consumption of non-health care goods.

Now consider a situation when the individual is utilising a health care provider whose quality and price are represented by the vector (Q, P) to her. Suppose the maximum utility the individual derives from this health care provider net of no-care is \hat{V} . Assume that the quality is improved (from Q to Q') and price is increased (from P to P'), then the maximum utility the individual can derive from this improved quality and increased price is \hat{V}' . The change (improvement in quality and increase in price) will be acceptable to the individual if $\hat{V}' > \hat{V}$.

We need to know how much the individual will be willing to pay (as direct price) for the improved quality. The standard microeconomic theory suggests that willingness to pay can be measured by computing compensating variation (CV). CV is the amount of income that an individual must earn to make her just as well off as she was before the price change. Suppose the maximum utility an individual attains at price P , quality Q and her income Y (given the individual-level characteristics other than income, say X') is V . This means, at price P and quality Q , the minimum income required to reach utility level V is Y (By Duality Theorem). Now if there is an improvement in quality, the minimum income required to achieve the same utility level V would be lower than Y , say Y' . CV show that $(Y - Y')$ can be considered as the individual's willingness to pay for improved quality and therefore, collected from the individual in the form of increased direct price, without affecting her welfare. Similarly one can calculate an individual's willingness to pay for reduced access cost or a combination of improved quality and reduced access cost.

It is often argued that individuals will be willing to pay higher price at government facilities if quality is improved. This argument is generally based on the empirical evidence that individuals do pay higher price to private facilities for better quality and misses out the significance of access cost. It can be easily seen that the additional direct price an individual pays at private facility could be the combined willingness to pay for better quality and lower access costs.¹² Suppose an individual faces a choice between two health care providers: a government provider (G) and a private provider (P). Suppose the quality-price combinations of these providers for the individual are (Q_G, P_G^A, P_G^D) and (Q_P, P_P^A, P_P^D) respectively. Now

¹² Generally, to an individual a private facility is characterised by better quality or/and lower access costs.

if $Q_G < Q_P$ and $P_G^D < P_P^D$ and the individual is choosing P, it does not imply that the additional money ($P_P^D - P_G^D$) individual is paying is for the additional quality ($Q_P - Q_G$). If $P_G^A = P_P^A$, $Q_G < Q_P$ and $P_G^D < P_P^D$, and the individual is still choosing P, then the additional money ($P_P^D - P_G^D$) can be considered as willingness to pay for additional quality ($Q_P - Q_G$). But if $P_G^A > P_P^A$ and $Q_G < Q_P$, $P_G^D < P_P^D$ and the individual is still choosing P, then the additional money the individual is spending at private facility (i.e. $P_P^D - P_G^D$) should be considered as combined willingness to pay for additional quality ($Q_P - Q_G$) and lower access cost.

Our theoretical framework also gives us some ideas to predict several other relevant issues. For example, a medical insurance basically reduces the direct price of health care (P^D) at the time of health care need, which results in demand for more Q. Therefore, when an individual comes under medical insurance, her demand for good quality health care increases. When there is strong information asymmetry between the health care providers and consumers regarding the quality of care, some components of direct price or full direct price is often considered as indicator(s) of health care quality by the consumer.

4.3 Some Theoretical Results

Now we assume that utility of an ill individual is a function of quality of health care (as perceived by her) and the consumption of non-health care goods. The basic difference in this utility function compared with the earlier one is that instead of health outcome and functional quality of care, now we are considering (overall) quality of health care as an argument in the function.¹³ Therefore, utility function of the individual can be expressed as

$$U = U(Q, C); \frac{\delta U}{\delta Q} > 0, \frac{\delta U}{\delta C} > 0, \frac{\delta^2 U}{\delta Q^2} < 0, \frac{\delta^2 U}{\delta C^2} < 0 \quad 14 \quad (4.12)$$

Figure 4.1 shows the indifference curve of the ill individual where utility is a function of quality of health care and consumption of non-health care goods

¹³ Quality of health care may or may not have one-to-one correspondence with the health outcome. When quality improvement takes place through improvement of technical quality, it certainly has a positive impact on the health outcome. But there can also be improvement in functional quality, which will not result in better health outcome but increases the utility of the individual. (All three terms 'health outcome', 'technical quality' and 'functional quality' are defined from the individual's point of view).

¹⁴ One might reasonably argue that the one-to-one correspondence between perceived health outcome and perceived quality implicitly assumed in the specification $U = U(Q, C)$ is too simplistic, especially when we attempt to measure quality by using both descriptive and evaluative indicators (see Chapter 3). However, a simple functional form like the above is consistent with our basic concept of quality and helps us draw certain basic results using the microeconomic theoretic framework of consumer behaviour.

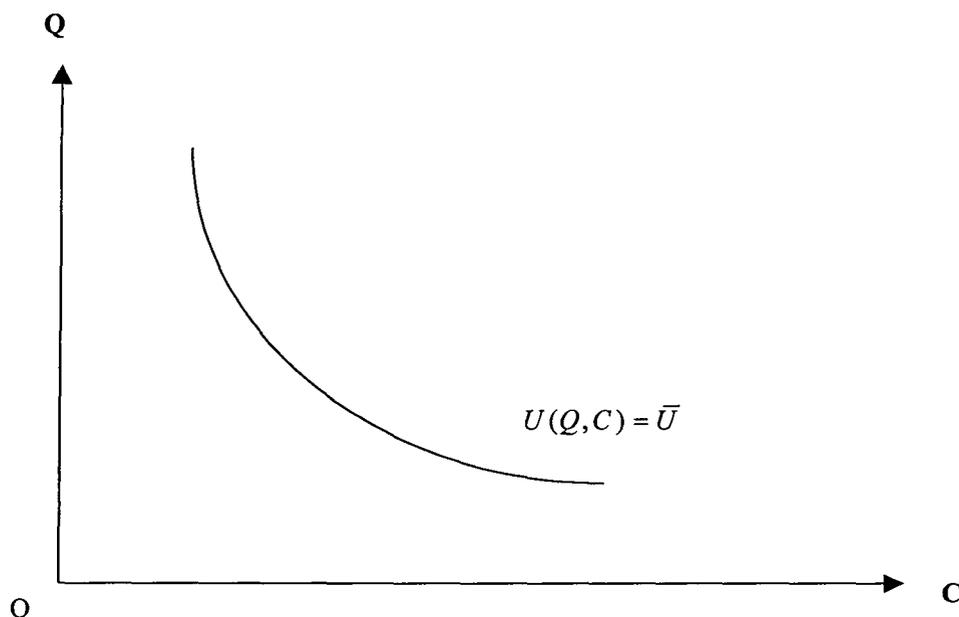


Figure 4.1: Quality and consumption of non-health care goods indifference curve.

By total differentiation of (4.12) we get, $dU = \frac{\delta U}{\delta Q} dQ + \frac{\delta U}{\delta C} dC$.

$$\text{Setting } dU = 0, \text{ we get } \frac{dQ}{dC} = -\frac{\delta U / \delta C}{\delta U / \delta Q} \quad (4.13)$$

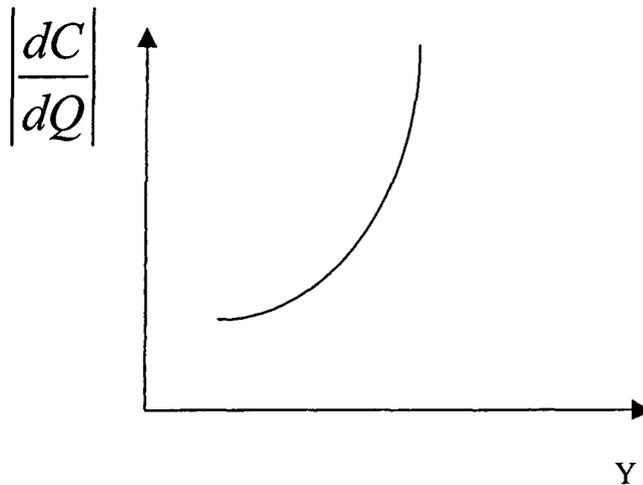
The slope of the indifference curve is given by $\frac{dQ}{dC}$, which shows the rate at which the individual would be willing to substitute C for Q per unit of C in order to maintain a given level of utility. The negative of the slope $-\frac{dQ}{dC}$ is the rate of commodity substitution/marginal rate of substitution of C for Q, and it equals the ratio of the partial derivatives of the utility function (i.e. the ratio between marginal utility of C and marginal utility of Q). The reciprocal of the MRS is the rate at which the individual would be willing to substitute Q for C per unit of Q.

The law of diminishing marginal rate of substitution says that marginal rate of substitution of C for Q (i.e. $\frac{\partial U / \partial C}{\partial U / \partial Q}$) decreases as the individual consumes more and more C. This indirectly implies that as an individual's income increases, she is expected to sacrifice more and more

non-health care goods in order to get an extra unit of quality.¹⁵ In other words, the tradeoff between quality and consumption of non-health care goods gets stronger in favour of quality as individual's income increases. The tradeoff between quality and non-health care goods (i.e. how much consumption of non-health care goods an individual is willing to sacrifice in order to get an additional unit of quality) can be measured by the absolute value of the reciprocal of the slope of the indifference curve, i.e. $\left| \frac{dC}{dQ} \right|$. As Y increases, $\left| \frac{dC}{dQ} \right|$ is also expected to increase

(Figure 4.2).

Figure 4.2: Changes in tradeoff between quality and consumption of non-health care goods with increase in income

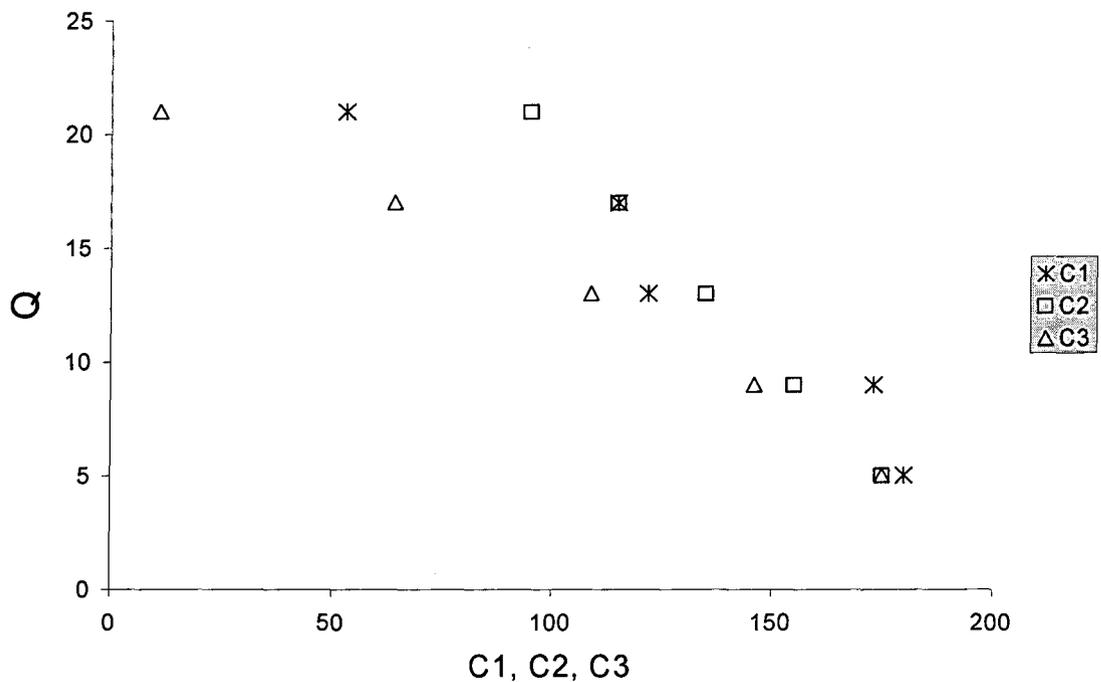


Instead of assuming that the individual is having a negative sloped linear budget line, it is more realistic to assume that the individual has access to a limited number of health care providers. We have defined in Chapter 3 that an individual can be said to have access to a health care provider if price of the health care provider (sum of direct price and access cost) does not exceed the sum of individual's full income and value of time. Each health care provider represents a particular combination of quality (Q) and price (P) to the individual. This essentially means that given the income, each provider represents a particular combination of C and Q to her. Therefore, the budget set of the individual is basically collection of all such points. This can be explained with a hypothetical example. Suppose the individual has access to five health care providers, say A, B, C, D and E. Suppose for the individual the quality-price attributes of these five health care providers are (5,20), (9, 27),

¹⁵ We are assuming that consumption of non-health care good and services of the individual is strongly correlated with her income.

(13, 78), (17, 85) and (21, 147) respectively. Suppose the individual's total resource (sum of full income and value of time) expressed in monetary terms is Rs. 200. Therefore, the (C, Q) combination corresponding to these five health care providers will be (180, 5), (173, 9), (122, 13), (115, 17) and (53, 21). These five points, which constitute the budget set of the individual, are presented in Figure 4.3 (see scatter plot of series C1). In other words, when each health care provider an individual has access to represents a particular combination of quality and price, the budget constraint can be represented by a scatter plot, where each point represents individual's (C, Q) combination corresponding to a particular provider. It can easily be seen from Figure 4.3 that these scatters do not fall on a line. It is because the providers do not represent equal price per unit of quality.¹⁶ Equilibrium is achieved where the highest possible indifference curve goes through any of these points.

Figure 4.3: Scatter Plots showing the budget sets of the individual



Suppose the price is constant at Rs. 5 per unit of quality. In such a situation we can get a scatter which will perfectly fall on a line (See the scatter plot of series C2 in Figure 4.3). Although lot of theoretical insights can be drawn from a constant negatively sloped budget line, a more reasonable assumption should be an increasing price per unit of quality. If the price per unit of quality is an increasing function of quality, then the scatter will form a non-

¹⁶ The prices per unit of quality of the five providers in our hypothetical example are Rs. 4, Rs. 3, Rs. 6, Rs. 5 and Rs.7 respectively.

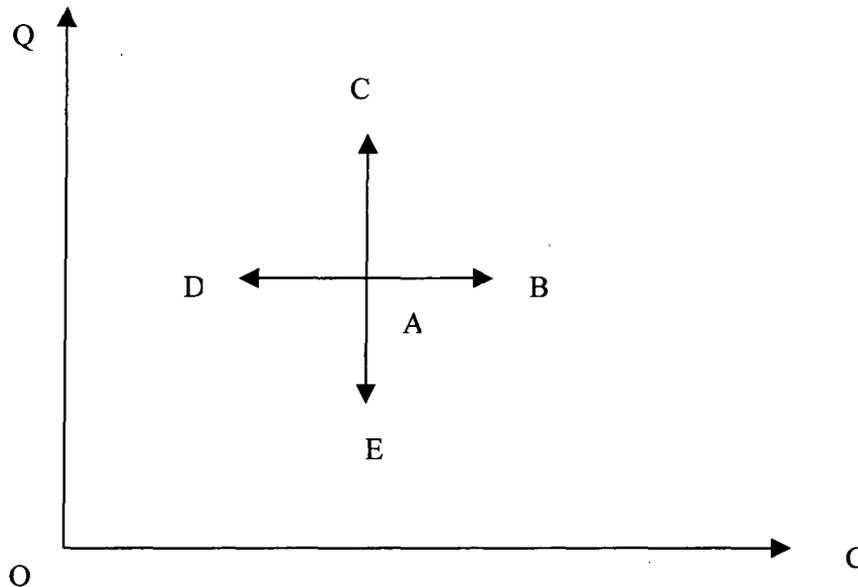
linear pattern (see the scatter plot of series C3 in Figure 4.3). All the scatters (corresponding to the series C1, C2 and C3) help us to understand what would happen to the budget set if there is a quality improvement and/or price hike in one or more providers under different assumptions about the price per unit of quality.

4.4 Theoretical Model: Some Further Implications

Let us now see the implication of a change in quality and/or price of health care of a single provider for the budget constraint. In Figure 4.4 the C-Q combination of the individual corresponding to Q-P combination of a single health care provider is represented by the point A. An improvement in quality without any change in price will shift point A upwards along the line AC, since the individual is able to consume same amount of non-health care goods but gets higher quality.¹⁷ On the other hand, an increase in price without any improvement in quality will cause a leftward shift of the point A along the line AD. Therefore, if there is an increase in price per unit of quality of a particular provider, the probability of choosing that particular provider is expected to come down. Generally it is expected that quality improvement will be coupled with increase in price. In such a situation, the point A will be shifted to some point indicated by the right angle CAD.

¹⁷ An improvement in quality without change in price implies decrease in per unit price of quality. Similarly an increase in price without any change in quality essentially means increase in the per unit price of quality.

Figure 4.4: Change in the C-Q combination due to change in the quality and price of a single health care provider



Although a scatter plot (like C1 series) or non-linear budget line (like C3 series) are more realistic presentation of the budget set, assumption of constant price per unit of quality can still be illuminating in drawing some interesting theoretical insights. So let us assume that the price of quality and non-health care goods are P_Q and P_C respectively. We also assume Q and C are perfectly divisible and it is possible to get any finite amount of Q . If Y is the individual's total resource (i.e. the sum of permanent income and value of time), her budget line can be expressed as

$$Y = P_Q \cdot Q + P_C \cdot C \quad (4.14)^{18}$$

The utility maximisation problem of the individual can mathematically be expressed as
 Maximise $U = U(Q, C)$ with respect to Q, C subject to

$$Y = P_Q \cdot Q + P_C \cdot C$$

¹⁸ Unlike standard textbook definition, equation 1.14 does not reflect objective market information because we are defining quality from an individual's point of view. However, information on quality directly obtained from the individual is no less quantifiable than objective market information, even though the two kinds of information may not converge for the same individual. To have a choice model, all we need to assume is that the individual is able to measure quality of each health care visit in some units. Defined in this way, P_Q is nothing but the ratio between sum of direct price (i.e the basic price of health care) and access cost and unit of quality. It is obvious that if total unit of quality and amount of access cost remain constant, price per unit of quality (P_Q) increases if there is an increase in the basic price of health care. Similarly other things remaining the same, the relationship between access cost and P_Q is positive, and quality and P_Q is negative.

The lagrangian of the above problem is

$$L = U(Q, C) + \lambda[Y - P_Q \cdot Q - P_C \cdot C]$$

The first order conditions for utility maximisation implies

$$\frac{\delta L}{\delta Q} = \frac{\delta U}{\delta Q} - \lambda P_Q = 0 \Rightarrow \frac{\delta U}{\delta Q} = \lambda P_Q$$

$$\frac{\delta L}{\delta C} = \frac{\delta U}{\delta C} - \lambda P_C = 0 \Rightarrow \frac{\delta U}{\delta C} = \lambda P_C$$

$$\frac{\delta L}{\delta \lambda} = Y - P_Q \cdot Q + P_C \cdot C = 0 \Rightarrow P_Q \cdot Q + P_C \cdot C = Y$$

From the first two conditions we get

$$\frac{\frac{\delta U}{\delta Q}}{\frac{\delta U}{\delta C}} = \frac{P_Q}{P_C} \tag{4.15}$$

$$\therefore P_Q = P_C \cdot \frac{\delta U / \delta Q}{\delta U / \delta C} \tag{4.16}$$

The above equation indicates that WTP for quality of health care depends on the marginal utility of quality ($\frac{\delta U}{\delta Q}$), the marginal utility of consumption of non-health care goods ($\frac{\delta U}{\delta C}$) and price of non-health care goods (P_C). In particular, at the optimum, the WTP for a unit of health care quality is equivalent to $P_C \cdot \frac{\delta U / \delta Q}{\delta U / \delta C}$. That is, the WTP for quality is the product of price of non-health care goods and rate of substitution between quality of health care and non-health care goods.¹⁹

The own price elasticity of demand for quality can be defined as $\varepsilon_{QQ} = -\frac{\frac{\delta Q}{Q}}{\frac{\delta P_Q}{P_Q}} = -\frac{\delta Q}{\delta P_Q} \cdot \frac{P_Q}{Q}$

For an individual, a large value of own price elasticity implies that demand for quality is highly responsive to price changes. If price per unit of quality increases, this implies that demand for quality comes down. If price per unit quality is constant, then a fall in demand for quality implies increase in the probability of utilising less expensive care.

¹⁹ It is reasonable to assume that for each individual there is a threshold level for willingness to pay per unit of quality. Such a threshold level may depend on many factors including the severity of illness. If the price per unit of quality exceeds that threshold level, consumption of non-health care goods become more important than quality

Let us now examine what happens to expenditure on health care when there is an improvement in quality coupled with increase in price so that price per unit of quality is increased. The expenditure on health care is $P_Q \cdot Q$. Differentiating expenditure on health care with respect to per unit price of quality gives

$$\frac{\delta(P_Q \cdot Q)}{\delta P_Q} = Q + P_Q \cdot \frac{\delta Q}{\delta P_Q} = Q \left(1 + \frac{\delta Q}{\delta P_Q} \cdot \frac{P_Q}{Q}\right) = Q \left(1 - \left(-\frac{\delta Q}{\delta P_Q} \cdot \frac{P_Q}{Q}\right)\right) = Q(1 - \epsilon_{QQ}) \quad (4.17)$$

Equation (4.17) implies that the individual's expenditure on health care will increase with increase in per unit price of quality (i.e. P_Q) if $\epsilon_{QQ} < 1$, remain unchanged if $\epsilon_{QQ} = 1$ and decrease if $\epsilon_{QQ} > 1$.

The income elasticity of demand for quality can be defined as $\eta_Q = \frac{\delta Q/Q}{\delta Y/Y} = \frac{\delta Q}{\delta Y} \cdot \frac{Y}{Q}$

It is reasonable to assume that quality is a normal good, $\frac{\delta Q}{\delta Y} > 0^{20}$, which implies $\eta_Q > 0$.

Further, quality will be a necessary or luxury good depending upon $\eta_Q < 1$ or $\eta_Q > 1$.

If quality is a luxury good, let us see what happens to individual's expenditure on health care as a proportion of income when there is an increase in her income.

Individual's expenditure on health care = $P_Q \cdot Q$

$$\frac{d\left(\frac{P_Q \cdot Q}{Y}\right)}{dY} = \frac{Y \cdot P_Q \cdot \frac{dQ}{dY} - P_Q \cdot Q}{Y^2} = \frac{P_Q \cdot Q \left[\frac{dQ}{dY} \cdot \frac{Y}{Q} - 1\right]}{Y^2} > 0 \text{ since } \frac{dQ}{dY} \cdot \frac{Y}{Q} > 1 \quad (4.18)$$

Therefore, if quality is a luxury good, individual's expenditure on health care as a proportion of her income will increase with increase in income.

Let us see what is the implication of price changes when we express it in the form of Slutsky equation.

The Slutsky equation of the individual can be expressed as

$$\frac{\delta Q}{\delta P_Q} = \left(\frac{\delta Q}{\delta P_Q}\right)_{U=const} - Q \left(\frac{\delta Q}{\delta Y}\right)_{P_Q, P_C=const} \quad (4.19)$$

²⁰ Earlier studies hypothesised that as income increased, the demand for health care (measured in number of visits) would increase. We are making altogether a different assumption; as income of an individual increases, her demand for health care quality increases.

The term $\left(\frac{\delta Q}{\delta P_Q}\right)_{U=const}$ indicates substitution effect. This shows the rate at which the individual substitutes Q for C when P_Q changes and she moves along a given indifference curve.²¹ The term $-Q\left(\frac{\delta Q}{\delta Y}\right)_{P_Q, P_C=const}$ indicates income effect. It shows the rate at which the individual's purchase of Q would change with the changes in her income (Y), prices remaining constant. The sum of two rates gives the total rate of change for Q as P_Q changes. Substitution effect of a price increase is always negative. A change in real income may cause a reallocation of the consumer's resources even if prices do not change or if they change in the same proportion. Since quality is assumed to be a normal good, the income effect of a price increase must be negative. Equation (4.19) also shows that lower is the level of Q, the less significant is the income effect.

Manipulating (4.19) we get

$$-\frac{\delta Q}{\delta P_Q} \cdot \frac{P_Q}{Q} = -\left[\left(\frac{\delta Q}{\delta P_Q}\right)_{U=const} \cdot \frac{P_Q}{Q}\right] + \left[\frac{P_Q \cdot Q}{Y}\right] \cdot \left[\left(\frac{\delta Q}{\delta Y}\right)_{P_Q, P_C=const} \cdot \frac{Y}{Q}\right]$$

$$\text{Or, } \varepsilon_{QQ} = \xi_{QQ} + \alpha_Q \eta_Q \quad (4.20)$$

Where ε_{QQ} = elasticity of the ordinary demand curve; ξ_{QQ} = elasticity of the compensated demand curve; α_Q = proportion of expenditure on health care; and η_Q = income elasticity of demand for quality.

Since $\alpha_Q \eta_Q > 0$, $\varepsilon_{QQ} > \xi_{QQ}$. That is, ordinary demand curve will have a greater elasticity than the compensated demand curve.

Therefore if there is an increase in price of health care without a proportional improvement or no improvement in quality (price per unit of quality increases as a result), it will have both income and substitution effect. Income effect implies that an increase in price per unit of quality lowers the purchasing power of the individual and as a result the individual will go for low quality provider (including the possibility of no care at all). The substitution effect indicates that an increase in price makes quality relatively expensive in terms of non-health care goods and as a result the individual will go for low quality provider. So the total price effect results in an increase in the probability of going for low quality provider.

²¹ Slutsky called this the residual variability of the commodity in question (Slutsky 1952).

As we have assumed quality as a normal good, the demand for quality increases with increase in income. However, increase in income due to increase in wage rate and increase in non-wage income is expected to have different effect on the demand for quality. An increase in income due to an increase in wage rate produces an income effect, which acts to increase demand for better quality health care. It also raises the opportunity cost of time which reduces demand for time intensive activities. The net effect would be the increase in demand for quality with lower time cost. The demand for quality is expected to vary with individual-characteristics (e.g. severity of illness, age, gender, whether the individual is an earning member or not and so on).

Let us examine the responsiveness of the demand for quality with respect to direct price and access cost. The price per unit of quality is the sum of direct price per unit quality and access cost per unit of quality.

That is $P_Q = P^D_Q + P^A_Q$

$\therefore dP_Q = dP^D_Q$, keeping P^A_Q constant and $dP_Q = dP^A_Q$, keeping P^D_Q constant.

$$\varepsilon_{QP^D} = \frac{dQ}{dP^D} \cdot \frac{P^D}{Q} = \frac{dQ}{dP} \cdot \frac{P}{Q} \cdot \frac{P^D}{P} = \varepsilon_{QP} \cdot \frac{P^D}{P}$$

$$\text{Similarly } \varepsilon_{QP^A} = \frac{dQ}{dP^A} \cdot \frac{P^A}{Q} = \frac{dQ}{dP} \cdot \frac{P}{Q} \cdot \frac{P^A}{P} = \varepsilon_{QP} \cdot \frac{P^A}{P} \quad (4.21)$$

$$\varepsilon_{QP^D} \geq \varepsilon_{QP^A} \Leftrightarrow P^D \geq P^A \quad (4.22)$$

When access cost is higher than direct price, demand for quality is more responsive to changes in access cost than changes in direct price.

4.5 Highlighting the Main Inferences

If quality of a provider is improved and price is also hiked, whether such a change will be acceptable to the individual would depend on her trade-off between quality and consumption of non-health care good. If an individual is incurring higher monetary cost at private facilities, the additional cost she is incurring should not be just considered as her willingness to pay for better quality, rather it may be a combined willingness to pay for better quality and lower access cost. An individual's willingness to pay for quality depends on the price of non-health care goods and rate of substitution between quality of health care and non-health care goods. To an individual a change in quality or price of health care implies change in the price per unit of quality. If price per unit of quality increases for an individual, it would increase the

probability of going for lower quality care. Whether expenditure on health care will increase or not as a result of increase in price per unit of quality would depend on the value of price elasticity of quality for the individual. If quality is a luxury good, individual's expenditure on health care as a proportion of her income is expected to increase with increase in income. When access cost is higher than direct price, demand for quality is expected to be more responsive to changes in access cost than changes in direct price.

However, to what extent we can empirically examine individuals' sensitivity to quality and price would depend upon the kind of data available to us on individuals, providers and individual-provider interactions. We would also need to have a sufficiently large sample to generalise individuals' health care seeking behaviour. In the next chapter, we shall see how good are the available large-scale survey data sets (viz. NSS 52 and NFHS 2) to serve our purpose.