The Economics of Consumer Directed Health Care

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January 30, 2007

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Abstract

This paper presents a model of consumer directed health care, high deductible insurance plans. Insurance companies in a competitive market offer such plans; higher deductibles result in lower premiums. Such changes affect consumers' decisions on preventive care. I show that preventive care may or may not increase when consumers face more risk and lower premium. Furthermore, I look at selection and cross subsidization when insurance firms offer both conventional, low-deductible plans and high-deductible plans. The extent of cross subsidization may be reduced. I also examine the moral hazard effect of higher deductible plans. Consuming more health care early within a fiscal year carries an option value. Once the deductible is reached, consumers' out-of-pocket prices are significantly lowered. Consumers have an incentive to consume more because of the option value of reduced prices later within a fiscal year. The paper also contains a survey of recent empirical findings on consumer directed health care.

1 Introduction

Consumer Directed Health Care is one of the latest innovations in the health market. Apparently this innovation is a consumer revolt against managed care plans, which impose restrictions on physician and hospital choices. Although the goal of restriction is of course cost containment and better incentives for provider qualities, consumers have begun to dislike managed care practices. Consumers seem to value flexibility and choice more than lower premiums.

The reaction against managed care has prompted the market to offer a family of high-deductible, insurance-managed-care plans. The typical consumer directed health care plan has a deductible in the order of $1000 to $5000; an enrollee is responsible for the first, say, $3000 of health care expenses in a calendar year. After the deductible threshold has been reached, health care expenses will be covered for a large percentage (say, 80%) or the enrollee's health care use may be subject to usual managed care restrictions such as use of providers within networks, authorizations, and utilization reviews. The premium of the typical consumer directed health care plan is likely to be lower than a conventional insurance plan with lower coinsurance rate or copayment.

The basic idea is that a consumer enrolled in a consumer directed health plan is responsible for the threshold amount of health care expenses. This gives complete flexibility to the consumer for which kind of care and from whom care is to be obtained. The consumer will be exposed to more financial risks; presumably the premium will adjust downward to account for the lower expected costs paid by the insurer. What are other effects under consumer directed health care? Can these be understood in terms of the common incentives in the health market such as moral hazard and adverse selection?

First, preventive care decisions—ex ante moral hazard—may be affected by the higher financial responsibility. One may expect that the consumer has an incentive to reduce the likelihood of falling ill. However, the consequence of high-deductible insurance plans cannot be understood entirely in terms of avoiding the loss. The risk attitude of the consumer is also relevant. In Section 2, I present a formal model to evaluate the consequence of consumer directed health care plans on prevention. I show that in a competitive insurance market, a high deductible may reduce the premium in such a way that incentive to prevent illness may not increase. The outcome is analogous to a neoclassical market analysis where shifts in both supply and demand functions result in ambiguous changes in the equilibrium price and quantity.

Second, there is a worry that consumer directed health care plans will lead to adverse selection, attracting either those who are very healthy, or those who are very sick. It is attractive to those who are very healthy because of the lower premium. It may also be attractive to the very sick because these consumers expect their health care expenses to reach the deductible level. In Section 3, I use a simple model to study the selection problem. The issue of cross subsidization has been largely ignored in popular discussions. Risk sharing must involve some cross subsidization since consumers' risks of incurring health costs are heterogeneous. I show in that Section that consumer directed health plans may lead to risk fragmentation, reducing subsidization across different risk classes.

Third, consumer directed health care may potentially lead to a new form of moral hazard or overconsumption of health care. The deductible threshold and the subsequent low copayment implies a set of nonlinear prices for consumers. By incurring sufficient expenses to reach the threshold, say, \$3000, a consumer faces a lower price of health care thereafter. There is, therefore, some option value in health care use. Early in a calendar year, a consumer may find it attractive to spend enough to reach the deductible threshold in order to enjoy the lower coinsurance rate later. In Section 4, I derive formally such an option value.

Section 5 is devoted to a survey of the existing empirical findings concerning consumer directed health care plans. The available empirical literature is small. Studies are often limited to surveys on consumers, employers or insurance companies. Furthermore, formal statistical studies often use data from a single employer. Nevertheless, the available evidence does reflect the theoretical findings Broadly speaking, the effects of consumer directed health plans on moral hazard and adverse selection are ambiguous. Selection, and utilization tend to be different across plans. The evidence available now indicates that the impact of consumer directed health plans may not exhibit clear patterns. In this Chapter I concentrate on incentive and related effects. In the Chapter on Medical Savings Accounts, Jerry Hurley el al. will consider financing issues.

2 Consumer Preventive Care Decisions

In this section, I present a model of consumer preventive care decision under consumer directed health care (CDHC) plans. Compared to conventional insurance or managed care, CDHC imposes more risk to consumers by letting them bear all the financial risks up to a threshold. It seems quite natural to expect that a higher financial risk will translate into a stronger incentive for consumers to prevent illness. This is the same as the basic principle that when the price of a good (likelihood of falling ill) increases, consumers tend to buy less of it (by investing more in preventive care to lower that likelihood). Nevertheless, we know from basic economic theory that a change in the price of a good brings along an income effect, which may act against the price effect. In fact, I will demonstrate in this section that there is such an analogy in preventive care decisions under CDHC. While it is income effect that may counteract against the price effect in the standard demand theory, here it is the premium effect. While CDHC raises the consumer copayment (to the full cost up to a threshold), it lowers the premium. The reduction of premium affects the amount of risk a consumer bears, and this may alter the incentives to invest in preventive care.

I set up a model to illustrate these ideas. I begin with a conventional insurance plan. In this plan, the consumer is charged a premium π, and in return, she bears only 20% of health care expenditures. I will abstract from moral hazard issues, and assume that the consumer's health care expenditure is randomly distributed according to a uniform distribution on $[0, 5000]$ if she becomes sick. Preventive care is captured by the assumption that the consumer can affect the probability of staying healthy; she has a zero medical expenditure in that state. Let p denote this probability. I will let this be affected by the consumer's decision. If the consumer's probability of staying healthy is p, she incurs a disutility of $G(p)$ for that effort. The disutility function G is strictly increasing, strictly convex, and twice differentiable. I will assume enough convexity in G so that the consumer's probability of staying healthy is always strictly between 0 and 1.

The consumer has wealth W. She is risk averse, and her utility function is U, which is strictly increasing, strictly concave, and twice differentiable. The consumer pays the premium up-front, and is responsible for 20% of medical expenses. If she becomes ill, and if her medical cost turns out to be c, her utility is $U(W - \pi - 0.2c)$. If she chooses an effort that leads to a probability of staying healthy p, her expected utility is

$$pU(W - \pi) + (1 - p) \int_0^{5000} \frac{U(W - \pi - 0.2c)}{5000} \mathrm{d}c - G(p). \quad (1)$$

In this expression, the first term is the utility of staying healthy multiplied by that probability; the consumer simply has paid the premium π. The second term is the probability of falling ill multiplied by that expected utility, which is the average of the utility $U(W - \pi - 0.2c)$ over the range of the cost from $c = 0$ to $c = 5000$ with the density of the uniform distribution being $1/5000$.

The incentive to invest in preventive care is characterized as follows. The marginal disutility of raising the probability of staying healthy is $G'(p)$, while the marginal benefit is the difference between the expected utilities in the healthy and sick states:

$$U(W-\pi)-\int_0^{5000}\frac{U(W-\pi-0.2c)}{5000}\mathrm{d}c. \tag{2}$$

An optimal choice of p balances the marginal benefit and the marginal disutility. For a given premium and the coinsurance rate, the consumer's optimal preventive care, in terms of the probability of staying healthy, is given by the solution p of the following equation

$$U(W-\pi)-\int_0^{5000}\frac{U(W-\pi-0.2c)}{5000}\mathrm{d}c=G'(p). \tag{3}$$

Given that consumers' copayment is 20%, I determine the premium endogenously. I let the insurance market be perfectly competitive. Insurance companies compete by setting premiums. Each insurer therefore reduces the premium until it makes a zero profit. So the equilibrium premium is the actuarially fair value:

$$\pi=(1-p)\int_0^{5000}\frac{0.8c}{5000}\mathrm{d}c \qquad \text{which simplifies to} \qquad p=1-\frac{\pi}{2000}. \tag{4}$$

For a given coinsurance rate (here 20%), I say that the premium π and preventive care p form an equilibrium if the premium let an insurer break even given the preventive care p, and if the preventive care p is optimal given the premium. Formally, (π, p) is an equilibrium if it is the solution to simultaneous equations (3) and (4).

Equation (3) establishes a positive relationship between π and p; I derive this in an appendix. Clearly equation (4) shows a negative relationship between π and p. Therefore, the equilibrium must be unique. If we represent these relationships in a plane with π on the horizontal axis, and p on the vertical axis, as in Figure 1, the upward sloping solid line represents equation (3) while the downward sloping solid line is equation (4). There is a unique intersection point, which is the equilibrium.

Next I consider the equilibrium in the CDHC regime. I will consider a typical contract: a deductible of \$1000, and a coinsurance rate of 20% thereafter. I maintain all the assumptions regarding health care expenditures and preferences. Under this scheme, the consumer's expected utility becomes

$$pU(W-\pi)+(1-p)\left[\int_0^{1000}\frac{U(W-\pi-c)}{5000}\mathrm{d}c+\int_{1000}^{5000}\frac{U(W-\pi-0.2c)}{5000}\mathrm{d}c\right]-G(p). \tag{5}$$

The difference from (1) is that here the consumer's utility is $U(W-\pi-c)$ when health expenditure c is below \$1000. The incentive to incur preventive care becomes stronger. The marginal benefit from preventive care for a given premium is

$$U(W-\pi)-\left[\int_0^{1000}\frac{U(W-\pi-c)}{5000}\mathrm{d}c+\int_{1000}^{5000}\frac{U(W-\pi-0.2c)}{5000}\mathrm{d}c\right].$$

The consumer's optimal choice of preventive care is given by the first-order condition:

$$U(W-\pi)-\left[\int_0^{1000}\frac{U(W-\pi-c)}{5000}\mathrm{d}c+\int_{1000}^{5000}\frac{U(W-\pi-0.2c)}{5000}\mathrm{d}c\right]=G'(p). \tag{6}$$

For the same premium, the consumer's incentive to invest in preventive care is stronger: the left-hand side of (6) is larger than that of (3). Since the consumer has to bear more financial risks, she has a stronger incentive to reduce the probability of falling ill.

An insurer is responsible for 80% of the consumer's health care cost when it exceeds \$1000. The determination of the premium in the competitive market is again given by the zero-profit condition:

$$\pi=(1-p)\int_{1000}^{5000}\frac{0.8c}{5000}\mathrm{d}c \qquad \text{which simplifies to} \qquad p=1-\frac{\pi}{1920}. \tag{7}$$

An equilibrium in the CDHC regime is a premium and a level of preventive care that satisfy both equations (6) and (7). Again, we can use a graphical approach. The optimal preventive care equation (6) sets up a positive relationship between p and π, while the premium determination equation (7) establishes a negative relationship. As in conventional insurance, the intersection of the positively-sloped, optimal preventive care dashed line and the negatively-sloped, premium dashed line yields the equilibrium.

How is the equilibrium under CDHC different from conventional insurance? This can be studied in terms of how equation (6) is related to equation (3). The optimal preventive-care line in the CDHC regime is an upward shift from the conventional insurance line; the upward sloping dashed line is above the solid line. For a given value of the premium, because the left-hand side of (6) is larger than in (3), the value of p that satisfies (6) must be larger than the one that satisfies (3). Hence, the entire locus that describes the consumer's optimal preventive care as a function of the premium must shift up when conventional insurance is changed to CDHC. (Note that typically the shift is not parallel.)

It is easy to compare the premium equation under CDHC (7) with that under conventional insurance (4). The two lines have the same vertical intercept in the π-p space, but the premium line under CDHC is less steep.

A shift from conventional insurance to CDHC must reduce the equilibrium premium. Nevertheless, the effect on preventive care is less clear. In Figure 1, I have drawn a CDHC equilibrium in which preventive care has decreased from that under conventional insurance. The determination of equilibrium preventive care depends on the consumer's attitude towards risk. Furthermore, because CDHC involves a discrete change from conventional insurance, usual local measures of risk aversion are insufficient for characterizing the change in optimal preventive care. By lowering the premium, the reference point of the consumer's wealth has increased, and the consumer may actually become less risk averse. When the consumer is willing to bear more risk, he may choose to reduce preventive care effort. For a modest change in premium, perhaps due to cross subsidization across heterogeneous groups in a large organization, consumers will likely increase preventive effort.

3 Selection and Cross Subsidization

In this section, I will discuss selection in CDHC plans compared to conventional insurance plans. I will let the probability of staying healthy be heterogeneous. There are two types of consumers: more healthy consumers have a probability of staying healthy p_H, and less healthy consumers have a corresponding probability p_L, with $0 < p_L < p_H < 1$. These probabilities cannot be altered by the consumer. There are equal proportions of more and less healthy consumers in the population.

An insurance company cannot observe consumers' type. I continue to assume that the insurance market is competitive. The premium will be set at the actuarially fair level. As in the previous section, I again will use the conventional insurance coverage as a benchmark; the consumer will be covered for 80% of the health care cost when she becomes sick. For CDHC, I let the consumer bear the full cost when the medical expense is below \$1000, and 20% thereafter.

Consider now a conventional insurance policy that covers all consumers. Because the premium cannot be based on the consumer's type, it must cover the expected expense of the average consumer. When the consumer is sick, the expected expense is \$2500, but the policy only covers for 80%. So the expected payment by the insurance company is \$2000 conditional on the consumer falling ill. Now the probability of staying healthy is either p_H or p_L. When there are equal proportions of healthy and less healthy consumers, the population average probability of staying health is $(p_H + p_L)/2$. The fair premium of a 20% copayment insurance contract to cover the entire population is

$$\pi_{\text{ins}} = \left[1 - \frac{p_H + p_L}{2}\right] 2000. \tag{8}$$

The consumer's expected utility from such a contract is

$$p_t U(W - \pi_{\text{ins}}) + (1 - p_t) \int_0^{5000} \frac{U(W - \pi - 0.2c)}{5000} \mathrm{d}c \tag{9}$$

where t denotes the type and is either L or H, and the value of the premium π is in equation (8). The equilibrium premium is higher that the actuarially fair level for the health type, which is $(1 - p_H)2000$. Because of asymmetric information, the healthy consumers are subsidizing the less healthy ones.

Now I turn to the typical CDHC contract. Here the 20% copayment takes effect after the first $1000 of medical expenditure. So conditional on a consumer falling ill, the expected payment is

$$\int_{1000}^{5000} \frac{0.8c}{5000} \mathrm{d}c = 1920. \tag{10}$$

If both types of consumers are enrolled in a CDHC plan, the premium that breaks even is

$$\pi_{\text{cdhc}} = \left[1 - \frac{p_H + p_L}{2}\right] 1920. \tag{11}$$

The consumer's expected utility from such a contract is

$$p_t U(W - \pi_{\text{cdhc}}) + (1 - p_t) \left[\int_0^{1000} \frac{U(W - \pi - c)}{5000} \mathrm{d}c + \int_{1000}^{5000} \frac{U(W - \pi - 0.2c)}{5000} \mathrm{d}c \right] \tag{12}$$

where $t = L, H$.

The CDHC plan has a lower premium, and imposes more financial risks on consumers. The extent of cross subsidization is less, though, since the premium is lower. When the CDHC plan is offered, it may well be that both types of consumers prefer it to the conventional plan. That is, for $t = L, H$, the expression in (12) may be higher than (9). I call this a CDHC pooling equilibrium.

The CDHC plan is more attractive to the more healthy type of consumers. In fact, if the CDHC was preferred by the less healthy type L consumers, it would also be preferred by type H. The converse is not true. When the expression in (12) is higher than in (9) for a type H, the reverse may hold for a type L. Then the pooling—both types of consumers joining the CDHC plan—fails to be an equilibrium. That is, at the pooling premium level under CDHC, the less healthy type L does not find it optimal to switch. The premium level calculated in (11) will not be an equilibrium.

A CDHC plan may only attract the more healthy consumers, while the less healthy consumers stay with the conventional insurance plan. I call this a separating equilibrium; each type of insurance plan attracts one type of consumers. The equilibrium premium level in the conventional plan is

$$\pi_{\mathrm{ins}}^{\mathrm{s}} = [1 - p_L]\, 2000 \tag{13}$$

since only the less healthy consumers are enrolled. On the other hand, the CDHC equilibrium premium is

$$\pi_{\mathrm{cdhc}}^{s} = [1 - p_H]\, 1920. \tag{14}$$

In a separating equilibrium, the type L consumer will prefer the conventional plan to the CDHC plan:

$$\begin{aligned} & p_L U(W - \pi_{\mathrm{ins}}^{\mathrm{s}}) + (1 - p_L) \int_0^{5000} \frac{U(W - \pi - 0.2c)}{5000} \mathrm{d}c \qquad (15) \\ \geq \;& p_L U(W - \pi_{\mathrm{cdhc}}^{\mathrm{s}}) + (1 - p_L) \left[\int_0^{1000} \frac{U(W - \pi - c)}{5000} \mathrm{d}c + \int_{1000}^{5000} \frac{U(W - \pi - 0.2c)}{5000} \mathrm{d}c \right]. \end{aligned}$$

The type H consumer will prefer the CDHC plan to the conventional plan:

$$\begin{aligned} & p_H U(W - \pi_{\mathrm{cdhc}}^{\mathrm{s}}) + (1 - p_H) \left[\int_0^{1000} \frac{U(W - \pi - c)}{5000} \mathrm{d}c + \int_{1000}^{5000} \frac{U(W - \pi - 0.2c)}{5000} \mathrm{d}c \right] \qquad (16) \\ \geq \;& p_H U(W - \pi_{\mathrm{ins}}^{\mathrm{s}}) + (1 - p_H) \int_0^{5000} \frac{U(W - \pi - 0.2c)}{5000} \mathrm{d}c. \end{aligned}$$

The pair of inequalities (15) and (16) are incentive constraints. A separating equilibrium, in which the more healthy type picks the CDHC plan while the less healthy type picks the conventional plan, must satisfy these constraints, together with the premiums in equations determined in (13) and (14)

Given that $p_H > p_L$, and that $\pi_{\mathrm{ins}}^{\mathrm{s}} = [1 - p_L]\, 2000 > \pi_{\mathrm{cdhc}}^{s} = [1 - p_H]\, 1920$, it is indeed possible to find preferences such that the two incentive constraints are satisfied. The more risky, lower premium plan is selected by the more healthy consumers, while the less risky, higher premium plan is selected by the less healthy.

In a separating equilibrium, each insurance plan just breaks even, and cross subsidization does not occur. Compared to the conventional insurance benchmark, the departure of the more healthy consumers for the CDHC plan raises the premium for the less healthy consumers who remain with the conventional plan. The less healthy consumers must become worse off when the CDHC plan implements a separating equilibrium.[1]

4 Health Care Demand and Nonlinear Prices

In this section, I study consumers' demand for health care when they are enrolled in high-deductible CDHC plans. I begin with a standard, static model of consumer usage of health care when the price depends on the amount of usage. Next, I extend it to a dynamic version, exploring consumers' intertemporal decisions.

4.1 A static model of demand

Let q denote the medical care a consumer purchases. I will normalize the price of medical care to 1. I define a typical CDHC scheme as follows. A consumer is responsible for all medical expenditures under \$1000; thereafter, she pays at a coinsurance rate of 20%. Let $\theta V(q)$ represent a consumer's benefit when she purchases q units of health care. The parameter θ measures the intensity of demand, while $V(q)$ is an increasing and concave function.

Under the CDHC scheme, when $q < 1000$, the consumer is responsible for the full cost of treatment. So when the consumer purchases q units of treatment, her utility is given by $\theta V(q) - q$, for $q \leq 1000$. If she purchases more than 1000 units of health care, her utility is $\theta V(q) - 1000 - 0.2(q - 1000)$, since she is responsible for 20% of the cost above 1000 units.

[1] I am not concerned with the existence of competitive equilibria here. Rothschild and Stiglitz (1976) is the classic reference on this issue.

How does the consumer decide on the optimal health care in the standard model? The marginal benefit of health care is always $\theta V'(q)$. For later use, I note that the marginal benefit schedule is increasing in θ. A higher value of θ indicates a stronger demand for care. The marginal cost, however, depends on the level of purchase. If $q \leq 1000$, it is 1, the normalized price of health care; if $q > 1000$, it is 0.2, since the consumer only pays at the 20% coinsurance rate. In each case, the consumer's optimal choice of quantity equates the marginal benefit and marginal cost.

Due to the nonlinear price of medical care, however, the consumer's optimal decision may become discontinuous. For any value of θ, the consumer must consider whether it is worthwhile to consume the full $q = 1000$ units; doing so will result in the price reduction (health care at 20%) for units thereafter. This can be illustrated in Figure 2. The downward sloping line is the marginal benefit schedule $\theta V'(q)$. A higher value of θ corresponds to an upward shift of the entire marginal benefit schedule. On the vertical axis, I have labelled two points, at prices equal to 1 and 0.20. If the price of medical care was always 1, the consumer would purchase 800 units because $\theta V'(800) = 1$. Similarly, if the price of medical care was always 0.20, the consumer would purchase 1250 units because $\theta V'(1250) = 1$. Nevertheless, to get the price reduction, the consumer must purchase at least 1000 units. How should the consumer decide whether it is worthwhile to go beyond the first 800 units of health care?

The total benefit from a purchase of q units is the area under the marginal benefit schedule.[2] The net benefit of purchasing 800 units at the full price of 1 is the area labelled A in Figure 1; this is the total benefit substracting the total cost. Now for the next 200 units above $q = 800$, the marginal benefit is actually below the full price of 1; the consumer experiences a reduction in her total net benefit when she purchases the next 200 units. This is a deadweight loss and is the area

[2]The total benefit is $\theta V(q) = \int_0^q \theta V(x)\mathrm{d}x$, which is the area under the $\theta V(q)$ schedule.

labelled B in Figure 1. After she has purchased 1000 units, the price for the consumer drops down to 0.2. Now, the optimal quantity is given by $q = 1250$. The net benefit for those 250 is the area labelled C.

There are two possible choices for the consumer. She can purchase 800 units at the price of 1. Or she can keep on purchasing until the price drops down to 0.20, for a total of 1250. Which is more attractive depends on the total (utility) cost the consumer must incur to get the final total (utility) benefit due to the lower price. The net (utility) benefit of purchasing above 800 units is the difference between areas C and B. Again, area B is the net loss due to the high price for those 200 units beyond $q = 800$; area C is the net benefit for going beyond $q = 1000$. So if area C is greater than area B, the consumer will purchase 1250 units, paying \$1000 for the first 1000 units and \$50 (=250 * 0.20) for the next 250 units. On the other hand, if area C is less than area B, the consumer only purchases 800 units, and the total expenditure is \$800.

The marginal benefit schedule in Figure 2 is the most interesting case. Depending on the sizes of B and C, the consumer may decide to stay with a quantity below 1000, or go beyond it. There are two other, more extreme possibilities. First, the demand for health care may be so strong that the marginal benefit schedule is very high. For a sufficiently high value of θ, the consumer may decide to purchase more than 1000 units even when the price is 1. Here, of course, the actual demand will definitely be larger than 1000. Graphically, this corresponds to a case where area B vanishes. Second, the demand for health care may be so little that the consumer purchases less than 1000 even when the price is 0.20. This corresponds to the case where area C does not exist.

There is a unique threshold value of the demand intensity parameter θ at which the consumer is just indifferent between consuming 850 units of health care and 1250 units. At this threshold level, the areas of B and C are exactly the same. If the actual value of θ is below the threshold, the optimal choice is 850 units; otherwise, it is 1250.

Generically, the consumer never finds it optimal to consume at exactly 1000 units. Because of the discrete reduction in the price of health care from 1 to 0.20 when q reaches 1000, the consumer either buys a quantity strictly less than 1000, or a quantity strictly larger than 1000. This is a strong prediction of the property of CDHC. Under a nonlinear price schedule in a CDHC plan, consumers never purchase an amount of health care to reach exactly the point when the price begins to drop.

4.2 A dynamic model of demand

Now I consider the consumer's dynamic decisions. I demonstrate that under CDHC a consumer has an incentive to increase consumption in an early period for the option of consuming more health care at a lower price in the future. I use a two-period model. In each period, the consumer chooses the health care quantity; these are q_1 in period 1 and q_2 in period 2. The total benefit is $\theta_1 V(q_1) + \theta_2 V(q_2)$, where θ_1 is the demand intensity in period 1, and θ_2 the demand intensity in period 2. I fix θ_1, and let θ_2 follow a distribution on an interval $[\underline{\theta}, \overline{\theta}]$ with density $f(\theta)$. I assume that in period 1, the consumer does not know the value of θ_2. At the beginning of period 2, the consumer gets to observe θ_2 before she makes the decision on health care consumption.

The CDHC policy is the same as in the previous subsection. That is, if the quantity of health care is below 1000, the price is 1; otherwise it is 0.2. The accounting of the quantity accumulation is over the entire two periods; the price reduction from 1 to 0.2 occurs whenever the total quantity is above 1000. This may happen in either period 1 or period 2, or not at all.

For any given consumption level q_1 in period 1, I derive the consumer's optimal decision in period 2. Then I will study how q_1 is to be chosen by the consumer. The model in the previous subsection will be adapted for the analysis.

When q_1 units of health care have been chosen, the price drops to 0.2 if $q_1 > 1000$. The more interesting case is when q_1 is less than 1000. Here, the consumer must purchase $1000 - q_1$ more units at the full price before the price drops to 0.2. In Figure 3, I have adapted Figure 2 to illustrate this situation. The two areas B and C are now different, since the extra quantities in period 2 to be purchased before the price reduction is only $1000-q_1$; the corresponding vertical line has moved to the left. As a result, area B becomes smaller while area C becomes larger.

For any given care quantity q_1 chosen by the consumer in the first period, I associate to it a threshold value of $\theta(q_1)$. At this demand intensity, the consumer will just be indifferent purchasing a lower quantity at full price of 1 and purchasing a high quantity at the lower price of 0.2. In other words, for a given q_1, $\theta(q_1)$ is the demand intensity at which areas B and C are identical. The threshold $\theta(q_1)$ is a decreasing function in q_1. A higher value of q_1 makes it that much easier for the consumer to reach the 1000 units level for the price reduction. As a result, for a less intense demand in the second period, the consumer may still want to go beyond the 1000 unit level. A lower threshold implies a higher level of consumer surplus due to the lower price.

A higher level of quantity in the first period brings in a higher option value. The consumer now finds it easier to choose optimally a high enough quantity to qualify for the lower price. This option value is in addition to the intrinsic benefit of health care. This is an incentive for overconsumption in the first period, despite the consumer bearing the full cost. By consuming beyond where the marginal benefit is equal to 1, the consumer incurs some deadweight loss but gains the option value in the possible consumption of medical care at the lower price of 0.2. In an appendix, I derive an expression for this option value.[3]

[3] Ellis (1986) is a general model for coverage ceiling and deductible in health insurance.

5 Empirical studies of Consumer Directed Health Care

In this section, I survey available evidence of consumer directed health care. Perhaps the benchmark for all studies is the RAND Experiment. To my knowledge, this is the only randomized experiment on health insurance. There were many types of insurance treatments in the RAND Experiment. In fee-for-service plans, consumers were subject to free care, 25%, 50%, and 95% coinsurance rates with maximum annual out-of-pocket expenditures (up to $1000 in 1974); beyond the annual expenditure cap, care expenditure was fully reimbursed. Manning et al. (1987) found that the group of consumers paying 95% coinsurance did have fewer office visits, lower outpatient and inpatient expenses, and lower likelihood of incurring any medical or inpatient expenses.

The RAND Experiment did demonstrate a "price" effect on the use of medical care. The RAND Experiment was conducted quite some time ago. Current practices of managed care under CDHC plans were not part of the experiment design. There is, however, little reason to believe that the price effect would be seriously affected by managed care practices that apply beyond the deductible in current CDHC plans. Newhouse (2004) advocates that high deductible plans should be regarded as complementary to managed care. The choice of the deductible threshold affects risk sharing. The 100% cost shares in the expenditures before the deductible provides price incentives, while managed care may be used to control those expenditures beyond the deductible.

Current enrollment in CDHC plans is still relatively small (about half a million at the end of 2004, according to America's Health Insurance Plans) but enrollment has been growing rapidly. More recent studies on CDHC plans tend to be surveys on plans and consumers, as well as on a single employer. Rosenthal and Milstein (2004) conducted a national survey of three types of CDHC plans; these are health reimbursement accounts, tiered-benefit and premium-tiered models. The first type is like the model presented above. Tiered models adjust premium or contribution to network restrictions. Rosenthal and Milstein report that in their survey the majority of enrollees are in the tiered models. Information support is emphasized by CDHC plans. This is a feature that the RAND Experiment could not have considered. Access to information about typical medical procedure and service costs is provided by plans, but information from specific providers is typically unavailable. Comparative cost information would have allowed consumers to "shop" around effectively. Perhaps due to business practice and the complexity of medical services, comparative cost information would be hard to expect to be made publicly available.

Lo Sasso et al. (2004) conduct site visits during the spring and summer of 2003 at four firms offering CDHC plans to employees. The visits yield useful information about plan characteristics and selection problems. Two sites report favorable selections: enrollees who choose CDHC plans over conventional Preferred Provider and Health Maintenance Organizations tend to incur much lower medical expenses (up to 50% over the average over the year prior to the introduction of CDHC plans). Basic managed care styles are still used by CDHC plans when enrollees have reached their deductible. Hence, CDHC plans will not replace managed care. Nevertheless, the survey methodology must be interpreted cautiously. The firms in the survey do not come from a random sample. Voluntary participation may bias the reported savings; firms that have been "successful" in cutting costs may be more willing to participate. Furthermore, all data are reported by firms; primary data collection is infeasible in the study.

Another survey examines the employees' experiences with CDHC plans. Fowles et. al. (2004) send a six-page questionnaire to Humana Inc. employees 18 years and older who are eligible for health benefits. The survey was conducted in 2001 after an open enrollment period. Information about the employee such as sociodemographic characteristics (age gender, race, education, and insurance coverage), health status, care utilization and plan preferences is collected. With a response rate of over 65%, Fowles et al. correlate plan choices using logistic regressions.

Only 7% of respondents choose the new CDHC plans after open enrollment. These tend to be more healthy: they are less likely to have a chronic condition, and less likely to have had recent medical visits. Enrollees in the new CDHC plans think that the lower premium is a significant factor in their decision. Information support is also a critical factor for consumers. Those who choose CDHC plans find the electronic enrollment process and benefit information easier to understand and use.

Two studies have looked at the experiences of big employers. The University of Minnesota in 2002 added a CDHC plan to the existing PPO an HMO and a set of tiered benefit plans. Parente el al. (2004a) investigate the characteristics of enrollees who have chosen the CDHC plan compared to those who have not. The data come from a telephone survey of about 900 employees, with about 45% of the respondents being enrolled in the CDHC plan. The survey results then are combined with payroll information for logistic estimations. In the Minnesota experience, CDHC plans are not disproportionately chosen by the young and healthy, although they are more attractive to wealthy individuals and those who value choices and flexibility. The study does not include actual health status prior to enrollment in CDHC plans. In a follow-up study, Christianson et al. (2004) look at experiences of University of Minnesota enrollees. Consumer experience information is obtained through a survey. Those consumers enrolled in CDHC plans generally report a satisfactory experience, although only a minority use the on-line information. The turnover rate among consumers in CDHC plans, however, is higher, with 8% leaving CDHC plans compared to 5% among enrollees of enrolled in other plans.

Parente et al. (2004b) use claims data to assess the effects of CDHC plans on medical expenditures and utilization at the University of Minnesota. This is a common pre-post study design. They identify three cohorts: (1) those University of Minnesota employees enrolled in an HMO plan between 2000 and 2002, (2) those enrolled in a PPO plan from 2000 to 2002, and (3) those enrolled in either an HMO or PPO plan in 2000 and in the CDHC plan in 2001 and 2002. A difference-in-difference methodology is used to identify the effect of CDHC on medical cost and utilization relative to other plans. Total expenditures for CDHC enrollees were lower than PPO enrollees but higher than Health Maintenance Organization (HMO) enrollees, yet CDHC enrollees had higher hospital costs and admission rates than either group. So the main conclusion is that CDHC plans seem to be a viable alternative.

Tollen et al. (2004) study the experiences of about 10,000 Humana Inc. employees and their dependents during the benefit years beginning July 2000 and July 2001. Claims and administrative data are used to assess risk fragmentation. Prior claims (care costs), and prior utilization (admissions, average length of stay, outpatient visits, and prescriptions) are combined with demographic data. The study shows that enrollees of CDHC plans have lower prior-year usage (by 60%) and lower spending (by 50%) than those in traditional PPO even though the two groups have similar demographic characteristics. The study is limited to the prior experiences of enrollees; this focus does not permit an analysis of the impact of CDHC plans on utilization.

The above studies on the University of Minnesota and Humana Inc. complement each other. While the former focuses on the impact, the latter is on selection. Each, however, looks at one large employer. The relevance of these results on the general population remains an open question. The available evidence on the moral hazard and adverse selection of CDHC plans is limited. Perhaps, in a market driven health care sector, the test for CDHC plans is their survival. Nevertheless, once public services such as Medicare and Medicaid use these plans, the policy implication of CDHC plans becomes important. At this point, it seems prudent for policy makers to adopt a "wait and see" approach. So far the experiences of CDHC seem to suggest the lack of very strong or clear impact on either adverse selection and moral hazard.

6 Conclusion

The potential policy benefits of CDHC plans include their affordability, their ability to empower consumers to select providers, and the provision of coverage for catastrophic events. However, public health researchers and economists have pointed out the potential problems of CDHC. Because health care use is highly skewed, with a small number of users incurring a large proportion of expenses, CDHC may lead to risk fragmentation, attracting primarily consumers who do not expect to incur large expenses. On the other hand, CDHC is often tied to a medical savings or reimbursement account, which may be funded by an employer. Because enrollees may not pay the full cost of the premium, and because balances of medical savings account can be rolled over or withdrawn with tax advantages, CDHC plans may also attract both healthy and less healthy enrollees.

This chapter has presented three theoretical models to evaluate the incentives of preventive care, selection and cross subsidization, and option value under a high deductible. The empirical findings appear to be broadly consistent with the theoretical results. Upon the introduction of a high deductible, consumers experience a lower premium. This then interacts with consumers' risk attitudes. Preventive care may increase or decrease. CDHC plans may not always lead to more preventive care. Selection is related to cross subsidization across different risk classes. The impact of CDHC plans on selection may lead to reduced cross subsidization. This then raises the premium of a high risk class and lowers the premium of a low risk class. Adverse selection and risk fragmentation may indeed occur. Finally, a high deductible health insurance policy implies nonlinear prices for consumers. Reaching the deductible is an option that consumers will consider. Moral hazard then takes on a new route. Excessive spending early in a fiscal year may be valuable for the option of lower prices later in the fiscal year.

It seems unlikely that CDHC plans will overtake conventional insurance or managed care plans to become the dominant form of health care coverage for Americans. Some consumers do value flexibility and the new information support system in CDHC plans may encourage these consumers to take charge of their health care. Consumer directed health care plans can be expected to complement managed care.

Appendix

Equation (3) yields a positive relationship between π and p. Let

$$W(p;\pi) \equiv pU(W-\pi) + (1-p)\int_0^{5000} \frac{U(W-\pi-0.2c)}{5000}dc - G(p).$$

Let $p(\pi) = \arg\max_p W(p;\pi)$. Then $p'(\pi) = -\frac{W_{p\pi}(p;\pi)}{W_{pp}(p;\pi)}$, where the subscripts denote the second-order partial derivatives. Since $G(p)$ is convex by assumption, W is concave in p, so that $W_{pp} < 0$. Next we have

$$W_{p\pi}(p;\pi) = \int_0^{5000} \frac{U'(W-\pi-0.2c)}{5000}dc - U'(W-\pi) > 0,$$

where the inequality follows from the concavity of U. So we have $p'(\pi) > 0$. The optimal preventive care is positively related to the premium.

I derive an expression for the option value of the first-period quantity in the dynamic model of consumer demand under CDHC. For any given q_1, let the threshold be $\widehat{\theta}(q_1)$: for $\theta < \widehat{\theta}(q_1)$, the consumer optimally chooses q_2 with $q_1 + q_2 \leq 1000$; for $\theta > \widehat{\theta}(q_1)$, $q_1 + q_2 > 1000$. Let $U^L(\theta) = \max_{q_2} \theta V(q_2) - q_2$. Let $U^H(\theta; q_1) = \max_{q_2} \theta V(q_2) - (1000 - q_1) - 0.2(q_2 - 1000)$. These are the indirect utility functions given the demand parameter θ and the first-period quantity q_1. The first indirect utility function U^L is a function of θ alone since for $\theta < \widehat{\theta}(q_1)$ the optimal quantity in the second period together with q_1 do not exceed 1000. The second indirect utility function U^H does depend on q_1. The consumer needs only purchase $(1000 - q_1)$ more units to qualify for the lower price of 0.2. By the Envelope Theorem, the partial derivative of U^H with respect to q_1 is 1.

Now consider the expected utility in the second period for a given q_1. This is

$$W(q_1) \equiv \int_{\underline{\theta}}^{\widehat{\theta}(q_1)} U^L(\theta)f(\theta)\mathrm{d}\theta + \int_{\widehat{\theta}(q_1)}^{\overline{\theta}} U^H(\theta;q_1)f(\theta)\mathrm{d}\theta.$$

The derivative of W is

$$W'(q_1) = \left(U^L(\widehat{\theta})f(\widehat{\theta}) - U^H(\widehat{\theta};q_1)f(\widehat{\theta})\right)\widehat{\theta}'(q_1) + \int_{\widehat{\theta}(q_1)}^{\overline{\theta}} \frac{\partial U^H(\theta;q_1)}{\partial q_1} f(\theta)\mathrm{d}\theta.$$

The term inside the brackets on the right-hand side is zero: by definition, at $\widehat{\theta}$, the consumer is just indifferent between consuming optimally an amount less than 1000 and more, $U^L(\widehat{\theta}) = U^H(\widehat{\theta}; q_1)$. The partial derivative of U^H with respect to q_1 is 1. So the derivative of W is actually $1 - F(\widehat{\theta}(q_1)) > 0$, where F is the distribution function of θ.

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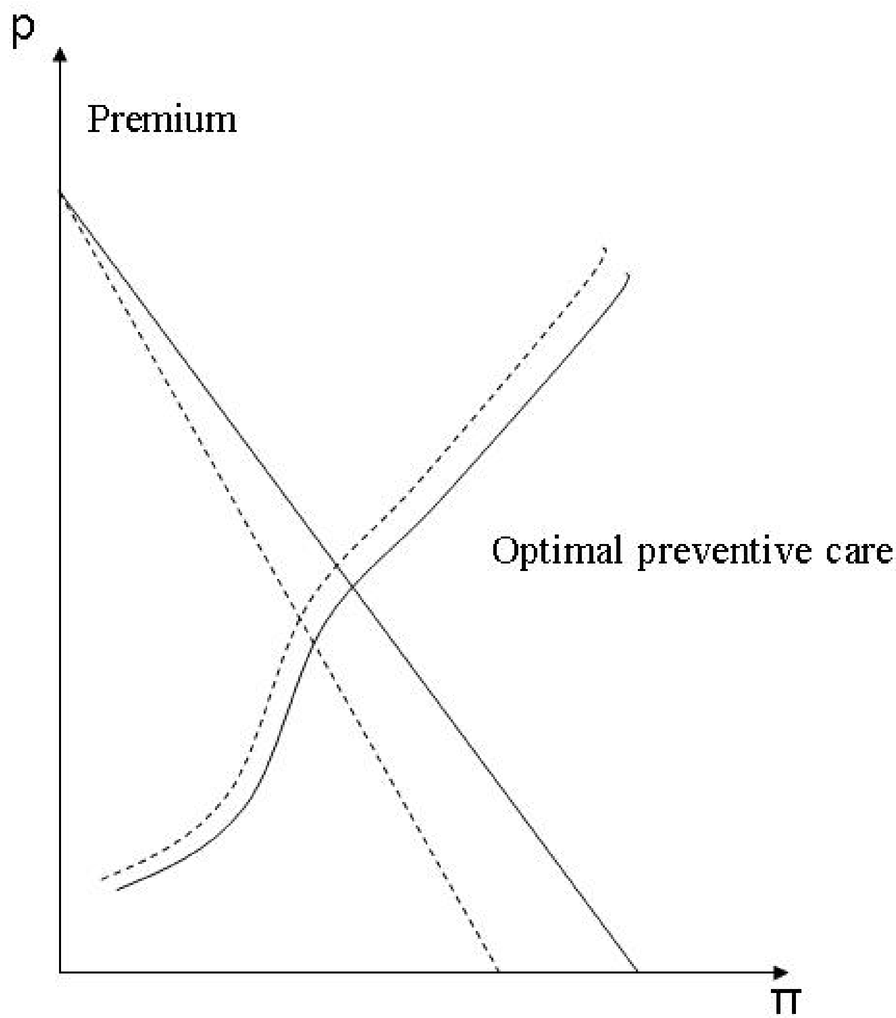

Figure 1: Equilibrium Premium and Preventive Care

Figure 1:

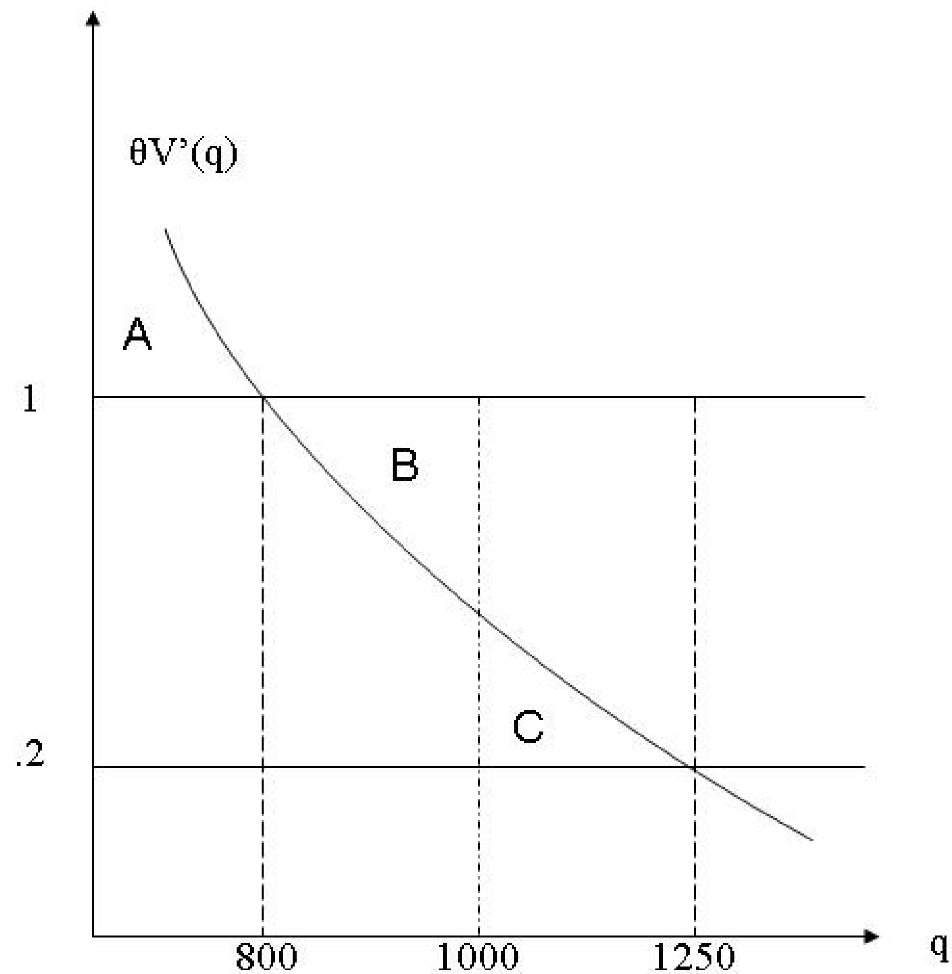

Figure 2: Optimal Quantity Decisions under CDHC

Figure 2:

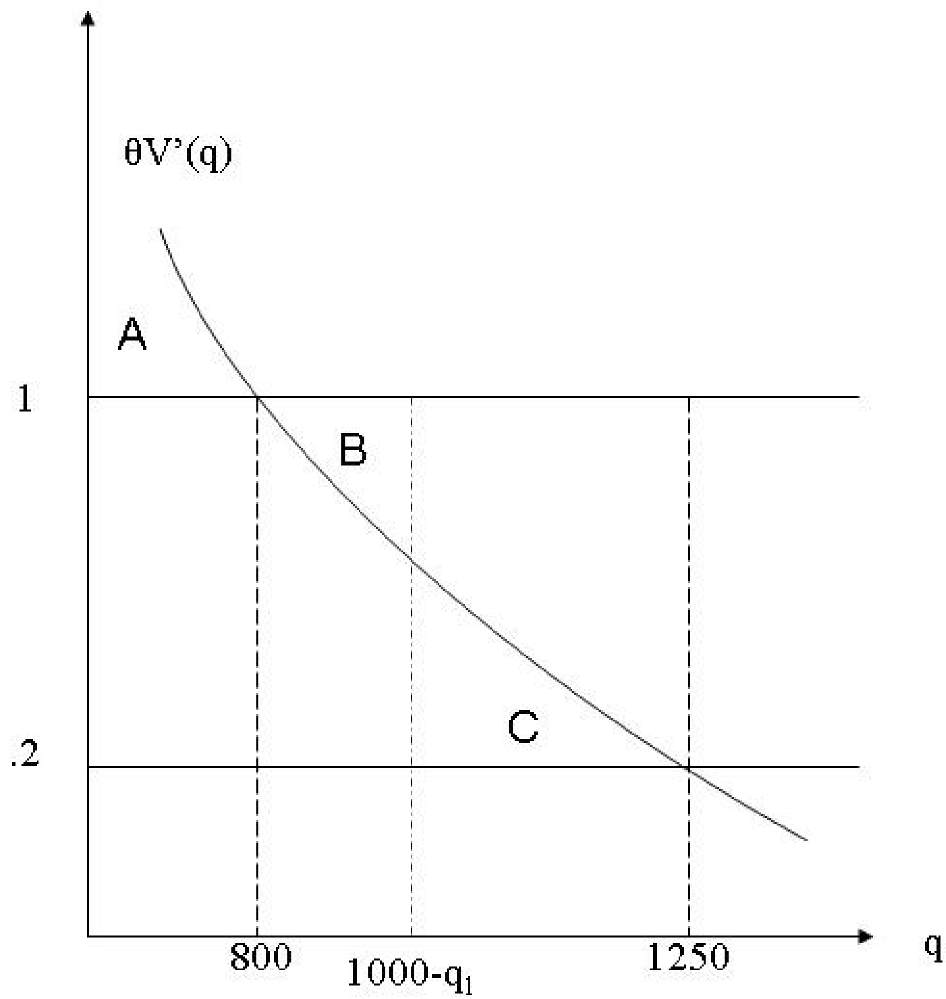

Figure 3: Optimal Second Period Decisions