

Enrollee Incentives in Consumer Directed Health Plans

Corresponding Author:

Roger Feldman

Blue Cross Professor of Health Insurance

School of Public Health

University of Minnesota

Feldm002@umn.edu

Stephen T. Parente

Curtis L. Carlson School of Management

University of Minnesota

April 21, 2007

Word Count: 6,652

This research was supported by a grant from Pfizer, Inc. We wish to thank students in Professor Peter Zweifel's health economics seminar at the University of Zurich and participants at a presentation to the AcademyHealth Annual Research Meeting in Seattle WA, June 25-27, 2006, for helpful comments.

Enrollee Incentives in Consumer Directed Health Plans Abstract

We propose a model of enrollee incentives in consumer directed health plans (CDHPs) and estimate the model with data from a large employer. A portion of the CDHP enrollee's pretax compensation is placed in a health reimbursement account. Healthy employees should save part of that account to pay for future medical contingencies. We found that enrollees whose predicted spending was less than the employer's contribution to the account tended to spend less in following years than a comparison group with traditional health insurance coverage. However, CDHP enrollees with predicted spending greater than the deductible spent more in the following years.

JEL Codes: D81 Criteria for decision-making under risk and uncertainty
 D12 Consumer economics – empirical analysis
 D14 Personal finance
 I10 Health/general

1. Introduction

Consumer directed health plans (CDHPs) have moved beyond the concept stage and are now available to employees of many large companies. Mainstream insurers such as Aetna, UnitedHealth Group, and Wellpoint have introduced their own CDHPs. This research presents important information on the impact of CDHPs on medical care use and expenditures, issues that are likely to merit attention as CDHPs become more commonly available as a health benefit option in employed groups. It builds on two earlier comparisons (Parente, Feldman, and Christianson, 2004; Feldman, Parente, and Christianson, 2007) of medical care use and expenditures among a cohort of employees who chose a CDHP with those of employees who chose a point-of-service (POS) plan or a preferred provider organization (PPO) offered by the same employer. Although the CDHP experienced favorable selection, by the second year, expenditures in the CDHP cohort as a whole were higher than in the POS cohort and about equal to the PPO cohort. These differences persisted in the third year after the CDHP was offered.

The current study proposes a new and innovative method for comparing service use and expenditures in a CDHP versus traditional health insurance plans. Specifically, we separate enrollees *within* plans into groups corresponding to their predicted medical care use. This further breakdown, by predicted use within plan, is motivated by the “kinked” budget constraint in a CDHP compared with traditional cost-sharing designs. The CDHP enrollee is given a fixed amount of dollars in a Health Reimbursement Account (HRA) that she can spend on medical care or drugs. If that account is exhausted, she must pay out-of-pocket until insurance coverage is available after meeting a deductible. CDHP enrollees whose expected spending is within the account might restrain their use of medical care in order to have money available for future medical contingencies. In contrast, those who expect to spend more than the deductible should

behave as if medical care is free because this employer imposed no coinsurance once the deductible was met.

To predict expected spending, we need a measure that is not affected by the actual plan that the employee chose. Our measure of expected spending is based on medical spending at the employee contract level during the year *before* the CDHP was introduced. This prediction is strongly influenced by the health status of the contract holder and his or her covered dependents. Then we estimate models of medical spending for three years after the CDHP was introduced as a function of expected prior spending and the employee's choice of health plans over that period.

Our work has much in common with theoretical models of medical care spending in high-deductible health plans (Keeler, Newhouse, and Phelps, 1977). But in contrast to theoretical models of deductibles – which explain consumers' behavior within a single accounting period depending on how much they have already spent and how many days are left in the period – we focus on explaining behavior over several accounting periods in the presence of a kinked budget constraint.

The paper has three sections. First, we present a theoretical model of a healthy, risk-averse enrollee who chooses present and future medical care spending subject to the kinked CDHP budget constraint. A key insight from the model is that spending to treat minor illnesses in the current time period involves an opportunity cost in the form of higher out-of-pocket spending if the enrollee becomes seriously ill later on. We derive expressions for the optimal levels of medical care spending for CDHP enrollees and enrollees in “traditional” plans that have deductibles or coinsurance. The second section estimates regression equations to determine if enrollees behave as predicted by the theory. The last section discusses the results and concludes.

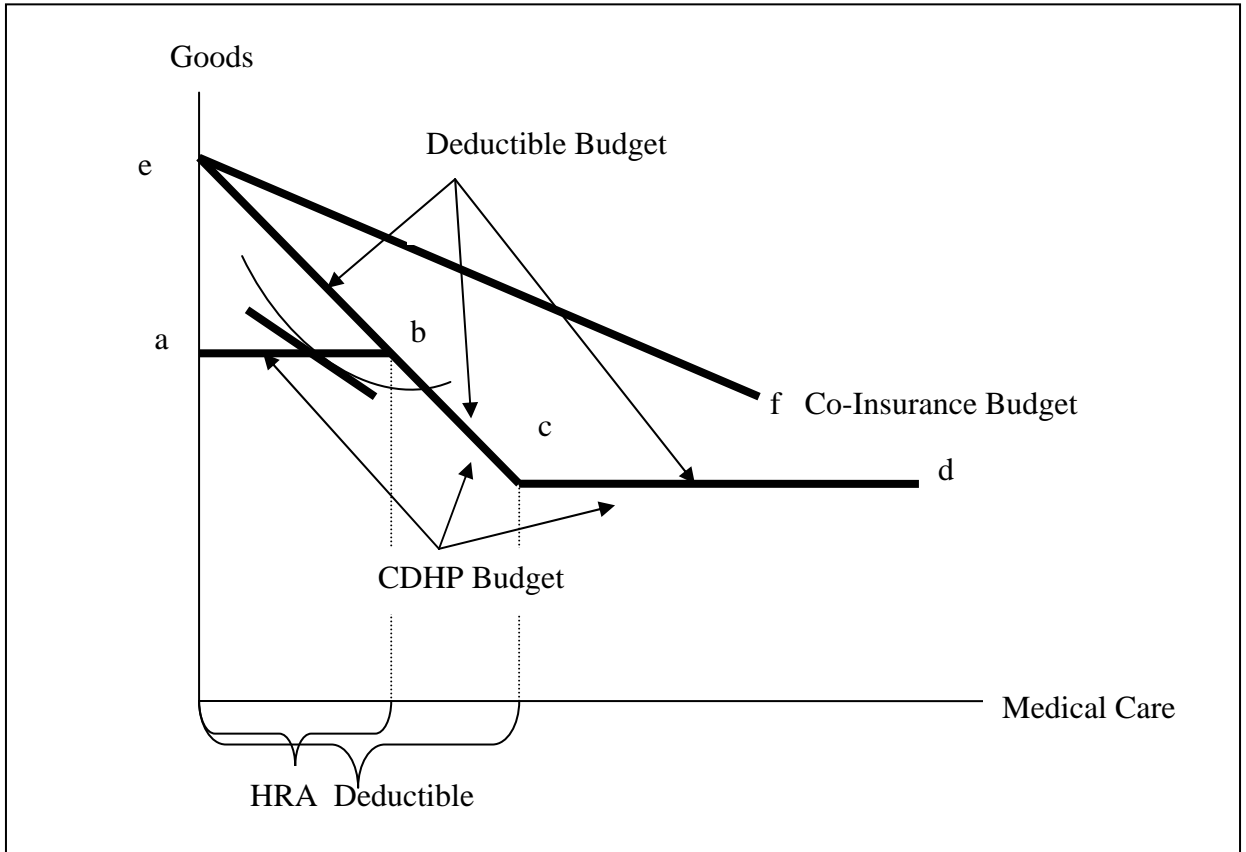
2. Theoretical Model of a CDHP

In a CDHP a portion of the employer's tax-deductible contribution to health benefits is placed in a "health reimbursement account" (HRA) from which the employee purchases medical care (Christianson, Parente, and Taylor, 2002). The unused portion of the account "rolls over" into the next year if the employee stays enrolled in the CDHP. Major medical insurance or some form of "wrap-around" coverage is also a key part of the benefit design. If an employee spends all of the dollars in the reimbursement account in a given year, she then spends her own money until the deductible requirement in the major medical coverage is met. Expenditures in excess of the deductible are covered by the major medical plan. The benefit design can be tailored to cover all or a part of these "excess" expenditures.

Figure 1 illustrates the CDHP budget constraint as $abcd$: ab is the health reimbursement account; bc represents out-of-pocket expenses after the account is exhausted but before the deductible is met; and cd is the consumer's budget after the deductible is met. Segment cd will be horizontal if the major medical insurance policy has no coinsurance, which was typical of many firms that offered CDHPs during the time of our study including the one we observed.

In contrast, a consumer with a deductible-only policy would face a budget constraint like ecd in Figure 1. She would pay all medical expenses out-of-pocket until she reached the deductible, after which she would be covered under the major medical policy. A consumer with coinsurance but no deductible would have a budget constraint like ef in Figure 1. A coinsurance policy with a limit on out-of-pocket expenditures would have a flat segment resembling the CDHP and deductible-only policies.

Figure 1
Budget Constraints for CDHP, Deductible Plan, and Coinsurance Plan



To understand how a healthy, risk-averse CDHP enrollee will use her health reimbursement account, we introduce uncertainty in the demand for medical care. In each period an enrollee may be in one of many health states, ranging from excellent health to a very serious illness with much higher use of medical care if she is seriously ill. Future health states are not known. If the enrollee who is healthy today spends the entire account, she will have less money available to pay the deductible if she becomes ill later on. In other words, there is an opportunity cost to spending the account to treat minor illnesses today. This means that a healthy, risk-averse enrollee will save part of her account to pay the deductible if she becomes seriously ill later on.

As we show below, she will use medical care up to the point where the marginal benefit of current spending is equal to the marginal opportunity cost of saving for future medical care use.

We construct a simple mathematical model to illustrate how an employee who plans to enroll in the CDHP for two periods will use her health reimbursement account. For simplicity, we assume that her utility in each period ($t=1, 2$) is a separable function of non-medical goods (G) and health (H), which is produced by medical care (M). Next, we assume there are only two health states: “good health” (GH) and “serious illness” (SI). Serious illness is associated with a large health loss, but medical care is more productive in that state of the world. We capture both the health loss from serious illness and the state-dependent difference in medical productivity by assuming that a “complete cure” for the serious illness is available for \bar{M} dollars, but anything less than \bar{M} would yield infinitely negative utility. This assumption ensures that the consumer always purchases the complete cure. The state-dependent utility function is:

$$\begin{aligned}
 U_t &= W(G_t) + H(M_t) \mid GH \\
 U_t &= -\infty \mid SI; M_t < \bar{M} \\
 U_t &= W(G_t) \mid SI; M_t \geq \bar{M}
 \end{aligned} \tag{1}$$

Next, we introduce several assumptions about the consumer’s health and finances. We assume she is in good health in the first period, but there is a known probability p that she will develop the serious illness in the second period. We also assume that her exogenous money income in each period is Y dollars and the employer contributes C dollars to her health reimbursement account in each period. In the first period, the account may be spent only on

medical care but in the second period it may be spent on medical care or goods.¹ This assumption is necessary in the 2-period model that we use; otherwise, there would be no maximization problem in the second period because the healthy enrollee would spend the entire balance in the account rather than losing it. We denote the amount saved from the health reimbursement account in the first period as S_1 . For a healthy enrollee, $M_1 = C - S_1$.

We assume the CDHP has a deductible of D dollars ($D < \bar{M}$) with no coinsurance once the deductible is met. This design was typical of those used by many employers that offered CDHPs at the time of our study. Finally, we assume that the enrollee cannot borrow against her future income. This assumption seems reasonable to us because future income generally is not recognized as good collateral for a loan.²

Given our assumptions and the health insurance policy parameters, we can write the enrollee's 2-period expected utility as:

$$E(U) = W(Y) + H(C - S_1) + (1 - p)[W(Y + C + S_1 - M_2) + H(M_2)] + pW(Y + C + S_1 - D) \quad (2)$$

In the first period, the healthy enrollee chooses S_1 , knowing that when the second period arrives and her health status is known, her use of M_2 will depend on her health condition. Consequently, to maximize (2) the enrollee starts by finding the optimal state-dependent value of M_2 denoted M_2^{*GH} if she is healthy and M_2^{*SI} if she is sick.

¹ Since January 1, 2004, employers have been able to offer "Health Savings Accounts" (HSAs), in which the employee owns the account and may take it with her if she leaves the plan or the firm. While the HSA must be spent on medical care to avoid tax penalties, it resembles the unrestricted accounts in our model.

² The prohibition against borrowing is important. If we drop that assumption, the consumer could overcome the first-period restriction against spending her health reimbursement account only on medical care. The CDHP would be equivalent to the deductible-only plan that we analyze shortly.

The second-period optimality conditions are:

$$\begin{aligned} W_2'^{GH} &= H_2' \\ M_2^{*SI} &= \bar{M} \end{aligned} \quad (3)$$

The first line of (3) says that if the enrollee is in good health in the second period, she will use medical care up to the point where the marginal product of medical care is equal to the marginal utility of income. The solution to the first line of (3) is the optimal M_2^{*GH} . Totally differentiating the first line yields an expression for the change in M_2^{*GH} with respect to first-period saving. This is positive, assuming that the employee's preferences are convex:

$$W_2''^{GH} (1 - dM_2^{*GH} / dS_1) = H_2'' dM_2^{*GH} / dS_1 \rightarrow dM_2^{*GH} / dS_1 = W_2''^{GH} / (W_2''^{GH} + H_2'') > 0 \quad (4)$$

If the enrollee is seriously ill in the second period, she will spend the deductible in order to obtain the complete treatment, so $M_2^{*SI} = \bar{M}$ is the solution to (as well as the form of) the second line of (3).

Next, the enrollee chooses how much to save in the first period. If an interior solution exists ($S_1 > 0$), the first-order condition is:

$$H_1' = (1 - p)W_2'^{GH} + pW_2'^{SI} - (1 - p)W_2''^{GH} dM_2^{*GH} / dS_1 + (1 - p)H_2' dM_2^{*GH} / dS \quad (5)$$

Using the first line of (3), equation (5) can be simplified to:

$$H'_1 = E(W'_2) \tag{6}$$

This equation says that the marginal utility of spending the employer's contribution to the HRA in the first period equals the expected marginal utility of saving it. If we divide both sides of (6) by the marginal utility of income evaluated at Y (operation not shown), (6) would represent the CDHP equilibrium in Figure 1. In other words, it is the point of tangency between an indifference curve representing a constant level of utility and the opportunity cost of discretionary medical spending in the first period. This equation provides the solution for M_1^* .

The second model we analyze is a deductible-only health insurance plan (“D-plan”) in which the enrollee has $Y + C$ income in each period to use any way she wants. Her expected utility in the D-plan is:

$$E(U) = W(Y + C - S_1 - M_1) + H(M_1) + (1 - p)[W(Y + C + S_1 - M_2) + H(M_2)] + pW(Y + C + S_1 - D) \tag{7}$$

The second-period optimality conditions for this problem have the same form as (3), while the first-period optimality conditions with respect to M_1 and S_1 are:

$$\begin{aligned} W'_1 &= H'_1 \\ W'_1 &= E(W'_2) \end{aligned} \tag{8}$$

Putting the two parts of (8) together, we have:

$$H'_1 = E(W'_2) \tag{9}$$

Equation (9) has the same form as (6) but the equilibrium *value* of M_1^* in the D-plan is less than in the CDHP. To show this, we assume M_1^* is equal under the two plans. Equal medical spending implies equal H_1' in both plans. Also, savings in the D-plan must be less than in the CDHP because the enrollee's total income in both plans is the same, but she spends more on non-medical goods in the D-plan. Smaller savings in the D-plan means that $E(W_2')$ is larger than in the CDHP. Equal H_1' but unequal $E(W_2')$ contradicts (9). The D-plan enrollee must reduce medical care spending in the first period, thereby increasing the marginal product of medical care and decreasing the expected marginal utility of savings. Optimal medical spending for health CDHP and deductible-only enrollees is shown in Figure 2.³

³ Restricting the use of the health care reimbursement account in the first period is inefficient because the D-plan enrollee could have chosen the CDHP equilibrium but did not do so, whereas the CDHP enrollee cannot choose the deductible-only equilibrium. The employee might prefer an inefficient CDHP over a deductible-only policy because the employer's contribution to the HRA is tax-free, whereas it would be taxable if the employee received it as money income. A full welfare analysis of CDHP health plans (as in Jack and Sheiner, 1997) would include the welfare gain from increased cost sharing in a CDHP compared with inefficiently low cost sharing in most traditional health insurance policies.

Insurance payments, represented by ϕ_1 and ϕ_2^{GH} , are subtracted from her income to remove income effects from the model. For example, if she has 20% coinsurance and spends \$100 on medical care in the first period, then $\phi_1 = \$80$. Without such adjustments, an enrollee with $Y + C$ income and a policy with a low coinsurance rate could have more medical care, more goods, and more savings than one with a deductible-only policy. We assume the adjustments are made by the employer and the employee regards them as exogenous because her medical care use has a negligible effect on them. Second-period utility maximization for the C-plan yields:

$$\begin{aligned} cW_2'^{GH} &= H_2' \\ M_2^{*SI} &= \bar{M} \end{aligned} \tag{11}$$

First-period optimality conditions for this plan are:

$$\begin{aligned} cW_1' &= H_1' \\ W_1' &= E(W_2') \end{aligned} \tag{12}$$

To compare medical spending in the C-plan with that in the D-plan, we contrast the first part of (11) with the corresponding part of (3). All else equal, a healthy C-plan enrollee will spend more money on medical care in the second period than one with a deductible, unless $c = 1$ (which would transform the C-plan into a D-plan). The same comparison of (12) and (8) shows that a healthy C-plan enrollee will spend more money on medical care in the first period than one with a D-plan unless $c = 1$. At $c = 1$, the adjustments to the enrollee's income are $\phi_1 = 0$ and $\phi_2^{GH} = 0$, so the C-plan and D-plan again are identical.

To compare the C-plan with a CDHP, we first assume the coinsurance rate is 1.0 (the employee pays the full price of medical care out-of-pocket). Because the C-plan and D-plan are equivalent at this coinsurance rate and the D-plan has lower spending than a CDHP, so does the C-plan. Next we assume other extreme: when $c = 0$ the healthy C-plan enrollee uses medical care medical care as if it were free in the second period (see equation (11)) and therefore she spends more than the healthy CDHP enrollee. This leads to a welfare loss compared with the CDHP enrollee. Assuming that the welfare loss is increasing in income, the C-plan enrollee saves less in the first period. Consequently, she spends more on discretionary medical care in *both periods* than does the CDHP enrollee.

According to a well-known property of demand functions (Varian, 1984, page 149), if consumer preferences are convex then the demand function is continuous. We have assumed preferences are convex, hence the demand for medical care is continuous on the interval $c = [0, 1]$. Because $M_1^*(c = 0) > M_1^*(CDHP)$ but $M_1^*(c = 1) < M_1^*(CDHP)$, and $M_2^{*GH}(c = 0) > M_2^{*GH}(CDHP)$ but $M_2^{*GH}(c = 1) < M_2^{*GH}(CDHP)$, the intermediate value theorem implies there is a coinsurance rate $0 < c^* < 1$ where CDHP and C-plan enrollees have equal medical spending. Also, because the demand function for medical care is monotonically decreasing in coinsurance, C-plan enrollees will spend more than CDHP enrollees at all coinsurance rates less than the intermediate value and vice versa.

What about CDHP enrollees who spend more than their accounts but less than the deductible in the first period? For these enrollees (who are on segment bc in Figure 1), the CDHP is exactly like a D-plan. Consequently, CDHP and D-plan enrollees in this region of the budget constraint should have equal spending, and they should spend less than C-plan enrollees because a deductible of ec dollars is more effective in controlling medical care spending than

coinsurance with stop-loss of *ec* dollars. Finally, all enrollees who exceed the deductible (or stop-loss) should have equal spending. Our predictions are summarized in Table 1.

Table 1
Medical Spending by Predicted Budget Region

Region 1: Predicted spending less than employer contribution to HRA	Region 2: Predicted spending above HRA but below deductible	Region 3: Predicted spending above deductible
D-plan < CDHP and C-plan (order of CDHP and C-plan is uncertain)	D-plan = CDHP < C-plan	All plans equal

3. Empirical Research

We analyzed health insurance claims and personnel data from a large, self-insured employer that offered a CDHP to employees at its main corporate location in a large metropolitan area in 2001 (Parente, Feldman, and Christianson, 2004). The employer previously offered a point-of-service (POS) plan and a preferred provider organization (PPO), and it kept these options when it offered the CDHP. Worldwide, the employer has 31,000 employees and \$10 billion in annual revenue. The company is adding employees each year through internal growth and acquisitions.

We used a quasi-experimental pre/post design to assign employee contracts to three cohorts: (1) enrolled in the POS plan from 2000 to 2003; (2) enrolled in the PPO from 2000 to 2003; and (3) enrolled in the CDHP from 2001 to 2003, after previously enrolling in either the POS or PPO in 2000. There were 429 observations in the CDHP cohort, 1,249 in the POS cohort, and 1,025 in the PPO cohort.

The insurance plan designs at the employer are shown in Table 2. The employer’s annual contribution to the HRA and the deductible in the CDHP both varied by contract type (single, 2-person, or family). There was no coinsurance once the deductible was reached, so the stop-loss limit was equal to the gap between the HRA and the deductible. The POS and PPO plans both used co-payments per unit of service rather than coinsurance for employee cost sharing; therefore, the employee’s incentives to use medical care differ slightly from the pure coinsurance plan in our theoretical model (in a co-payment plan, the marginal services received during each visit or episode of inpatient care are “free.”). However, co-payments can be converted into an equivalent average coinsurance rate, so we treat them as similar to coinsurance. As Table 2 indicates, the only difference between the POS and PPO plans was a slightly lower stop-loss limit for the PPO.⁴

Table 2
Plan Designs at Study Employer

Plan Characteristic	CDHP Plan	PPO and POS Plans
Employer HRA contribution	\$1,000 single \$1,500 2-person \$2,000 family	Not applicable
Deductible	\$1,500 single \$2,250 2-person \$3,000 family	None
Coinsurance/Co-pay	None	\$15 office visit co-pay \$100 inpatient co-pay
Rx coverage	Same as other covered services	\$10 generic \$20 formulary brand \$30 non-formulary brand
Preventive Care	100% covered	100% covered
Stop-loss limit	\$500 single \$750 2-person \$1,000 family	\$1,000 per person (PPO) \$2,000 per family (PPO) \$1,500 per person (POS) \$3,000 per family (POS)

⁴ All data in Table 2 refer to benefits and cost sharing for in-network or “preferred” providers. Benefits for non-preferred providers typically are less generous and cost sharing is higher.

As summarized in Table 1, our theory predicts that the CDHP will have different effects on health care use and cost, depending on the “region” of the budget constraint in which the enrollee is located. However, in order to identify the effect of these cost-sharing arrangements on medical care spending, we need to control for adverse or favorable selection into the CDHP, PPO, and POS plans. Our method of controlling for selection – and the key to our research design – is to use claims data from 2000, when all the employees were in the PPO or the POS plans with similar cost-sharing incentives, to predict base-year spending at the employee contract level. Base-year spending then serves as a control for health conditions and the permanent but unobserved effects of cohort membership on subsequent medical spending.

To implement this approach, we defined three spending regions: below the employer’s contribution to the HRA; above the HRA but below the deductible; and above the deductible. The regions are measured in dollars and are the same for all cohorts. We estimated a model for total health care spending at the employee contract level on the basis of health status, cohort (CDHP, PPO or POS), and demographics. We used this model to predict the 2000 region for each contract. Having identified contracts in the same predicted region, we compared how much they spent in the next three years in the CDHP versus the PPO or POS plans.

Table 3 provides descriptive statistics for the variables we used to estimate the 2000 cost-prediction model. In addition to the variables listed, we defined indicators (not shown) for 34 “adjusted diagnostic groups,” based on non-mutually exclusive encounters that may result in a separate medical diagnosis (Starfield, et al., 1991; Weiner et al., 1991).

Table 3
Variables in Year-2000 Cost Model

Name	Description	Mean	S.D.	Minimum	Maximum
\$TOTAL	Total allowed medical expenditure	4592.1	9986.5	5	237253.3
INCOME	contract-holder's 2000 wage income	65308.8	140918.1	1131.8	4862288
AGE	contract-holder's age	40.677	9.221	19	74
MALE	contract-holder's gender	0.571	0.495	0	1
COVERED LIVES	# of covered lives in contract	2.593	1.274	1	9
FSA	FSA elected = 1, no = 0	0.257	0.436	0	1
CDHP	CDHP cohort 1 = yes, 0 = no	429 contracts			
POS	POS cohort 1 = yes, 0 = no	1,249 contracts			
PPO	PPO Cohort 1 = yes, 0 = no	1,025 contracts			

The contract-holding employees in our study were 40.7 years old, on average, in 2000 and had mean wage income of \$65,309. About 57% of the employees were males, and the average number of covered lives per contract was 2.6. We set cases with zero allowed medical expenditure equal to \$5 before taking logarithms. After doing this, on average, the total allowed medical expenditure per contract was \$4,592 in 2000.

Table 4 presents the regression model for the natural logarithm of medical care spending in 2000, measured as total allowed dollars.⁵ Among the significant coefficients are the contract-holder's age and adjusted lives with positive effects on spending, and male with a negative effect. The estimated coefficients of the cohort indicators for CDHP and PPO are negative, indicating favorable selection into these plans. The adjusted R-squared for this regression is 0.64, which is typical of models that include current diagnostic information.

⁵ Coefficients for the adjusted diagnostic groups are omitted.

Table 4
Year-2000 Cost Model
Dependent Variable = ln(\$TOTAL)

Variable	Coefficient Estimate	Standard Error	t-value	Pr > t
Intercept	4.148	0.116	35.86	<.0001
INCOME	1.85E-07	1.59E-07	1.16	0.246
AGE	0.015	0.0026	5.75	<.0001
MALE	-0.166	0.0460	-3.61	0.0003
COVERED LIVES	0.0579	0.0215	2.71	0.0068
FSA	0.102	0.053	1.92	0.0551
CDHP	-0.236	0.0643	-3.66	0.0003
PPO	-0.119	0.0488	-2.43	0.0152

Next, we used the estimated coefficients from Table 4 and each employee's characteristics to predict the contract-level budget region in 2000.⁶ Because the cost prediction is an estimate, we assigned probabilities of locating in each region according to the formulae:

$$\Pr(\text{region} = 1) = \Pr\left(z < \frac{C_1 - \hat{Y}_i}{SE(\hat{Y}_i)}\right) \quad (13)$$

$$\Pr(\text{region} = 2) = \Pr\left(\frac{C_1 - \hat{Y}_i}{SE(\hat{Y}_i)} < z < \frac{C_2 - \hat{Y}_i}{SE(\hat{Y}_i)}\right) \quad (14)$$

$$\Pr(\text{region} = 3) = 1 - \Pr(\text{region} = 2) - \Pr(\text{region} = 1) \quad (15)$$

\hat{Y}_i is the predicted natural logarithm of total spending for the i^{th} contract and $SE(\hat{Y}_i)$ is the standard error of that prediction. C_1 and C_2 are the natural logarithms of the “cut points” for the

⁶ Even though the three regions are ordered, we didn't use ordered probit for this estimation because the regions are measured in cardinal units (dollars).

employer’s HRA contribution and deductible by contract type shown Table 2. These cut points are not adjusted by how much CDHP enrollees saved from the HRA each year toward meeting future deductibles. While this is a potential weakness because the kinks in the budget constraint depend on how much an employee saves, calculation of the kinks year-by-year for each CDHP enrollee would have introduced endogeneity into the predicted regions.

The advantage of using three probabilities over a single point estimate of the employee’s spending region is that the most likely point estimate may be in one region, but the prediction may be quite close to the border of another region. A point estimate would overlook this important detail.

The predictions and bootstrapped confidence intervals (based on 500 random samples with replacement) are shown in Table 5. On average, Regions 1 and 3 had higher probabilities than Region 2. Across cohorts, the CDHP cohort had the highest probability of Region 1 and the lowest probability of Region 3. The PPO and POS cohorts had very similar probabilities of locating in each region.

Table 5
Predicted Regions by Cohort

Plan	# Obs.	Probability of Region		Confidence Interval
CDHP	429	1	0.548	±0.0623
		2	0.118	±0.0278
		3	0.333	±0.0512
POS	1,249	1	0.473	±0.0402
		2	0.126	±0.0208
		3	0.401	±0.0321
PPO	1,025	1	0.465	±0.0410
		2	0.135	±0.0206
		3	0.400	±0.0339

Next, we estimated regression models to identify the impact of CDHP enrollment on medical care expenditures and utilization. The regressions used contract-level and employee-level data to control for differences in cohort demographics including the contract-holder's age, sex, wage income, number of covered lives in the contract, and election of a flexible spending account (FSA) contribution. We also used the ADGs mentioned above to develop a measure of a catastrophic "health shock" for the concurrent year. The presence of any ADG associated with an acute major illness, traumatic injury or cancer is recorded as a contract and year-specific categorical variable.

Because we had used the 2000 claims data to assign enrollees to regions, the models were estimated with data from 2001 through 2003. This means we could not use PPO and CDHP cohort indicators as regressors. However, this was not a problem because we used the cohort variables to predict the employee's region, so their permanent effects on medical care spending are incorporated in the models. The effects of plan design on medical care spending are captured by inter-acting the predicted regions with indicator variables for the cohort (CDHP, PPO, or POS). The omitted category is POS x Region 1.

We estimated the models in two parts, using probit equations for the probability of any medical spending or utilization, followed by OLS regressions for the natural logarithm of spending or utilization, conditional on it being greater than zero.⁷ The models control for time effects in 2002 and 2003 compared with 2001. Because no contracts with a contemporaneous health shock had "zero" values for several dependent variables, they were omitted from the probit equations. For the same reason, we omitted members of the CDHP cohort predicted to have any probability of being in Regions 2 and 3 from several probit models.

⁷ Observations with zero spending (which were set to \$5 in the cost regression) were reset to zero for the probit equations.

**Table 6
Total Expenditure**

Variable	Probit				Conditional ln(\$TOTAL)			
	Coefficient Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Coefficient Estimate	Standard Error	t-value	Pr > t
Intercept	1.148	0.167	47.092	<.0001	5.961	0.069	86.03	<.0001
YR2002	0.221	0.087	6.388	0.0115	0.140	0.0306	4.59	<.0001
YR2003	0.138	0.0871	2.493	0.114	0.347	0.0306	11.35	<.0001
AGE	-0.00093	0.00356	0.0677	0.795	0.0128	0.0014	9.08	<.0001
MALE	-0.546	0.0795	47.266	<.0001	-0.0096	0.0261	-0.37	0.713
INCOME	-2.42E-07	4.72E-07	0.263	0.608	1.13E-08	4.40E-08	0.26	0.797
COVERED LIVES	0.310	0.041	57.197	<.0001	0.252	0.0114	22.21	<.0001
FSA	0.278	0.109	6.537	0.0106	0.206	0.0286	7.21	<.0001
HEALTH SHOCK	NA	NA	NA	NA	0.669	0.0264	25.33	<.0001
POS x REGION2	0.637	0.281	5.150	0.0232	0.430	0.0702	6.12	<.0001
POS x REGION3	1.141	0.28	16.611	<.0001	0.656	0.0412	15.91	<.0001
CDHP x REGION1	-0.225	0.107	4.441	0.0351	-0.116	0.0524	-2.22	0.0262
CDHP x REGION2	NA	NA	NA	NA	0.588	0.120	4.89	<.0001
CDHP x REGION3	NA	NA	NA	NA	0.765	0.0647	11.82	<.0001
PPO x REGION1	-0.180	0.085	4.501	0.0339	0.0872	0.0422	2.07	0.0388
PPO x REGION2	0.968	0.388	6.245	0.0125	0.505	0.0763	6.61	<.0001
PPO x REGION3	0.944	0.259	13.255	0.0003	0.782	0.0453	17.26	<.0001
7875 cases = 1; 231 cases = 0; X-square = 308.049, p < .0001					Adjusted R-square = 0.316			

**Table 7
Physician Expenditure**

Variable	Probit				Conditional ln(\$PHYSICIAN)			
	Coefficient Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Coefficient Estimate	Standard Error	t-value	Pr > t
Intercept	0.898	0.155	33.741	<.0001	5.635	0.0612	92.09	<.0001
YR2002	0.162	0.0814	3.955	0.0467	0.103	0.0269	3.81	0.0001
YR2003	0.067	0.0811	0.676	0.411	0.319	0.0270	11.81	<.0001
AGE	0.000992	0.00331	0.0898	0.764	0.0057	0.00125	4.55	<.0001
MALE	-0.499	0.0725	47.412	<.0001	0.0226	0.0230	0.98	0.3272
INCOME	-2.28E-08	5.32E-07	0.0018	0.966	-4.10E-09	3.86E-08	-0.11	0.916
COVERED LIVES	0.364	0.0391	86.600	<.0001	0.267	0.0100	26.67	<.0001
FSA	0.211	0.0969	4.7316	0.0296	0.229	0.0252	9.08	<.0001
HEALTH SHOCK	NA	NA	NA	NA	0.656	0.0232	28.27	<.0001
POS x REGION2	0.216	0.210	1.0575	0.304	0.331	0.062	5.34	<.0001
POS x REGION3	1.226	0.276	19.741	<.0001	0.563	0.0363	15.54	<.0001
CDHP x REGION1	-0.314	0.1	9.852	0.0017	-0.0251	0.0464	-0.54	0.588
CDHP x REGION2	NA	NA	NA	NA	0.541	0.106	5.12	<.0001
CDHP x REGION3	3.861	83.492	0.0021	0.963	0.673	0.0569	11.83	<.0001
PPO x REGION1	-0.186	0.0808	5.276	0.0216	0.00284	0.0373	0.08	0.939
PPO x REGION2	0.542	0.276	3.858	0.0495	0.350	0.0672	5.2	<.0001
PPO x REGION3	0.774	0.207	14.031	0.0002	0.589	0.0398	14.78	<.0001
7815 cases = 1; 291 cases = 0; X-square = 373.995, p < .0001					Adjusted R-square = 0.349			

**Table 8
Pharmacy Expenditure**

Variable	Probit				Conditional ln(Pharmacy Expenditure)			
	Coefficient Estimate	Standard Error	Wald Chi-Square	Pr > Chi-Square	Coefficient Estimate	Standard Error	t-value	Pr > t
Intercept	0.135	0.107	1.596	0.206	4.235	0.0914	46.33	<.0001
YR2002	0.0775	0.0542	2.045	0.153	0.143	0.0340	3.61	0.0003
YR2003	0.143	0.0554	6.637	0.01	0.349	0.0395	8.86	<.0001
AGE	0.00335	0.00228	2.1479	0.143	0.0317	0.0018	17.22	<.0001
MALE	-0.313	0.0476	43.274	<.0001	0.000813	0.0338	0.02	0.981
INCOME	4.93E-08	2.04E-07	0.0587	0.809	2.10E-08	5.51E-08	0.38	0.703
COVERED LIVES	0.355	0.0231	235.951	<.0001	0.0662	0.0147	4.49	<.0001
FSA	0.139	0.0587	5.592	0.018	0.239	0.0366	6.51	<.0001
HEALTH SHOCK	0.471	0.0535	77.476	<.0001	0.2879	0.0339	8.5	<.0001
POS x REGION2	0.605	0.147	17.0323	<.0001	0.458	0.0901	5.09	<.0001
POS x REGION3	0.809	0.0978	68.476	<.0001	0.7492	0.0530	14.14	<.0001
CDHP x REGION1	-0.201	0.0714	7.936	0.0048	-0.359	0.0703	-5.11	<.0001
CDHP x REGION2	1.220	0.405	9.052	0.0026	0.237	0.152	1.56	0.118
CDHP x REGION3	0.482	0.152	10.117	0.0015	0.661	0.0827	7.99	<.0001
PPO x REGION1	0.033	0.0594	0.313	0.576	0.0544	0.0558	0.98	0.329
PPO x REGION2	0.605	0.161	14.129	0.0002	0.399	0.0976	4.09	<.0001
PPO x REGION3	0.767	0.107	51.606	<.0001	0.909	0.0581	15.65	<.0001
7377 cases = 1; 729 cases = 0; X-square = 1083.277, p < .0001					Adjusted R-square = 0.175			

The results are shown in Tables 6 – 8. Looking first at the total expenditure regressions (Table 6), we see that both CDHP enrollees and PPO enrollees in Region 1 were *less* likely to have positive total expenditures than were POS enrollees in Region 1. This finding also applied to the conditional total expenditure equation for CDHP enrollees in Region 1, who spent about 11 percent less than POS enrollees in that region ($e^{-.116} - 1 = -.11$). However, PPO enrollees in Region 1 spent about 9 percent more than POS enrollees in the same region. Across all cohorts, enrollees in “higher” regions spent more than those in “lower” regions and both CDHP and PPO enrollees in Region 3 spent *more* than those in the POS plan ($p < .10$ and $< .01$, respectively).

In the probit equation for physician expenditures (Table 7), CDHP and PPO enrollees in Region 1 were *less* likely to have positive expenditures than were POS enrollees in Region 1. However, these results did not carry over to the conditional physician expenditure equation, where both estimates were insignificant. Two other results from the conditional physician expenditure equation are that CDHP enrollees in Regions 2 and 3 spent more than POS enrollees in those regions ($p < .10$ and $p < .05$). The difference in Region 3 is approximately 20 percent ($e^{.673} - e^{.563} = .205$).

In the pharmacy probit equation (Table 8), we see, again, that CDHP enrollees in Region 1 were *less* likely than POS enrollees in that region to have any pharmacy expense. The difference reverses in Region 2 but reappears in Region 3. In the conditional pharmacy expenditure equation, CDHP enrollees in Region 1 spent *less* than POS enrollees, the difference being approximately 30 percent ($e^{-.359} - 1 = -.302$).

4. Discussion

The most strikingly finding from our empirical analysis is that CDHP enrollees in Region 1, whose predicted spending in the prior year was less than the employer’s annual contribution to

the HRA, spent less in following years than a comparison group with co-payments for medical care. In the probit equations, this difference was found in *all* service categories in our analysis: total expenditure, physician expenditure, and pharmacy expenditure. For those with positive spending, the difference was significant for total expenditure and pharmacy expenditure, but not physician expenditure.

These findings are striking because CDHP enrollees in Region 1 faced zero cost sharing – all medical expenses in that region could be covered from the employer’s annual contribution to the HRA. Nevertheless, these enrollees behaved *as if* spending from the HRA had a positive opportunity cost. This finding strongly supports our prediction that healthy, risk-averse CDHP enrollees may conserve resources to treat minor illness in the current time period because they want to avoid higher out-of-pocket spending if they become seriously ill later on.

Our finding implies that the employer’s contribution to an HRA has different incentives than the “flexible spending accounts” (FSAs) that predated consumer directed health plans. In a flexible spending account, the money is lost if it is not spent in the same year. An FSA imposes no opportunity cost on current spending. The message for employers is that their contribution to an HRA has a positive payoff in encouraging employees to use medical care conservatively.

However, once a CDHP enrollee is predicted to be in Region 2 or 3, she is likely to spend more money on medical care than a comparable POS enrollee. This result is similar to our previous work (Parente, Feldman, and Christianson, 2004; Feldman, Parente, and Christianson, 2007), in which we found a higher cost trend for CDHP enrollees from 2001 through 2003 compared with POS enrollees. It is surprising to find higher CDHP spending in Region 2, given that the CDHP enrollee faces 100 percent cost sharing in that region. A possible explanation is that the “gap” between the HRA and the deductible was only \$500 for single-coverage policies,

\$750 for 2-person policies, and \$1,000 family coverage (see Table 2). With Region 2 being so narrow it is possible that cost sharing in this region did not constrain employees' use of medical services. Once enrollees were in Region 3, they faced no cost sharing and tended to use more services than comparable POS enrollees. In contrast, the stop-loss limits in the POS plan of \$1,500 per person and \$3,000 per family would not be reached until total spending was much higher than in the CDHP.

This finding implies that the stop-loss limit in the CDHP in this study might be too low. Employers could address the problem by increasing the size of the "gap" or by imposing some cost sharing once the deductible is met. This could take the form of modest co-payments as in the POS plan.

This study examines the experience of only one employer. The effects of a CDHP may depend not only on the design of the CDHP, but also on the other plans that the employer offers. While we would ideally like to have additional comparison firms and plans to generalize our results, the non-CDHP health plans offered by this employer are relatively common in their design; therefore, we expect their experience to be similar to other plans in similar metropolitan markets. The advantage of focusing on one employer was the construction of a quasi-experimental design that would not have worked easily with other employers and would have amounted to an employer-by-employer study unless the health plan and employer data were sufficiently comparable. The major shortcoming is that we could not compare the CDHP with a deductible-only plan. Our theory suggests that the CDHP will not constrain medical care use and costs as strongly as a plan with an equal deductible but without an HRA.

Overall, our results indicate that analyses of costs and utilization in consumer directed health plans – questions that are likely to become more important if this new form of health

benefits becomes more popular – should be addressed by distinguishing *where* an enrollee is located on the budget constraint. Theoretical and empirical CDHP effects are not the same for all enrollees. These differences need to be recognized in future research.

References

Christianson JB, Parente ST, Taylor R. Defined contribution health insurance products: development and prospects. *Health Affairs* 2002; 21(1): 49-64.

Feldman R, Parente ST, Christianson JB. Consumer directed health plans: new evidence on spending and utilization. *Inquiry* 2007; forthcoming.

Jack W, Sheiner L. Welfare-improving health expenditure subsidies. *American Economic Review* 1997; 87(1): 206-221.

Keeler EB, Newhouse JP, Phelps CE. Deductibles and the demand for medical care services: the theory of a consumer facing a variable price schedule under uncertainty. *Econometrica* 1977; 45(3): 641-655.

Parente ST, Feldman R, Christianson JB. Evaluation of the effect of a consumer-driven health plan on medical care expenditures and utilization. *Health Services Research* 2004; 39(4): 1189-1209.

Starfield, B, Weiner J, Mumford L, Steinwachs, D. Ambulatory care groups: a categorization of diagnoses for research and management. *Health Services Research* 1991; 26(1): 53-74.

Varian, HR. *Microeconomic Analysis*, 2nd edition. New York, W.W. Norton & Company, 1984.

Weiner, JP, Starfield BH, Steinwachs DM, Mumford, LM. Development and application of a population-oriented measure of ambulatory case-mix. *Medical Care* 1991; 29(5): 452-472.