“Impact of full replacement with consumer driven health plans on health care cost and use of preventive services”

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Abstract

Enrollment in consumer driven health plans (CDHPs) continues to grow with nearly eight million United States enrollees in 2008. In this research study, we look at four large employers that replaced all of their traditional managed care plans with CDHPs. Our study represents 61,438 covered lives from the four employers. The study has two goals related to understanding the effect of full replacement: (1) What is the impact of full replacement of traditional managed care plans with CDHPs on health care costs? (2) What is the impact of full replacement on the utilization of preventive care services? The issue of selection bias will not arise as employees do not have the options of choosing other health plans. Our most important finding is that full replacement with CDHPs achieved a level of cost savings not seen in previous empirical studies where consumers had other plan choices. Second, full replacement with CDHPs led to a decrease in prevention. Employers considering full replacement might provide incentives for employees to use preventive services.

Precis:

Full replacement with CDHPs achieved a level of cost savings not seen in previous empirical studies where consumers had other plan choices. Full replacement with CDHPs led to a decrease in prevention.

Take away points:

This study is motivated by two questions:

- What is the impact of full replacement of traditional managed care plans with CDHPs on health care costs?
- What is the impact of full replacement on the utilization of preventive care services?

Using data representing 61,438 covered lives, we find:

- Full replacement with CDHPs achieved a level of cost savings not seen in previous empirical studies where consumers had other plan choices.
- Full replacement with CDHPs led to a decrease in prevention.

We suggest that employers considering full replacement might provide incentives for employees to use preventive services.

Keywords: health insurance, consumer demand and incentives, medical and pharmaceutical expenditure.

Introduction

Several large employers have replaced their traditional health insurance plans with consumer driven health plans (CDHPs)[1]. For example, UnitedHealth Group, as an employer, switched in 2005 from offering two managed care plans and a health reimbursement account (HRA) with almost no enrollees, to only one HRA and one health savings account (HSA) plan[2]. The impact of this change could be quite different than what we have observed previously (Parente, Feldman, and Christianson, 2004; Feldman, Parente and Christianson, 2007; Parente, Feldman, and Chen, 2008) when a CDHP was made available among other choices, such as preferred provider organization (PPO) and point-of-service (POS) plans.

In particular, prior research on CDHPs has had to overcome the problem of 'selection bias' – people who voluntarily join a CDHP being different in unobserved ways from those who stayed with traditional plans, with those differences potentially affecting the estimates of CDHP effects on utilization and costs. Selection bias can over- or under-state the true CDHP effects on cost and use, depending on whether healthy or unhealthy employees choose the CDHP plans (Parente, Feldman, and Christianson, 2008). In this study, we look at four large employers that replaced all of their traditional health plan options with CDHPs. The issue of selection bias will not arise in these 'full replacement' settings. This research study has two goals related to understanding the effect of full replacement on health care cost and utilization:

[1] It is important to note the difference between consumer driven health plans (CDHPs) and high deductible health plans (HDHPs). An HDHP would be considered a CDHP if it also features an account for first dollar coverage such as a health reimbursement arrangement (HRA) or a health savings account (HSA).

[2] The difference between an HRA and an HSA is that the consumer owns the HSA account as an actual financial asset dedicated for medical care expenditure. In contrast, an HRA is a notional account that represents funds made available by an employer to an employee for medical care. Typically, an employee cannot leave an employer with any accumulated or remaining balance in the HRA. Both HRAs and HSAs allow consumers to accumulate unused account balances for use in subsequent years of CDHP enrollment.

1. What is the impact of full replacement of traditional managed care (PPO or POS) plans with consumer driven health plans (CDHPs) on total health care cost as well as medical and pharmacy expenditures?
2. What is the impact of full replacement on the utilization of preventive care?

We address these research questions using administrative claims and benefit eligibility data for two years of health plan enrollment per member. For each member we have one year of pre-CDHP enrollment and an additional year of CDHP enrollment. As a result, we are able to examine only the short-run effects of replacing traditional managed care plans with CDHPs.

1. Previous research

Evidence has revealed that higher cost-sharing will reduce medical care consumption (Newhouse et al., 1993). Because CDHPs introduce cost-sharing in the form of high deductibles, the implementation of CDHPs may reduce health care use and costs. In fact, CDHP enrollees have lower expenditures than some traditional insurance plans, but higher expenditures than health maintenance organization (HMO) enrollees (Parente, Feldman, and Christianson, 2004; Lo Sasso et al., 2004). Additional comparisons have shown that CDHP enrollees make fewer physician visits than those in a POS plan (Feldman, Parente, and Christianson, 2007). Another study assessing the effect of offering CDHP options found that employees of Humana, Inc. who chose CDHPs were less likely to have recent medical visits compared with reference PPO and HMO enrollees (Fowles et al., 2004).

However, none of these studies has investigated the impact of full replacement on health care use or cost. The Humana study cited above also found that CDHP enrollees were healthier, and therefore the reduction in physicians' visits for CDHP enrollees may have been due to better health rather than the plan's financial incentives.

One of concerns about the impact of CDHPs is that a reduction in physician visits may result in less use of preventive care. The assumption behind this concern is that the CDHP benefit design provides a disincentive to use regular medical services that are complements to preventive care. Thus, a complementary test for the impact of full replacement by CDHPs on cost and use is whether preventive services are also affected.

A small but rapidly-growing literature has examined the effect of benefit design on the use of preventive services. Busch et al. (2006) compared the use of preventive services among employees in a traditional health plan who experienced a change in plan design – lower cost-sharing for preventive services and higher cost-sharing for other services – with that of a control group from the same company whose benefits did not change. Health care costs for the affected employees fell five percent while those for the control group rose four percent. There were no changes in rates of preventive care use. The authors concluded (p. 1529), "The evidence suggests that differential cost sharing can be used to preserve the use of critical health care services."

Rowe et al. (2008) compared use of preventive, cancer screening, and diabetic monitoring services among continuous enrollees in a CDHP for three years and a matched group of PPO enrollees who had free preventive and screening services. According to the authors (pp. 119-120), "…initially and over time, people enrolled in CDHPs such as those we studied do not underuse preventive services to any greater degree than do those in traditional PPOs."

Pollack, Polsky, and Mallya (2008) used vignettes to elicit physicians' recommendations for colorectal cancer screening. They found that patients with low socio-economic status (SES) received inappropriate recommendations more often than those with high SES, but there were no differences in inappropriate recommendations for patients of either SES group in low and high-deductible plans. If physicians were told that the low SES/high-deductible patients had $700 in their health savings account, these patients no longer received a higher rate of inappropriate recommendations compared with other patients.

Finally, in a full replacement study that is closest to our work, Wharam et al. (2008) found little change in cancer screening among enrollees at Harvard Pilgrim Health Plan whose employers switched to a high-deductible plan, compared with an HMO control group. Members of a high-deductible health plan did not seem to change their use of breast, cervical, and colorectal cancer screening when these tests were fully covered.

2. Conceptual model

Health benefit design affects the demand for medical care, including preventive services. Increased patient cost-sharing acts as a price increase to reduce medical care demand. Therefore, patients in high-deductible health plans should use fewer services and spend less on medical care than those in plans with low cost-sharing (Newhouse et al., 1993). To mitigate this effect, CDHP designs often exempt preventive care partially or totally from the cost-sharing requirements imposed on other services. A partial exemption might specify a dollar limit for covered

spending on preventive care; a full exemption would waive this limit on all preventive services covered by the policy.

Despite this exemption, patients in CDHPs might use fewer covered preventive services if there are strong linkages or 'complementarities' between acute and preventive medical care services. For example, patients seen in non-preventive physician visits may be advised to use preventive services, and the reduced frequency of the former could lead to reduced use of the latter. Evidence supports the association between the number of non-preventive physician visits and the probability of using preventive care. For example, the number of non-preventive physician visits has been found to be associated with the likelihood of influenza vaccination among diabetic adults (Egede, 2003). Such studies suggest that CDHP enrollees might use fewer preventive services than those in comparison PPO/POS plans, despite the CDHP exemption of preventive services from cost-sharing.

3. Data

Data for our study came from four large employers. We had access to medical and pharmacy claims and enrollment data for two years: one year pre- and one year post-full replacement of their PPO/POS plans with CDHPs. Firm #1 adopted an HSA and HRA in 2005. In 2004, it had PPO and POS plans and an HRA with almost no enrollees. Its annual total cost increase per enrollee from 2004 to 2005 was six percent. Firm #2 adopted an HRA in 2004 and had no prior CDHP experience. Firms #3 and #4 adopted CDHP plans in 2006 and had no prior experience with CDHPs. Firm #3 chose only an HSA while Firm #4 adopted an HRA and HSA. Thus, Firms #2 and #3 provide insights into 'pure' HRA and HSA replacement, respectively. Firms #1 and #4 illustrate the impact of mixed HRA and HSA replacement.

We selected employees who were enrolled in the employers' health benefits programs for two continuous years. This provided us with a cohort to identify the short-run effects of full replacement with CDHP plans. Firms #1 and #3 had the highest cohort retention rates with 60.8% and 61.6%, respectively, of the first-year population also being in the second year. The retention rate for Firm #2 was 52.9%, and Firm #4 had the lowest retention rate of all the employers, at 47.2%. The selection of a cohort reduced our total sample to a population-weighted 57% of those enrolled in the pre-full replacement year. These cohorts include not only the employees but also their spouses and dependents. As a result, even if a firm has relatively low employee turnover, changes in coverage among spouses and dependents can substantially reduce the size of a continuous cohort. We had a total of 61,438 covered lives for our study.

The demographics of our study sample are described in Table 1. Firm #1 has the youngest population (29.6 years of age), while Firm #3 has the oldest population (34.1 years of age). However, the gap between the youngest and oldest firm-specific mean ages is just under five years. Firm #1 has the greatest share of female enrollees of the four firms. In addition to having the oldest enrollees, Firm #3 is also associated at baseline with the most chronic illnesses and the presence of serious health events that could be catastrophic[1]. Firm #2 has the greatest share of subscribers (70.7%) and Firm #3 has the greatest share of dependents (37.3%).

Table 1. Study sample demographics

Variable	Firm 1	Firm 2	Firm 3	Firm 4
Age (years)	29,626	30,810	34,118	33,928
Female = 1, else 0	0,567	0,461	0,527	0,439
Baseline illness count	2,846	2,111	3,406	2,472
Catastrophic shock = 1, else 0	0,216	0,181	0,268	0,234
Enrollee is subscriber = 1, else 0	0,451	0,707	0,375	0,445
Enrollee is spouse = 1, else 0	0,195	0,101	0,252	0,258
Enrollee is dependent = 1, else 0	0,353	0,193	0,373	0,295
Observations (total = 61,438)	40 976	16 534	2 464	1 464

4. Econometric approach

We used a two-part model to estimate the effect of CDHP full replacement on expenditures and the probability of preventive care use for a set of specific measures: any preventive care visit; colonoscopy screening for members aged 40 to 64; mammography screening for women aged 40 to 64; and cervical cancer screening for women aged 24 to 64.

Because all the employers in our study were CDHP 'adopters', we did not have a control group of non-CDHP firms. Instead, we used each firm as its own control and compared pre- versus post-full replacement medical care spending and use of preventive services. As noted above, one company implemented CDHPs in 2004, one in 2005, and two others did this in 2006. We needed to control for this difference, so we estimated:

$$Y_t = a_0 + a_1 POSTYEAR + a_2 EMPLOYER + a_3 POSTYEAR * EMPLOYER + a_4 DEMOGRAPHICS + a_5 2005 BASEYEAR, \quad (1)$$

where Y_t is the dependent variable in year t, *POSTYEAR* indicates the data come from the year

[1] Overall illness burden is based on a count of Ambulatory Diagnostic Groups (ADGs) in the base year of observation and derived from an algorithm described by Weiner et al. (1991). Catastrophic shock is a concurrent year variable based on the presence of an ADG where the patient had a major acute care event, cancer diagnosis, injury or trauma.

after CDHP adoption, EMPLOYER is a set of fixed effects that control for unmeasured differences in benefit generosity and employee health status across the employers, DEMOGRAPHICS is a set of employee demographic characteristics, and 2005 BASEYEAR indicates that the firm still had traditional health plans in 2005 (i.e. it implemented full replacement with CDHPs in 2006). After controlling for employee demographics and the employer fixed effects, the base-year value of the dependent variable for those firms would be $a_0 + a_5$. The effect of full replacement and medical cost inflation is captured by a_1. Hence, we cannot identify the effect of full replacement separately from that of medical cost inflation. However, assuming that all firms were subject to the same cost trend (roughly 6-8 percent inflation per year), we can infer the CDHP effect as the difference. Finally, the estimated coefficient a_3 allows the CDHP-and-inflation effect to differ across employers.

5. Results

We present three levels of results. First, we present bivariate results of CDHP full replacement for expenditures and prevention. Second, we provide a summary of our multivariate regression results. Third, we interpret specific regression results for each of the key dependent measures examined.

Table 2. Descriptive statistics of expenditures

Variable	Firm 1		Firm 2		Firm 3		Firm 4	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Total expenditures	$2 906	$2 909	$2 097	$1 883	$3 209	$3 686*	$2 520	$2 335
Total medical expenditures	$2 341	$2 299	$1 789	$1 584	$2 170	$2 628*	$1 970	$1 820
Consumer medical expenditures	$ 334	$ 557***	$ 544	$ 455***	$ 105	$ 378***	$ 339	$ 546***
Total pharmacy expenditures	$ 565	$ 611***	$ 308	$ 300	$1 039	$1 057	$ 550	$ 514
Consumer pharmacy expenditures	$ 178	$ 186***	$ 156	$ 122***	$ 55	$ 282***	$ 185	$ 237***

Note: Statistical significance: *** p<=.001, ** p<=.01, * p<=.05.

In Table 2, five measures of expenditures are compared across the four firms in their pre- and post-years described hereafter as Year 1 and Year 2. With respect to total expenditures, only Firm #3 had a significant (p<=.05) increase in average expenditure per enrollee from $3,209 to $3,686. There was little statistically significant difference in total medical expenditures, though most went down. Consumer medical expenditures increased significantly for all firms except Firm #2, which had a decrease. Firm #2 also was the only firm to have full replacement with an HRA. Firm #3 had the greatest increase in consumer medical expenditures, and it is also the only employer with full HSA replacement. With respect to pharmacy costs, Firm #1 had a statistically significant increase, while Firms #2 and #4 had small decreases. Consumer pharmacy expenditures increased for all firms except Firm #2, where they decreased.

Table 3 presents descriptive statistics for the four measures of prevention. Only Firm #2 had a statistically significant decrease in preventive visits, including physical exams and well child visits. With respect to cervical cancer screening, all but Firm #4 had statistically significant decreases. Firm #4 had a slight, non-significant increase from 39% to 40%. Mammography use decreased significantly for Firms #1 and #3. Colonoscopy screening decreased significantly in Firms #1 and #4. In the case of Firm #4, there was a 38.8% reduction in colonoscopy screening from 18% to 11%. It is important to note that only preventive visits are recommended for every enrollee every year.

Table 3. Descriptive statistics of prevention services

Variable	Firm 1		Firm 2		Firm 3		Firm 4	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
Preventive care binary variables (1 = had service, 0 = did not have service)								
Preventive visit in year = 1, else 0	26%	26%	15%	13%***	34%	33%	14%	14%
Cervical cancer screening in year = 1, else 0	51%	46%***	45%	41%***	70%	64%**	39%	40%
Mammography visit in year = 1, else 0	56%	52%***	38%	35%	70%	65%*	52%	46%
Colonoscopy visit in year = 1, else 0	20%	19%*	17%	15%	23%	22%	18%	11%**

Note: Statistical significance: *** p<=.001, ** p<=.01, * p<=.05.

The remaining tables provide results from the econometric models described previously. Specifically, these results show the marginal effects associated with firms and personal attributes affecting both expenditure and the use of preventive services.

Table 4 provides a summary of the firm-specific percentage changes from Year 1 to Year 2 in variables of interest. For total expenditures, no firm had an increase greater than 3.57% (Firm #3). Most of the additional cost associated with Firm #3 was the result of an increase in medical expenditures, borne mainly by consumers. The same firm also had a substantial increase in out-of-pocket expenditures for pharmacy services, but overall expenditures on pharmaceuticals were down by 19.93%, the largest reduction among all firms for this variable. Firm #2 had the largest decrease in total expenditures of 4.11%. This was due mainly to a decrease in total medical costs. The two firms with both HRAs and HSAs (Firm #1 and Firm #4) offered in Year 2 had a smaller overall impact.

Across all firms, it appears that full replacement is associated with a decrease in the use of preventive services. The largest decrease in preventive visits was associated with Firm #2; however, Firm #2 also had the least decrease in cervical cancer screening. The probability of mammography screening decreased for all firms except Firm #4, where it increased by 3.10%; however, Firm #4 was associated with the largest decrease (6.69%) in the probability of colonoscopy screening.

Table 4. Summary of CDHP impact – by firm – for expenditures and prevention

Total replacement employer	Total expenditures	Total medical expenditures	Consumer medical expenditures	Total pharmacy expenditures	Consumer pharmacy expenditures
Firm 1	1,28%	-1,32%	99,24%	9,79%	5,40%
Firm 2	-4,11%	-4,35%	-7,22%	3,99%	-6,62%
Firm 3	3,57%	8,20%	141,45%	-19,93%	114,91%
Firm 4	-0,94%	0,93%	80,51%	-1,42%	15,72%
Total replacement employer	Preventive visit probability	Colonoscopy probability	Cervical cancer screening probability probability	Mammography screening probability	
Firm 1	-0,24%	-0,99%	-3,28%	-5,39%	
Firm 2	-2,78%	-1,48%	-2,94%	-3,98%	
Firm 3	-0,95%	-2,20%	-11,93%	-2,29%	
Firm 4	-0,66%	-6,69%	-8,78%	3,10%	

Table 4 is the product of nine separate regressions[1]. The individual regression results are presented in Tables A1 through A9 in the Appendix. There are three notable findings from the detailed regression models. First, the demographic variables are quite significant, particularly the age and health status variables (chronic illness and presence of a major acute event).

The second finding is that most of the significant firm-specific effects of full replacement are associated with out-of-pocket expenditures. The only significant firm-specific effect for preventive services was the negative impact in Firm #2 on the probability of any preventive visit. However, the Year 2 effect was negative for all preventive services except any preventive visit, indicating a decline in prevention among all firms in the sample.

Third, the spouse and dependent variables can be important attributes associated with higher (spouse) and lower (dependent) total and medical expenditures, compared with the subscriber. However, these relations tended to reverse for pharmacy expenditures – possibly a reflection of higher prescription drug use among children. The spouse and dependent variables had negative impacts on the probability of any preventive visit.

6. Discussion

Our study has several significant findings. Most important, full replacement with CDHPs achieved a level of cost savings not seen in previous empirical studies where consumers had other plan choices. Given that Firm #1 had a 6% increase in total expenditures in 2004 to 2005, the full replacement effect of a 1.28% increase is a substantial change. However, the cost savings across the firms were not uniform. Increases in expenditures were found in two of the four firms, although some of this increase may have been the result of general trends in employers' health benefit costs (Mercer, 2008).

Second, total replacement with CDHPs led to a decrease in prevention. Every one of the preventive measures had at least one firm with a statistically significant decrease and three measures showed decreases for all firms. The irony is that prevention was covered at 100% reimbursement with no cost-sharing in all of the firms. Therefore, it appears that the overall reduction in medical care use had implications for decreased preventive care, despite this 100% coverage. Further investigation of the mechanisms behind this relationship is warranted. For example, patients seen in non-preventive

[1] Each of the results represents coefficients from Tables A1 to A9. In all cases the statistics represent the sum of the second-year effect and the firm of interest interacted with the second-year effect.

physician visits may be advised to use preventive services, and reduced frequency of the former could lead to reduced use of the latter. It may also be the case that patients misunderstood the preventive benefit in these full-replacement firms. Additional data for a longer time period, during which consumer learning might take place, would be needed to confirm this possibility.

In the interpretation of our data, we assume that a decrease or neutral response in total expenditures from the first to second year is good because the underlying medical care inflation trend is about 6-8%. However, when we interpret our findings for prevention we do not have comparison trend data. As a result, it is difficult to conclude whether full replacement had a negative impact on preventive services without counterfactual data for a similar employed population.

7. Caveats

Our study is subject to several caveats. First, unlike our previous work (Parente, Feldman, and Christianson, 2004) where we had access to employers' human resources information, we cannot control for the impact of employee income on cost and use of services. Second, there is unexplained market-level variation among the employers in our study. We have considered using state fixed-effects to control for this variation. The results presented here must be interpreted as early indicators of the effect of CDHPs on prevention.

Finally, we do not have information needed to study the longer-run implications of full replacement. Early anecdotal evidence from Whole Foods (2007) and other firms suggest large first-year savings followed by second-year increases in costs. What we do know from Firm #1, the largest firm in this study, is that year-over-year cost increases have not gone above their pre-adoption year of rate of 6% and that the company continues with its full replacement decision. At this time, the other firms we have analyzed have not switched their benefits back to include PPO or POS plans as well.

8. Policy implications

This analysis finds new evidence of significant reductions in expenditures resulting from full replacement of PPO/POS plans with only CDHP plans. The firm with the biggest reduction in cost was the full replacement HRA-only design (Firm #2). This is counter to other findings, but in those instances, the experiment assessed was not full replacement. Interestingly, the firm with the greatest increase in cost was the HSA-only design (Firm #3). Part of the story with Firm #3 could be due to the fact that it is the oldest and sickest firm of the four in our study. Firms #1 and #4 offer the best insights into the effects of a mixed CDHP offer. Firm #1 has the greatest statistical power due to its size.

Although we do not find consistent cost savings from these firms, there is a slower rate of health care cost growth than that reported nationally among employers. As reported in a Kaiser Family Foundation survey, premiums for a family contract offered by employers increased by 9.3% from 2004 to 2005 and 5.5% from 2005 to 2006 (Kaiser Family Foundation, 2008). Assuming that increasing premiums among employers reflect increasing health care costs, the national trends for increases in health care expenditure are in excess of the experience of our study's full-replacement firms.

We find that full replacement led to a reduction in the use of preventive services. Firm #2, with the largest decrease in total expenditures, also experienced across-the-board decreases in preventive services. The other firms experienced decreases in three of the four preventive services.

The finding that employees appear to seek less preventive care could have a potential impact on future health care costs. Employees and their family members who delay care or avoid early detection of serious conditions through screening for colon or breast cancer could experience higher long-term health care costs due to later detection when a disease is more advanced. To the extent that availability of insurer-covered preventive care services can deter these long-term costs, the recent enactment of the 2010 health reform legislation, where all health plans must offer preventive care services, should mitigate potential long-term costs implied from our results. Future studies following the health reforms will be able to provide a much cleaner test of whether the prospect of a high deductible to be paid following early diagnosis of preventive care may have a unique behavioral response that deters preventive care seeking.

As employers and policy makers consider the value of CDHPs, these results provide early evidence that plan design can reduce the growth in health care inflation. With respect to prevention, there are concerns that warrant further attention. In particular, multiple years of full replacement data are required to test fully the impact on preventive services that are not required annually. For example, of our preventive care measures, only preventives visits are generally recommended annually. Investigation of consumer learning about the preventive benefit in CDHP plans over the longer run is also warranted. If neither investigation showed differences from our

short-run findings, employers would be advised to consider changes in the design of their preventive benefits. These could include positive incentives to use preventive services, for example, larger employer contributions to the HRA or HSA account for preventive care users.

Our evidence suggests that the full replacement development is worthy of future investigation and that employers contemplating austerity in light of the current financial crisis will find CDHPs a reasonable cost-control alternative to not offering any employer-sponsored insurance.

References

1. Busch, Susan H., Colleen L. Barry, Sally J. Vegso, Jody L. Sindelar, and Mark R. Cullen (November/December, 2006), "Effects of a Cost-Sharing Exemption on Use of Preventive Services at One Large Employer", *Health Affairs*, 25:6, pp. 1529-1536.
2. Egede, L.E., (2003) "Association between Number of Physician Visits and Influenza Vaccination among Diabetic Adults with Access to Care", *Diabetes Care*, 26:9, pp. 2562-2567.
3. Feldman, Roger, Stephen T. Parente, and Jon B. Christianson (Spring, 2007), "Consumer Directed Health Plans: New Evidence on Spending and Utilization", Inquiry, 44:1, pp. 26-40.
4. Fowles, Jinnet Briggs., Elizabeth A. Kind, Barbara L. Braun, and John Bertko (August, 2004), "Early Experience with Employee Choice of Consumer-Directed Health Plans and Satisfaction with Enrollment" *Health Services Research*, 39:4, Part II, pp. 1141-1158.
5. Kaiser Family Foundation. Employer Health Benefits, Henry J. Kaiser Foundation, Menlo Park, CA, 2008, p. 30.
6. Lo Sasso, Anthony T., Tomas Rice, Jon R. Gabel, and Heidi Whitmore (August, 2004), "Tales from the New Frontier: Pioneers' Experiences with Consumer-Driven Health Care", *Health Services Research*, 39:4, Part II, pp. 1071-1089.
7. Mercer. National Survey of Employer-Sponsored Health Plans, 2008. Available for viewing at http://www.mercer.com/usplansurvey
8. Newhouse, Joseph P. and the Health Insurance Group, Free For All? Lessons from the RAND Health Insurance Experiment, Cambridge, MA: Harvard University Press, 1993.
9. Parente, Stephen T., Feldman, Roger, and Jon B. Christianson (August, 2004), "Evaluation of the Effect of a Consumer-Driven Health Plan on Medical Care Expenditures and Utilization", *Health Services Research*, 39:4, Part II, pp. 1189-1209.
10. Parente, Stephen T., Roger Feldman, and Song Chen (October, 2008), "The Effects of a Consumer Driven Health Plan on Pharmaceutical Spending and Utilization: Do Three-Tier Plans Have a Competitor?" *Health Services Research*, 43:5, pp. 1542-1556.
11. Parente, Stephen T., Roger Feldman, and Jon B. Christianson, "The Impact of Health Status and Price on Plan Selection in a Multiple-Choice Health Benefit Program Including HRA and HSA Options", University of Minnesota, unpublished paper, May, 2008.
12. Pollack, Craig Evan, Giridhar Mallya, and Daniel Polsky (2008), "The Impact of Consumer-Directed Health Plans and Patient Socio-economic Status on Physician Recommendations for Colorectal Cancer Screening", *Journal of General Internal Medicine*, 23:10, pp. 1595-1601.
13. Rowe, John W., Tina Brown-Stevenson, Roberta L. Downey, and Joseph P. Newhouse (January/February, 2008), "The Effect of Consumer-Directed Health Plans on the Use of Preventive and Chronic Illness Services", *Health Affairs*, 27:1, pp. 113-120.
14. Weiner, Jonathan P., Barbara H. Starfield, Donald M. Steinwachs, and Laura M. Mumford (May, 1991), "Development and Application of a Population-Oriented Measure of Ambulatory Care Case-Mix", Medical Care, 29:5, pp. 452-472.
15. Wharam, J. Frank, Galbraith, Alison A., Kleinman, Ken P., Soumerai, Stephen B., Ross-Degnan Dennis, and Bruce E. Landon (2008), "Cancer Screening before and after Switching to a High-Deductible Health Plan," Annals of Internal Medicine, 6:148, pp. 647-655.
16. Whole Foods, "Whole Foods Market Reports First Quarter Results," February 21, 2007, available for viewing at http://www.wholefoodsmarket.com.

Appendix. Detailed regression results

Table A1. CDHP replacement effect: total expenditures

Total expenditures			
	Coefficients	T-stat	Pr > |t|
Intercept	5,2453	273,76	<.0001
Age (years)	0,0160	38,89	<.0001
Female = 1, else 0	0,1351	16,66	<.0001
Baseline illness count	0,3117	175,66	<.0001
Catastrophic shock = 1, else 0	0,5976	62,68	<.0001
Year 2 = 1, else year 1	0,0128	1,39	0,1657
Later sample = 1, else 0	-0,0398	-0,54	0,5874

Table A1 (cont.). CDHP replacement effect: total expenditures

Total expenditures			
	Coefficients	T-stat	Pr > |t|
Firm 2 = 1, else 0	-0,2587	-19,61	<.0001
Firm 3 = 1, else 0	0,0753	0,97	0,3343
Firm 4 = 1, else 0	-0,0674	-1,18	0,2369
Firm 2 & Year 2 interaction	-0,0539	-2,91	0,0036
Firm 3 & Year 2 interaction	0,0229	0,28	0,7815
Firm 4 & Year 2 interaction	-0,0222	-0,33	0,7434
Enrollee is spouse = 1, else 0	0,0617	5,66	<.0001
Enrollee is dependent = 1, else 0	-0,1523	-10,03	<.0001
Second year impact			
Firm 1	1,28%		
Firm 2	-4,11%		
Firm 3	3,57%		
Firm 4	-0,94%		
Adjusted R-squared	0,384		

Table A2. CDHP replacement effect: total medical expenditures

Total medical expenditures			
	Coefficients	T-stat	Pr > |t|
Intercept	5,2399	272,06	<.0001
Age (years)	0,0081	19,68	<.0001
Female = 1, else 0	0,1416	17,44	<.0001
Baseline illness count	0,2831	158,90	<.0001
Catastrophic shock = 1, else 0	0,7077	75,65	<.0001
Year 2 = 1, else Year 1	-0,0132	-1,43	0,1516
Later sample = 1, else 0	-0,0075	-0,10	0,9189
Firm 2 = 1, else 0	-0,0987	-7,43	<.0001
Firm 3 = 1, else 0	-0,1128	-1,44	0,1505
Firm 4 = 1, else 0	-0,0199	-0,35	0,7281
Firm 2 & Year 2 interaction	-0,0303	-1,62	0,106
Firm 3 & Year 2 interaction	0,0952	1,15	0,2502
Firm 4 & Year 2 interaction	0,0225	0,33	0,7415
Enrollee is spouse = 1, else 0	0,0642	5,88	<.0001
Enrollee is dependent = 1, else 0	-0,2523	-16,53	<.0001
Second year impact			
Firm 1	-1,32%		
Firm 2	-4,35%		
Firm 3	8,20%		
Firm 4	0,93%		
Adjusted R-squared	0,348		

Table A3. CDHP replacement effect: consumer out-of-pocket medical expenditures

Consumer out of pocket medical expenditures			
	Coefficients	T-stat	Pr > |t|
Intercept	4,0551	228,93	<.0001
Age (years)	0,0047	12,47	<.0001
Female = 1, else 0	0,0571	7,60	<.0001
Baseline illness count	0,2244	137,19	<.0001
Catastrophic shock = 1, else 0	0,5548	65,61	<.0001
Year 2 = 1, else Year 1	0,9924	116,05	<.0001
Later sample = 1, else 0	0,0013	0,02	0,9842
Firm 2 = 1, else 0	1,0133	83,79	<.0001
Firm 3 = 1, else 0	-1,0161	-14,41	<.0001
Firm 4 = 1, else 0	0,2383	4,62	<.0001
Firm 2 & Year 2 interaction	-1,0646	-62,58	<.0001

Table A3 (cont.). CDHP replacement effect: consumer out-of-pocket medical expenditures

Consumer out of pocket medical expenditures			
	Coefficients	T-stat	Pr > |t|
Firm 3 & Year 2 interaction	0,4221	5,61	<.0001
Firm 4 & Year 2 interaction	-0,1873	-3,04	0,0024
Enrollee is spouse = 1, else 0	0,0215	2,15	0,0319
Enrollee is dependent = 1, else 0	-0,2886	-20,59	<.0001
Second year impact			
Firm 1	99,24%		
Firm 2	-7,22%		
Firm 3	141,45%		
Firm 4	80,51%		
Adjusted R-squared	0,377		

Table A4. CDHP replacement effect: total pharmacy expenditures

Total pharmacy expenditures			
	Coefficients	T-stat	Pr > |t|
Intercept	3,3627	131,73	<.0001
Age (years)	0,0376	70,17	<.0001
Female = 1, else 0	0,0459	4,18	<.0001
Baseline illness count	0,2296	99,41	<.0001
Catastrophic shock = 1, else 0	-0,0966	-7,69	<.0001
Year 2 = 1, else Year 1	0,0979	7,97	<.0001
Later sample = 1, else 0	-0,1814	-1,84	0,0658
Firm 2 = 1, else 0	-0,4840	-26,94	<.0001
Firm 3 = 1, else 0	0,5472	5,24	<.0001
Firm 4 = 1, else 0	-0,1162	-1,52	0,1291
Firm 2 & Year 2 interaction	-0,0580	-2,29	0,022
Firm 3 & Year 2 interaction	-0,2972	-2,70	0,0069
Firm 4 & Year 2 interaction	-0,1121	-1,23	0,2174
Enrollee is spouse = 1, else 0	-0,0091	-0,63	0,5257
Enrollee is dependent = 1, else 0	0,2454	12,10	<.0001
Second year impact			
Firm 1	9,79%		
Firm 2	3,99%		
Firm 3	-19,93%		
Firm 4	-1,42%		
Adjusted R-squared	0,256		

Table A5. CDHP replacement effect: consumer out-of-pocket pharmacy expenditures

Consumer out of pocket pharmacy expenditures			
	Coefficients	T-stat	Pr > |t|
Intercept	3,0338	144,17	<.0001
Age (years)	0,0300	67,92	<.0001
Female = 1, else 0	0,0987	10,90	<.0001
Baseline illness count	0,1895	99,43	<.0001
Catastrophic shock = 1, else 0	-0,0873	-8,42	<.0001
Year 2 = 1, else Year 1	0,0540	5,33	<.0001
Later sample = 1, else 0	-0,1125	-1,39	0,1654
Firm 2 = 1, else 0	0,0325	2,20	0,0281
Firm 3 = 1, else 0	-0,8478	-9,85	<.0001
Firm 4 = 1, else 0	0,0846	1,34	0,1795
Firm 2 & Year 2 interaction	-0,1202	-5,76	<.0001
Firm 3 & Year 2 interaction	1,0951	12,01	<.0001
Firm 4 & Year 2 interaction	0,1033	1,37	0,1692
Enrollee is spouse = 1, else 0	-0,0359	-3,05	0,0023
Enrollee is dependent = 1, else 0	0,0981	5,87	<.0001

Table A5 (cont.). CDHP replacement effect: consumer out-of-pocket pharmacy expenditures

Consumer out of pocket pharmacy expenditures			
	Coefficients	T-stat	Pr > |t|
Second year impact			
Firm 1	5,40%		
Firm 2	-6,62%		
Firm 3	114,91%		
Firm 4	15,72%		
Adjusted R-squared	0,253		

Table A6. CDHP replacement effect: probability of preventive visit

Any preventive visits			
	Coefficients	T-stat	Pr > |t|
Intercept	0,1082	21,08	<.0001
Age (years)	0,0016	14,05	<.0001
Female = 1, else 0	0,1911	86,77	<.0001
Baseline illness count	0,0311	63,79	<.0001
Catastrophic shock = 1, else 0	-0,0376	-13,31	<.0001
Year 2 = 1, else Year 1	-0,0024	-0,91	0,3612
Later sample = 1, else 0	-0,0031	-0,16	0,876
Firm 2 = 1, else 0	-0,1030	-29,45	<.0001
Firm 3 = 1, else 0	0,0720	3,41	0,0006
Firm 4 = 1, else 0	-0,0928	-6,12	<.0001
Firm 2 & Year 2 interaction	-0,0254	-5,28	<.0001
Firm 3 & Year 2 interaction	-0,0071	-0,32	0,7512
Firm 4 & Year 2 interaction	-0,0042	-0,24	0,8141
Enrollee is spouse = 1, else 0	-0,0311	-10,31	<.0001
Enrollee is dependent = 1, else 0	-0,2226	-54,76	<.0001
Second year impact			
Firm 1	-0,24%		
Firm 2	-2,78%		
Firm 3	-0,95%		
Firm 4	-0,66%		
Adjusted R-squared	0,220		

Table A7. CDHP replacement effect: probability of colonoscopy screening

Any colonoscopy screening			
	Coefficients	T-stat	Pr > |t|
Intercept	-0,2750	-15,96	<.0001
Age (years)	0,0080	23,18	<.0001
Female = 1, else 0	0,0266	5,80	<.0001
Baseline illness count	0,0203	23,36	<.0001
Catastrophic shock = 1, else 0	-0,0167	-3,33	0,0009
Year 2 = 1, else Year 1	-0,0099	-1,98	0,0482
Later sample = 1, else 0	-0,0091	-0,27	0,7893
Firm 2 = 1, else 0	-0,0235	-3,11	0,0019
Firm 3 = 1, else 0	0,0093	0,26	0,7971
Firm 4 = 1, else 0	-0,0214	-0,82	0,4144
Firm 2 & Year 2 interaction	-0,0049	-0,45	0,6497
Firm 3 & Year 2 interaction	-0,0122	-0,32	0,7501
Firm 4 & Year 2 interaction	-0,0570	-1,82	0,0684
Enrollee is spouse = 1, else 0	-0,0026	-0,53	0,5989
Enrollee is dependent = 1, else 0	-0,0376	-1,69	0,0911
Second year impact			
Firm 1	-0,99%		
Firm 2	-1,48%		

Table A7 (cont.). CDHP replacement effect: probability of colonoscopy screening

Any colonoscopy screening			
	Coefficients	T-stat	Pr > |t|
Second year impact			
Firm 3	-2,20%		
Firm 4	-6,69%		
Adjusted R-squared	0,043		

Table A8. CDHP replacement effect: probability of cervical cancer screening

Any Cervical cancer screening			
	Coefficients	T-stat	Pr > |t|
Intercept	0,6648	55,47	<.0001
Age (years)	-0,0060	-22,06	<.0001
Baseline illness count	0,0266	25,62	<.0001
Catastrophic shock = 1, else 0	-0,0593	-9,54	<.0001
Year 2 = 1, else Year 1	-0,0539	-9,22	<.0001
Later sample = 1, else 0	0,0380	0,71	0,48
Firm 2 = 1, else 0	-0,0637	-7,26	<.0001
Firm 3 = 1, else 0	0,1686	2,97	0,003
Firm 4 = 1, else 0	-0,1169	-2,85	0,0044
Firm 2 & Year 2 interaction	0,0142	1,13	0,2573
Firm 3 & Year 2 interaction	0,0310	0,52	0,6014
Firm 4 & Year 2 interaction	0,0849	1,74	0,0819
Enrollee is spouse = 1, else 0	0,0089	1,39	0,1652
Enrollee is dependent = 1, else 0	-0,0650	-2,01	0,0449
Intercept	0,6648	55,47	<.0001
Second year impact			
Firm 1	-5,39%		
Firm 2	-3,98%		
Firm 3	-2,29%		
Firm 4	3,10%		
Adjusted R-squared	0,037		

Table A9. CDHP replacement effect: probability of mammography screening

Any mammography screening			
	Coefficients	T-stat	Pr > |t|
Intercept	0,2531	8,81	<.0001
Age (years)	0,0041	7,01	<.0001
Baseline illness count	0,0275	19,93	<.0001
Catastrophic shock = 1, else 0	-0,0355	-4,21	<.0001
Year 2 = 1, else Year 1	-0,0328	-4,03	<.0001
Later sample = 1, else 0	-0,0635	-1,01	0,3146
Firm 2 = 1, else 0	-0,1693	-13,01	<.0001
Firm 3 = 1, else 0	0,1773	2,67	0,0077
Firm 4 = 1, else 0	-0,0144	-0,30	0,7631
Firm 2 & Year 2 interaction	0,0034	0,18	0,8539
Firm 3 & Year 2 interaction	-0,0865	-1,24	0,2139
Firm 4 & Year 2 interaction	-0,0550	-0,97	0,3323
Enrollee is spouse = 1, else 0	0,0113	1,23	0,22
Enrollee is dependent = 1, else 0	-0,0848	-1,68	0,0929
Intercept	0,2531	8,81	<.0001
Second year impact			
Firm 1	-3,28%		
Firm 2	-2,94%		
Firm 3	-11,93%		
Firm 4	-8,78%		
Adjusted R-squared	0,048		