The Price Sensitivity of Medicare Beneficiaries:
A Regression Discontinuity Approach

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October 2010

Abstract

We use four years of data from the retiree health benefits program of the University of Michigan (UM) to estimate the effect of price on the health plan choices of Medicare beneficiaries. During the period of our analysis, changes in the UM's premium contribution rules led to substantial price changes. A key feature of this "natural experiment" is that individuals who had retired before a certain date were exempted from having to pay any premium contributions. This "grandfathering" creates quasi-experimental variation that is ideal for estimating the effect of price. Using regression discontinuity methods, we compare the plan choices of individuals who retired just after the grandfathering cut-off date, and were therefore exposed to significant price changes, to the choices of a "control group" of individuals who retired just before that date, and therefore did not experience the price changes. The results indicate a small, but statistically significant effect of price.

For many years, leading health care reform proposals have been based on the concept of "managed competition" (Enthoven 1993). Under this approach, consumers choose from a menu of health plans offering similar benefits. While premiums are subsidized by a sponsor—the government in the case of these public policy proposals and employers in existing private sector health benefit programs—the subsidies are set so that consumers choosing more costly plans bear the incremental cost of that decision. The goal of this arrangement is to induce consumers to choose less costly plans and to switch plans when premiums change, which in turn will provide an incentive for health plans to compete more vigorously on price. Price-elastic demand is critical for the success of this strategy.

This approach is a key element of the recently enacted Federal health care reform legislation. Starting in 2014, newly insured individuals will be able to purchase insurance through state-sponsored health insurance exchanges designed according to the principles of managed competition. The Commonwealth Connector, a purchasing pool as part of the 2006 Massachusetts health care reforms, is another notable example of this approach (Kingsdale 2010). Managed competition has also been proposed as a model for restructuring Medicare in order to control the growth of program spending. In the 1990s, there were several prominent proposals[1] and the managed competition approach was a major focus of the National Bipartisan Commission on the Future of Medicare that was established at the end of the decade. Although a majority of its members supported

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[1] See, for example, Enthoven (1988), Aaron and Reischauer (1995), Butler and Moffit (1995) and Dowd et al. (1996).

reforms based on this model, the Commission did not achieve the super-majority vote required to make a formal recommendation.[2]

While fundamental Medicare reforms have not been enacted, private insurance plans and consumer choice play an increasingly important role in the program. Medicare beneficiaries have had the option of receiving their benefits through a health maintenance organization (HMO) since the mid-1980s, though access to such plans has been limited to certain geographic areas. More recently the menu of private plan options available to beneficiaries has expanded to include Preferred Provider Organizations (PPOs) and private fee-for-service (FFS) plans. Enrollment in these new types of private plans has grown rapidly. Since 2003, the number of beneficiaries in these plans has nearly doubled from 5.3 million to 10.2 million in March 2009. (Kaiser Family Foundation 2009). By the end of 2008, nearly one quarter of Medicare beneficiaries received their health care through a private plan (Gold 2009). Private insurers also play a central role in Medicare's prescription drug program. In Medicare Part D as in the standard model of managed competition, consumers choose from a menu of private insurance options and bear the incremental cost of choosing a more costly plan (Neuman and Cubanski, 2009). In light of these public policy developments, there is great interest among health policy analysts in the health plan choices of elderly consumers and, in particular, the effect of price on those choices.

This paper analyzes a unique natural experiment to provide new evidence on this issue. We use four years of data from the health benefits program of the University of

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[2] http://thomas.loc.gov/medicare/mtg31599.html, accessed on July 21, 2010.

Michigan (UM) to estimate the effect of price on the health plan choices of Medicare-eligible retirees. The analysis exploits quasi-experimental variation in price caused by two important changes in the UM's benefits policies that occurred during the period we analyze. First, changes in the University's premium contribution rules dramatically increased the price of the plan that had the greatest enrollment among retirees. This price increase is similar to variation that is the basis of elasticity estimates produced by prior studies on health plan choice in a managed competition setting (Buchmueller and Feldstein 1997; Cutler and Reber 1998; Buchmueller 2000; Strombom et al 2002).

It is the second policy change that makes the natural experiment we analyze unique and which allows for a stronger identification of the effect of price on plan choice. At the same time that the UM changed its contribution rules it decided that individuals who retired before a certain date would be exempted from having to pay any premium contributions for their health insurance. So, while at the start of our analysis period all retirees faced the same prices, by the end of the period there was a dramatic difference in premiums between people who retired before and after the cut-off date.

The sharp discontinuity in prices caused by the UM's "grandfathering" policy allows for stronger econometric identification than the research design employed in most prior studies. We use regression discontinuity techniques to compare the plan choices of people who retired just after the cutoff date, and therefore faced significant price changes, to a control group of otherwise similar retirees who retired just prior to this date, for whom price was not a factor at all. This comparison allows us to isolate the effect of price, effectively controlling for unobserved plan characteristics that may be correlated with premiums and unobserved individual characteristics that may affect plan choices.

We find a small, but statistically significant effect of price on health plan choice. While very small changes in price have no discernible effect on plan choice decisions, larger price increases lead to a significant reduction in plan market share. Our estimates imply that, ceteris paribus, a $10 increase in monthly premium contributions will lead to a 1 to 2 percentage point decrease in a plan's market share. This estimate of the marginal effect of price and the corresponding price elasticities are close to estimates generated by previous studies.

Previous Literature

Estimating the effect of price on health plan choice decisions requires detailed data on the choice set facing individual consumers, including the exact prices for each choice alternative. The best source of such data is the administrative files of large employer-sponsored health benefits programs. One concern with research based on such data is external validity. Even if a study exploits variation in price that is plausibly exogenous, the results may still be sensitive to specific features of the program analyzed and therefore may not generalize to other settings. As a result, there is a benefit to having multiple studies using data from different sources and different identification strategies.

A number of studies analyze the effect of premium contributions on the health plan choices of active employees who are offered a choice of health plans (Feldman et al 1989; Dowd and Feldman, 1994; Buchmueller and Feldstein 1997; Cutler and Reber 1998; Royalty and Solomon 1999; Strombom et al 2002; Naessens et al 2008). A consistent finding from this literature is that employees are quite sensitive to price and are willing to switch plans in response to relatively small differences in premiums. In the

studies that explicitly calculate them, elasticities of plan choice with respect to the employee's out-of-pocket premium—i.e., the "enrollee perspective" elasticity—are generally in the range of -.2 to -.8. Because the enrollee's out-of-pocket premium represents only a small portion of the total premium, taking the insurer perspective—i.e., calculating the elasticity of plan choice with respect to the total premium—yields much higher elasticities. These elasticities range from -1 to -8.

Analyses that allow the effect of price to vary with age and health risk indicate that older employees and individuals with greater expected health care utilization are considerably less price-sensitive than their younger, healthier counterparts (Royalty and Solomon 1999; Strombom et al 2002; Naessens et al., 2008). These patterns raise a concern that research based on working adults may not generalize well to Medicare beneficiaries. There has been less research on the price sensitivity of this population.

Two prior studies use data on retirees that are similar in important ways to ours. Buchmueller (2000) analyzes the plan choices of retirees from the University of California (UC) after the UC adopted a fixed dollar contribution policy, which caused out-of-pocket premium contributions to increase for some plans but not others. Regression estimates for retirees imply that a $10 increase in monthly premium contribution led to a 1.3 percentage point decline in plan enrollment. A key limitation of this analysis is that the main source of price variation is across plan types (i.e., fee-for-service vs. HMO) and affected all retirees in the same way. Thus, estimates of price sensitivity may be confounded by consumer preferences for other plan attributes or by changes in those attributes occurring at the same time as the price change.

A second study by Buchmueller (2006) uses data from another employer-sponsored program in which premium contributions for retirees are determined by the date an individual retired and his or her years of service at that time. As in our UM data, the rules of the program create essentially random within-plan variation in prices, which is ideal for estimating price effects. The results suggest a slightly more elastic demand than what was found for UC retirees, though the estimated elasticities are smaller in absolute value than what most studies have found for active employees. One limitation of this study is that the sample analyzed is relatively young and includes both Medicare-eligible retirees and retirees under age 65. Employer-sponsored insurance plans, because of the way they interact with Medicare, provide different benefits for these two groups. As a result, elasticity estimates for a mixed sample may be confounded by changes in plan enrollment occurring when an individual qualifies for Medicare. Even if this were not an issue, there remains a question of how well results for younger Medicare beneficiaries generalize to older beneficiaries.

Data and Descriptive Analysis

Data Source and Sample Construction

Our analysis includes retirees from all three UM campuses (Ann Arbor, Dearborn, and Flint) and covers the years 2002 to 2005. Over this period, the UM provided health benefits to over 6,000 retirees, of whom over 5,000 were Medicare beneficiaries. The menu of plans available to these retirees resembles the options currently available to Medicare beneficiaries more generally. The choice set included, in various years, three different HMOs, a point-of-service (POS) plan, two fee-for-service (FFS) plans and two

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preferred provider organizations (PPOs). Plan choices are made during an annual open enrollment period that takes place in the fall, with the choices being effective for the following calendar year.

Since our interest is in understanding the price sensitivity of Medicare beneficiaries, we exclude from the analysis all retirees under the age of 65 as well as those with covered spouses not yet eligible for Medicare. We also exclude a small number of retirees who cover dependent children. Because the data extract was formed based on individuals who were in the benefits system in 2007, we do not have data on retirees who were enrolled in the early years and subsequently died and left the system. However, this selection is likely to be of negligible importance because surviving spouses of UM retirees retain eligibility for health benefits. So, the family units will remain in the sample, though their characteristics will change. These sample selection criteria result in a sample of 3,172 individuals per year.

Plan Prices and Enrollment

As noted, our identification strategy exploits changes in the University's policies that generated quasi-experimental variation in plan premiums. The effect of these various policy changes on the prices faced by retirees can be seen in Table 1, which presents the monthly premium contribution for each plan in each year. In the first two years of our data, the UM's contribution toward retiree coverage was set at the premium of the plan with the greatest enrollment, a major medical plan offered by Blue Cross/Blue Shield of Michigan in conjunction with United Health Care. (For brevity, we will refer to this plan as BCMM.) In 2002, over 70 percent of UM retirees were in this plan. BCMM

enrollees were not required to make monthly premium contributions, while those choosing a more costly plan paid the difference between that plan's premium and the BCMM premium. The single coverage contributions for the other plans ranged from $30 to $115 per month.

Starting in 2003, the University "carved out" prescription drug benefits. Because prescription drug spending was not distributed equally across plans, this change had an impact on plan premiums and enrollee premium contributions.[3] As a result of this change, the required contributions for all plans besides BCMM decreased, while BCMM remained free to retirees.

The next year, the University changed its premium contribution policy to one where it paid 95% of the cost of the plan chosen by employees or retirees.[4] At that time, it was decided that individuals who had retired prior to January 1, 1987 would not be required to pay any premium contributions, regardless of the plan they chose. This date was chosen for legal reasons, rather than for anything to do with the retirement or plan choice decisions of UM retirees.[5] Given this motivation and the retrospective nature of this decision, it is reasonable to assume that the price variation generated by this policy is exogenous to retiree preferences or other unmeasured factors that might influence plan choice decisions.

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[3] Under the carve-out, coverage (e.g., preferred formularies) and copayments for prescription drugs do not vary across plans. Plan premiums are set to reflect the vendor's cost for medical coverage plus the uniform (across plan options) average self-insured cost of the prescription coverage.

[4] Details of the 2004 policy change and its impact on premiums for active employees are described in Okeke , Hirth and Grazier (2010a).

[5] When they began considering altering the contribution policy, HR administrators were concerned about the potential perception that the UM was reneging on an implicit contract with existing retirees. A review of benefits materials and related communications with employees and retirees indicated that since at least 1988 these materials had explicitly stated that the UM retained the right to alter its policy on plan premium contributions and consequently retirees could at some point be required to pay more for their coverage.

The combination of the change in the contribution policy and the grandfathering decision meant that in 2004 out-of-pocket prices for pre- and post-1987 retirees began to diverge. The small contributions that were required in 2003 were eliminated for pre-1987 retirees. For individuals who had retired after January 1, 1987, enrollment in BCMM now required a monthly premium contribution of $16.30 for single coverage and $32.50 for family coverage. BCMM was no longer the lowest cost option for retirees, though the difference between it and less expensive plans was very small—about one or two dollars per month for single coverage.

The University altered its contribution policy more significantly in 2005. Under the new policy, the University's contribution toward single coverage was set equal to 95% of the average premium for the two lowest cost plans on the menu and the contribution for dependent coverage was set so that in aggregate the University paid 85% of total premiums. Employees and retirees who chose more expensive plans now had to pay the full difference between the plan's premium and the fixed University contribution. The combination of this change plus differential trends in total plan premiums meant that BCMM, which only two years before had been the low cost plan on the menu, was now the most expensive option, with a monthly contribution of $42.60 for single coverage and $130.00 for two-party (i.e., retiree plus spouse) coverage.

Table 2 presents the distribution of plan choices for the period of our analysis. The top panel presents data for all retirees with Medicare coverage; in the second and third panels we cut the data by retirement age, differentiating our "control group" of pre-1987 retirees and our "treatment group" consisting of individuals retiring on or after January 1, 1987. In 2002, approximately 70 percent of all Medicare-eligible retirees were

enrolled in BCMM. The second most popular plan (MCare HMO) enrolled 19 percent of the full sample. MCare also offered a point-of-service (POS) plan that enrolled 3.3 percent of all UM retirees. Because the market shares for the remaining plans were all in the low single digits we group these plans together.

As noted, between 2002 and 2003 premium contributions for the HMOs fell, though these plans were still more expensive than BCMM. The figures in Table 2 show that the HMOs did not gain market share as a result of this change in relative prices. Similarly, the small price changes that occurred between 2003 and 2004 did not shift enrollment. In contrast, it appears that the increase in BCMM's price between 2004 and 2005 did lead to a significant decline in that plan's market share. In the full sample, BCMM enrollment declined by roughly 12 percentage points. The data in the lower two panels of Table 3 show that this decline was almost entirely driven by the retirees who faced a price increase. Among post-1987 retirees, BCMM enrollment fell by 16.7 points, compared to a decline of 1.9 percentage points for pre-1987 retirees. Most of the retirees who left the BCMM plan switched to the less costly PPO that Blue Cross began offering that year. The market share of other plans on the menu changed only slightly.

Econometric Analysis

Regression Discontinuity Results

The difference in the way that enrollment patters changed over time for pre- and post-1987 retirees suggests a negative effect of price on health plan choice. The obvious problem with this comparison is that the two groups are different in a number of ways. Indeed, in 2002 when the two groups faced the same prices, pre-1987 retirees were 20

percentage points more likely to be enrolled in BCMM. This problem of heterogeneity can be minimized, however, if we limit the comparison to individuals who retired just before and just after January 1, 1987. Even if there is a general relationship between retirement date and plan choice, the stark nature of the grandfathering policy provides a source of clean identification. Because the cutoff date was chosen retroactively in 2004, there is no way that the difference in contribution rules applying to pre- and post-1987 retirees could have affected retirement decisions. As a result, for people who retired near the cut-off date, assignment to the treatment and control groups is essentially random. Therefore, we can use regression discontinuity techniques to estimate the effect of the price changes that took place in 2004 and 2005.

Because BCMM enrolled such a high percentage of UM retirees over this period and because it appears that it was the price increase for this plan between 2004 and 2005 that induced the strongest demand response, our regression analysis focuses on enrollment in that plan. The main dependent variable we analyze is a binary variable, $BCMM_{it}$, that equals one for individuals enrolled in BCMM in year t and zero for those who enrolled in other plans or chose to waive coverage.[6] For each year of enrollment data we estimate the following model:

$$BCMM_{it} = \alpha_t + Xi\beta_t + (1-T_i) \times g_{1t}(R_i) + \delta_t T_i + T_i \times g_{2t}(R_i) \qquad (1)$$

The binary variable T identifies members of the treatment group who retired after January 1, 1987; R_i is an integer corresponding to the exact date of retirement and $g_{1t}(.)$ and $g_{2t}(.)$

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[6] Our focus on this binary outcome is similar to the approach taken by Cutler and Reber (1998) and Buchmueller (2000). In those studies, as in ours, the main source of price variation was changes in the price of a popular plan and there was limited price variation among other smaller plans.

are flexible functions of R. In Figures 1-4 we report results from a weighted local polynomial regression (Nichols 2007).[7] The estimates of δ from this specification along with bootstrapped standard errors are reported in the first column of Table 3. For the sake of comparison, and to show that our results are not sensitive to functional form, we also report two alternative parametric specifications. In column 2 of Table 3, we report results from a model in which $g_{1t}(.)$ and $g_{2t}(.)$ are specified as fourth order polynomials of R. In column 3 we add to that model the following covariates: age (in 2002), age squared, gender, marital status, surviving spouse status, residential location (dummies for living in Ann Arbor and living out of state) and a ZIP code level measure of average income (from the 2000 Census).

We begin by estimating the relationship between retirement date and BCMM enrollment in 2002 and 2003. These outcomes provide an important test of the validity of the RD approach for analyzing the effect of price changes that occurred in later years. Because the grandfathering policy was not yet established, in 2002 and 2003 pre-and post-1987 retirees faced the same prices. In other words, for these years there is no "treatment", which means there is no reason to expect a discontinuity in BCMM enrollment around the retirement date of January 1, 1987. The regression discontinuity results are consistent with this expectation. In Figure 1 it appears that in 2002 individuals who retired in early 1987 were slightly *more* likely to be in BCMM than those retiring in late 1986.[8] However, this difference is not significantly different from zero. The point estimate of δ from the local polynomial regressions is .03 with a bootstrapped standard

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[7] The models reported in the figures and column 1 of Table 3 use a triangular kernel with a bandwidth of 2. The results are not sensitive to the use of alternative kernels or bandwidths.
[8] For visual clarity we limit the plot to observations with retirement dates no more than 5 years before or after January 1, 1987.

error of .06. The other two models reported in Table 3 also indicate that there was no significant difference in BCMM enrollment between our treatment and control groups in 2002. The plot for 2003 (Figure 2) is barely distinguishable from the one for 2002, which reflects the fact that the decline in required contributions for the HMOs between 2002 and 2003 did not induce movement out of BCMM.

By 2004, the grandfathering policy was in place, though the difference in prices faced by pre- and post-1987 retirees was small. For pre-1987 retirees BCMM was free, while for post-1987 retirees the required contribution for BCMM was only $1 to $2 per month higher than the cost of other plans. The RD results presented in Figure 3 and Table 3 suggest that this price difference was not enough to affect enrollment decisions. The estimated treatment effect for the local polynomial model is 0.012, with a standard error of 0.07. The results from the quartic models also indicate no significant difference in BCMM enrollment between the treatment and control groups.

We do find a larger and statistically significant treatment effect in 2005. Recall that in that year the price of BCMM for post-1987 retirees increased to $42.60 for single coverage and $130.50 for two-party coverage. Figure 4 plots the relationship between retirement date and BCMM enrollment in 2005. The plot to the left of the grandfathering cut-off date is virtually identical to the plot for the earlier years, indicating that there was very little plan switching among pre-1987 retirees. Just to the right of the grandfathering cut-off date there is a discrete drop in BCMM enrollment, indicating that the price increase caused some post-1987 retirees to switch out of BCMM. The three regression specifications reported in Table 3 imply that the price increase led to a significant decline in BCMM enrollment. The point estimate is slightly larger in column 1 than in columns

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2 and 3. The reason is that in the nonparametric model puts more weight on observations around the cut-off date. When we limit the sample to individuals who retired no more than two years before or after January 1, 1987, the parametric models yield comparable estimates of the difference between our treatment and control groups.

The effect of the price increase on plan switching can be shown more directly by analyzing the relationship between retirement date and the change in BCMM enrollment between 2002 and 2005: $\Delta BCMM = BCMM_{2005} - BCMM_{2002}$.[9] Analyzing switching allows us to better hold constant time invariant factors, such as individual preferences and non-price plan attributes, which may affect plan choice decisions. Figure 5 presents the plot of the local polynomial regressions for this outcome. On both sides of the cut-off date, the fitted curves are essentially horizontal.[10] The estimated gap between the two curves is 21 percentage points, which is slightly larger than the corresponding cross-sectional result for 2005. The parametric models in columns 2 and 3 produce somewhat smaller, though still significant, estimates of the treatment effect. Again, this difference across models appears to be driven by differences in the weight put on observations away from the discontinuity.

The fact that the fitted regression line is flat to the right of the cut-off date indicates that within the treatment group the response to the price increase did not vary with retirement date. This finding along with the null results for 2002 and 2003 provides support for the research design. As an additional specification check, we test whether

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[9] Buchmueller and Feldstein (1997) and Buchmueller (2000) examine the effect of price changes on the decision to switch out of any plan, which they model as a binary outcome. In our switching analysis, the dependent variable takes the value of -1 for people who switched from BCMM into one of the other plans, 1 for people who switched into BCMM and 0 for people who did neither.

[10] In the quartic model, none of the estimated coefficients on the retirement date terms are significantly different from zero. More restricted models, such as one constraining $g_1(.)$ and $g_2(.)$ to be quadratic or linear functions also show no significant relationship between retirement date and plan switching apart from the shift of the function at the grandfathering.

other variables exhibit discontinuities at the grandfathering cut-off date. It is to be expected that pre-1987 retirees are older on average than post-1987 retirees. But a difference in mean age is not by itself a threat to our research design. On the other hand, we would be concerned if there were a discontinuity in age around the retirement date of January 1, 1987. We test for such a discontinuity as well as for discontinuities in the other covariates that enter the Table 3, column 3 model as controls.

Results from these "placebo" tests are reported in Table 4. The specifications are the same as those in columns 1 and 2 of Table 3.[11] With one exception, all of the estimated discontinuities are statistically insignificant. That exception is the local polynomial model for the percent male, which suggests that men represent a higher proportion of individuals who retired just before January 1, 1987 as compared to those retiring just after that date. A closer inspection of the date suggests that this is not a real discontinuity. In Appendix Table A1, we plot the percentage of retirees who are male by year of retirement. The figure shows that this percentage is generally *increasing* with respect to retirement date, though the graph is fairly jagged. Because the value for 1985 (30.7%) is below the trend line, while the value for 1986 (48.3%) is above, the slope of the local polynomial regression is quite steep just to the left of the cutoff. Alternative specifications that put less weight on the data from 1986, such as the other model reported in Table 4, indicate a smaller, statistically insignificant change in the percent male around the cutoff date. Similarly, a simple comparison of all individuals who retired in the two years before and after January 1, 1987 reveals no significant difference between in the percent male (see Table 5). Because of this general pattern and the fact

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[11] Because there is little correlation among the covariates, adding controls to the quartic model reported in column 2 has no effect on the estimated discontinuity. Therefore, we do not report these models.

that gender is not a significant predictor of BCMM enrollment (see Table 6), we are

confident that our main estimates are not confounded by the gender composition of our

treatment and control groups.

Estimating the Marginal Effect of Price

The RD analysis provides strong evidence that the increase in BCMM's price

between 2004 and 2005 led to a significant decline in that plan's market share, though the

smaller price changes in prior years did not affect plan enrollment. However, this model

does not generate a marginal effect of price that can be compared to prior studies and

used to calculate a price elasticity of demand. To estimate such a parameter we pool the

data for all four years and estimate the following regression model:

$$BCMM_{it} = X_{it}\beta + \theta\ P_{it}^B\ + \mu_i + v_{it}. \tag{2}$$

The vector X_{it} includes the same individual characteristics as in equation (1): age and its

square, ZIP code level average income and indicator variables for gender, marital status,

residence in Ann Arbor, residence out of state and whether or not the individual is the

surviving spouse of a former UM employee.[12] We also include a continuous measure of

retirement date and its square to account for any additional factors that may be correlated

with both retirement date and plan choice.

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[12] Some of these variables, such as gender, clearly do not vary over time. We subscript *X* by *t* because others such as those related to where a retiree lives can vary, though as a practical matter almost all the variation in the variables is across individuals.

The independent variable of primary interest is P_{it}^B, the monthly cost of the BCMM plan relative to the lowest cost option on the menu.[13] As shown in Table 1, this price depends on whether or not the policy covers a dependent. In principle, retirees could respond to an increase in price by dropping dependent coverage; in reality, we do not observe such behavior in our data on UM retirees.[14] Therefore, we assign to each individual the relative BCMM price corresponding to their coverage tier (retiree only or retiree plus spouse). So, for example, in 2005 the price variable equals $42.60 for single enrollees and $87.10 for two-party coverage ($130.50 - $43.40).

The error term includes both an individual-specific effect, μ_i, and an i.i.d. disturbance, ν_{it}. In order to present coefficients on all covariates including those that are constant over time, we report results from a linear probability specification that treats μ_i, as a random effect, though linear fixed effect models yield essentially identical estimates of θ. The concordance of these models is further evidence that the price variation induced by the UM contribution policies is exogenous to unobserved individual factors affecting plan choices. In addition to reporting results for the full sample of UM retirees, we also report estimates for a subsample who retired no more than 2 years before or after January 1, 1987. The logic for restricting the sample in this way is the same as that behind the regression discontinuity models. While more recent cohorts of retirees may

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[13] In principle, the relative price of BCMM should be computed with reference to each retiree's next preferred alternative, which is unobserved. In 2005, the prices for all the other plans are all within a dollar of each other, so choosing one or another as the point of comparison or using an average of non-BCMM prices yields essentially the same result. In 2005, the low cost option is the Blue Cross PPO, which is the plan chosen by the vast majority of individuals who switched out of BCMM. Thus, there is no reason to expect our results to be sensitive to the construction of the price variable.

[14] In other research, we find that active employees do drop dependent coverage when the incremental cost of that coverage increases (Okeke, Hirth and Grazier 2010b). Active employees who drop dependent coverage typically do so when their spouse has the option of coverage through his or her own employer. Spouses of retirees are much less likely to have an alternative source of employer-sponsored coverage. In addition, the university's rules make it difficult to re-enroll the spouse of a retiree after dependent coverage has been dropped.

make different health plan choices than earlier cohorts, there is no reason to think that individuals who retired just before this date are different in ways that affect their demand for health insurance than individuals who retired just after this date.[15]

Table 5 presents summary statistics for the full sample of retirees and for the treatment and control groups defined according to the two year window. As would be expected, individuals who retired between 1985 and 1988 are slightly older than the full sample of UM retirees and those who retired in 1985-1986 are slightly older than those who retired in 1987-1988. Other differences between the treatment and control groups relate to where they live: pre-1987 retirees are more likely to have moved out of state and less likely to live in Ann Arbor. Because of these location decisions, pre-1987 retirees live in areas with lower average incomes.

The regression results, which are reported in Table 6, indicate that these differences in observable characteristics explain much of the baseline relationship between retirement date and BCMM enrollment. Compared to the omitted group of retirees living in Michigan but outside of Ann Arbor, those living in other states are more likely to enroll in BCMM and those living in Ann Arbor are less likely to do so. The explanation for this pattern is straightforward. Because their provider panels consist of physicians and hospitals located in southeast Michigan, the HMOs on the UM menu are not attractive options for retirees living in other parts of the state and are not an option at all for retirees who have moved out of state. The coefficients on the retiree demographic variables—age, gender, marital status, and surviving spouse status are not statistically significant. We saw in Figures 1 and 2 that even when they faced the same prices, more

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[15] The regression results are not at all sensitive to the size of the window around the cutoff date. Estimates from alternative sample definitions are available upon request.

recent cohorts of retirees are slightly less likely to enroll in BCMM than earlier cohorts. The results in Table 6 show that when we control for where people live, there is no clear relationship between retirement date and the probability of enrolling in BCMM.

Given the lack of a significant relationship between retirement date and plan choice, it is not surprising that the estimated price effect is not at all sensitive to whether we estimate the model using the full sample or limit the sample to a narrow window around the cut-off date. The estimates from both samples imply that a $10 increase in monthly premium contributions will lead to a reduction in plan market share of roughly 2.4 percentage points. As noted, a fixed effect specification yields similar point estimates. The estimated price coefficients from the fixed effect model are -0.0023 (standard error = 0.0002) in the full sample and -0.0025 (standard error = 0.0005) in the 2 year window sample.

The magnitude of the price effect is similar to that found in prior studies. The most comparable study is Buchmueller's (2000) analysis of data on University of California retirees in the 1990s. The parameter estimates from that study imply that a $10 increase in monthly premium contributions would cause a plan's enrollment to decline by between 1 and 2.5 percentage points, depending on the estimation sample analyzed. After accounting for inflation, our estimates fall squarely in the center of that range. Our estimated price effects are slightly smaller in magnitude than the estimates from the other study by Buchmueller (2006) that uses data on retirees from a private company.

In Table 7 we report alternative elasticity estimates for the full sample as well as for different subsamples of interest. Expressing marginal price effects as elasticities can

be sensitive to the point at which the function is evaluated. Because premium contributions were fixed at zero for control group and started at zero for the treatment group, the mean price for BCMM in the full estimation sample is fairly low: $9.90 per month. Using this figure along with the full sample mean for BCMM's market share yields an "enrollee perspective" elasticity of roughly -0.04. When we evaluate the elasticity function at the mean price and market share for our treatment group, the price elasticity is -0.06. These are smaller in absolute value than the estimated elasticities from the two comparable prior studies (Buchmueller 2000, 2006). However, this difference is driven by the fact that the mean premium contribution was higher and the mean market share was lower in those data sets.[16]

In columns 2 and 3 we report results from models estimated separately by coverage tier—single and two-party. The point estimates of the marginal price effect and calculated elasticities are nearly identical for these two groups. One potential criticism of studies that use data on University employees is that highly educated academics are not representative of employees and retirees more generally. To address this concern we cut the data by job category, distinguishing academics and non-academic staff. The results are not sensitive to this stratification either. The point estimate for the marginal price effect is -0.0023 for academics and -0.0026 for non-academics.

It is common in the literature to calculate "insurer-perspective" elasticities by evaluating the elasticity function at the full premium charged by a health plan rather than at the subsidized price faced by enrollees. The lower panel of Table 7 reports such estimates. In 2005, the full premium for the BCMM plan was $318 per month for retirees

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[16] In terms of the regression specification our analysis is most similar to Buchmueller (2000). The plan that was the focus of that study had a mean monthly price of $56.80 and a mean market share of 51%.

with Medicare choosing single coverage and $636 for those choosing two-party coverage. Since 66 percent of UM retirees in the full sample chose single coverage, these figures translate to an average price of $425 per month. Evaluating the function at this price and the mean BCMM market share for the full time period yields an elasticity of approximately -1.5. Doing the same calculations using means for all post-1987 retirees gives an insurer-perspective elasticity of -1.8.[17] For all subsamples reported in the table the insurer-perspective elasticity falls between -1 and -2.

Conclusion

This paper presents new evidence on the effect of price on the health plan choices of retirees in a managed competition setting. The analysis uses data on Medicare-enrolled retirees from the University of Michigan and exploits quasi-experimental price variation caused by the University's policies governing the premium contributions required of retirees. During the period of our analysis, the premium contribution charged for the most popular plan on the UM menu increased significantly. Because of a prior policy decision, this price increase affected individuals who had retired after a certain date, but not those who had retired prior to this date. This grandfathering policy creates a sharp discontinuity in prices that effectively divides UM retirees into treatment and control groups according to when they retired. Because the cut-off date was set retroactively, it is not possible that the policy could have affected retirement decisions. We use regression discontinuity methods to analyze this natural experiment.

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[17] The insurer-perspective elasticity is slightly higher for the post-1987 retirees for two reasons. One is that because a slightly higher percentage of post-1987 retirees have two-party coverage, the mean BCMM premium for this group is slightly higher than the mean for the full sample ($438 vs. 425). Second, the BCMM market share over the full time period is lower for the post-1987 retirees (.582 vs. .667).

While our research design is different than previous studies on the health plan choices of retirees, our results are quite similar. Like prior studies focusing on this population, we find that prices matter for plan choice among Medicare retirees, though the magnitude of the effect is small. At the start of the analysis, the majority of UM retirees were in a major medical plan offered by Blue Cross and Blue Shield of Michigan in conjunction with United Health Care. Because of its importance in the program and because of the limited degree of price variation in other plans, we model the probability of choosing it relative to any of the others. Descriptive results show that small increases in the cost of the Blue Cross plan relative to others on the menu had no detectable effect on retiree enrollment decisions. However, when the price of this plan increased by roughly $40 per month for single coverage and over $100 per month for two-party coverage there was a significant migration to less expensive plans.

Using dating for the full period we estimate the average effect of price on the probability of choosing BCMM. Our point estimates imply that, ceteris paribus, a $10 increase in premiums leads to a reduction in plan market share of between 2 and 3 percentage points. This marginal effect translates to an insurer-perspective elasticity of between -1 and -2. These results are similar to those of earlier studies on retirees and smaller in magnitude than price effects estimated for active employees.

While the finding that the health plan choices of retirees are less sensitive to price than the choices of active employees, the exact reasons for this result are not clear. One possibility may be related to the fact that switching among managed care plans can require changing providers, or at least adapting to new policies regarding referrals and reimbursement. To the extent that they have stronger ties to particular providers, older

consumers may be more reluctant than younger consumers to make such changes. However, the fact that research from other countries also finds a negative relationship between age and sensitivity to health insurance premiums suggests that this cannot be the entire answer.[18]

The difference in choice behavior between active employees and retirees may have to do with the ability to make financial decisions and the resources that are available to inform those decisions. In order to make price-sensitive plan choices, consumers must be able to evaluate trade-offs between monthly premium payments and other financial and non-financial aspects of alternative plan options. Such decisions may be difficult for older consumers. Recent studies by Fang, Keane and Silverman (2008) and Levy and Weir (2010) find that cognitive ability is a significant factor influencing whether Medicare beneficiaries purchase supplemental insurance or enroll in Medicare Part D.

The ability to make good decisions will also depend on the information that is available about choice alternatives. While in the typical health benefits program active employees and retirees receive similar written materials, employees may have better access to informal sources of information, such as feedback from fellow employees. If cognition and information are important factors affecting retirees' health plan choices, careful consideration should be given to providing retirees information and decision aids that may enhance the response to price. More research on how exactly elderly consumers make health insurance purchase decisions would be valuable.

Because our estimated price effects are based on a comparison of treatment and control groups who faced different prices for the same plans in the same years, we are

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[18] For example, recent studies using data from Germany and the Netherlands, where consumers can switch insurers without having to switch providers, find that smaller premium elasticities for older consumers compared to younger consumers (Schut Gress and Wasem 2003; van Dijk et al 2008).

able to hold constant benefits and other plan characteristics, such as the size and reputation of the provider panel. This is both a strength and a limitation of our analysis. On the positive side, we can be sure that our estimates are not confounded by aspects of plan quality that may be correlated with price. The limitation is that it is not possible with data like ours to say anything about how consumers make trade-offs between premiums and other plan characteristics. Understanding these trade-offs is important in programs like Medicare Part D, where there is considerable variation in non-price plan attributes.

While a significant price response is consistent with arguments made by proponents of market-oriented reforms, the impact of such reforms will depend importantly on the strategic behavior of competing health insurers. Another limitation of case studies like the one we analyze is that they are generally not well suited for drawing lessons regarding the supply side of the market. However, such lessons may be gleamed from the health insurance exchanges that will soon be established (and the Massachusetts Connector, which is already in operation) as well as from the market for stand-alone drug coverage under Medicare Part D. Understanding how insurers compete in these new markets is an important goal for future research.

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Figure 1. BCMM Enrollment as a Function of Retirement Date
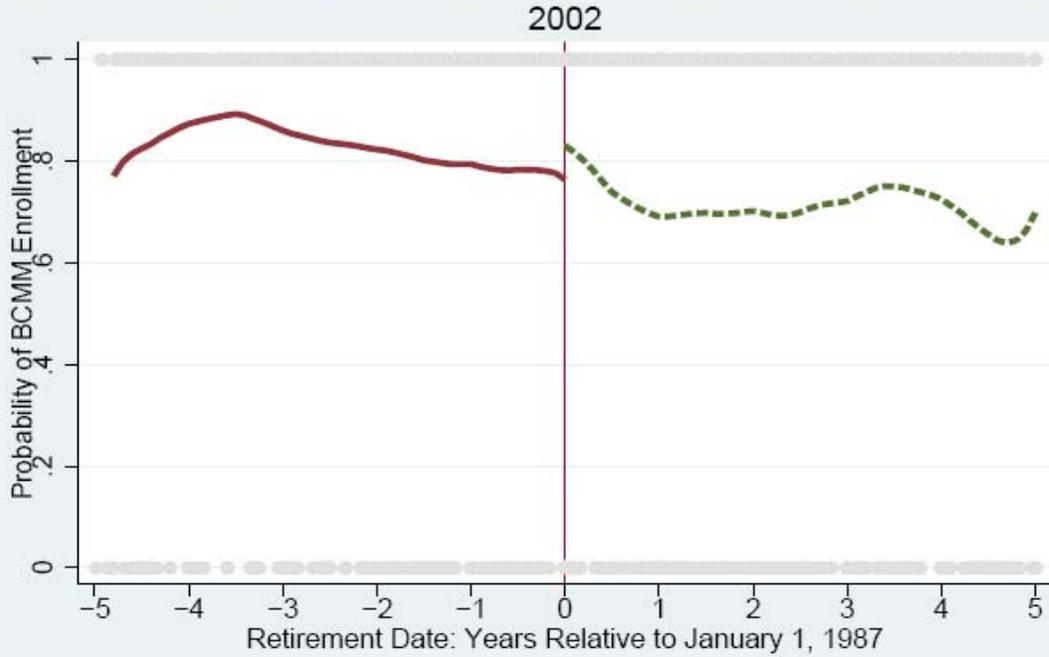
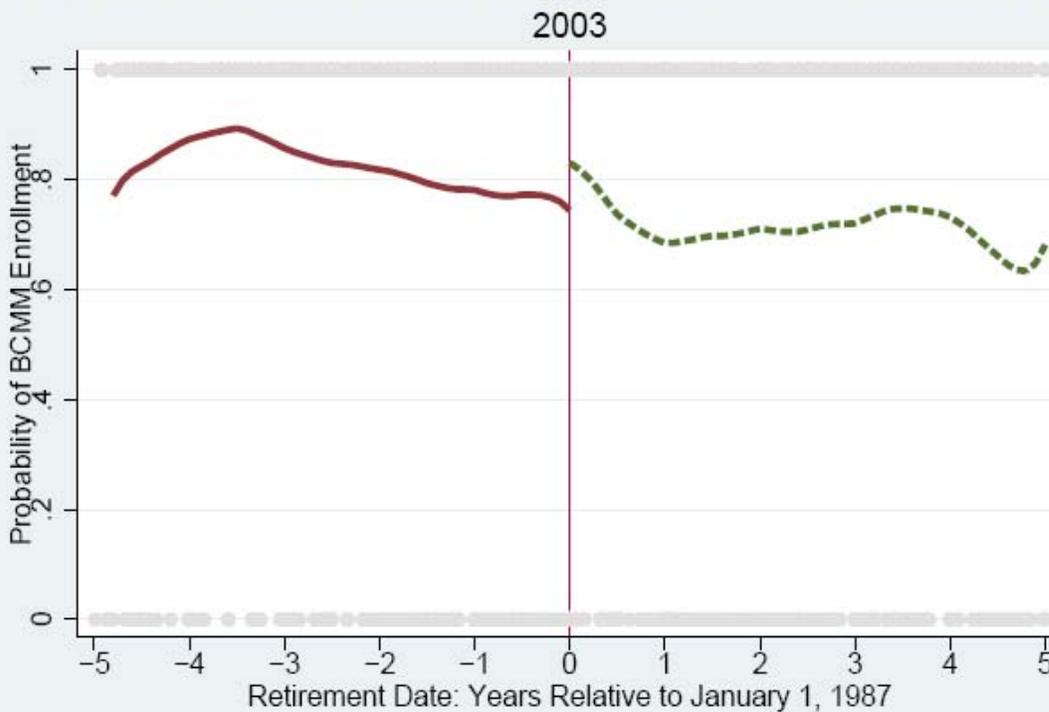Figure 2. BCMM Enrollment as a Function of Retirement Date

Figure 3. BCMM Enrollment as a Function of Retirement Date

2004

Probability of BCMM Enrollment

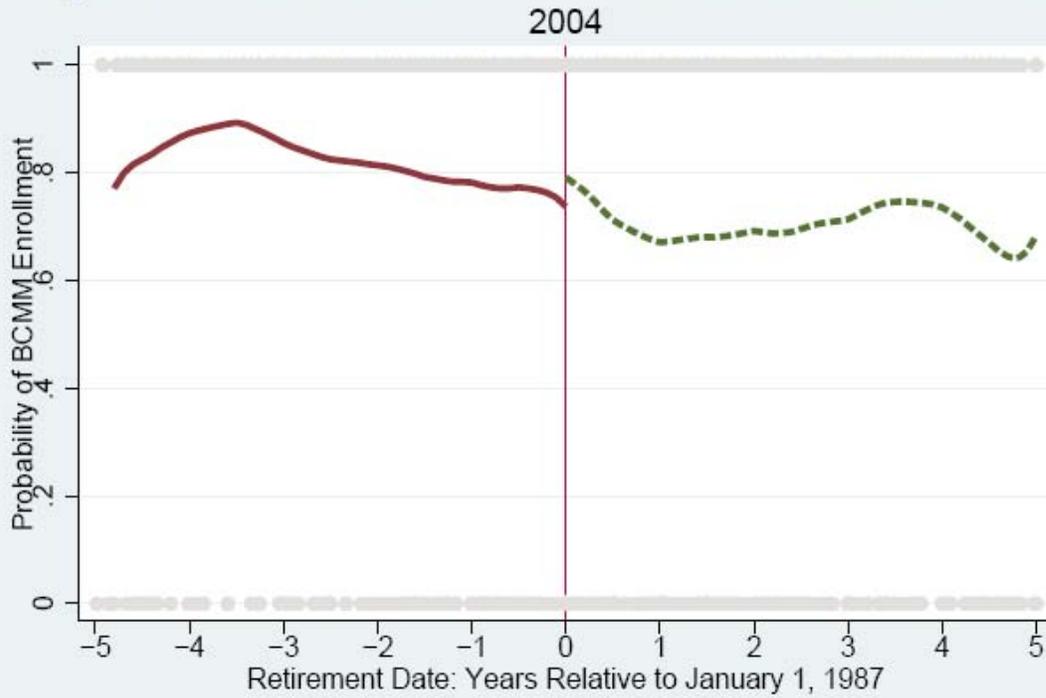Retirement Date: Years Relative to January 1, 1987

Figure 4. BCMM Enrollment as a Function of Retirement Date

2005

Probability of BCMM Enrollment

Retirement Date: Years Relative to January 1, 1987
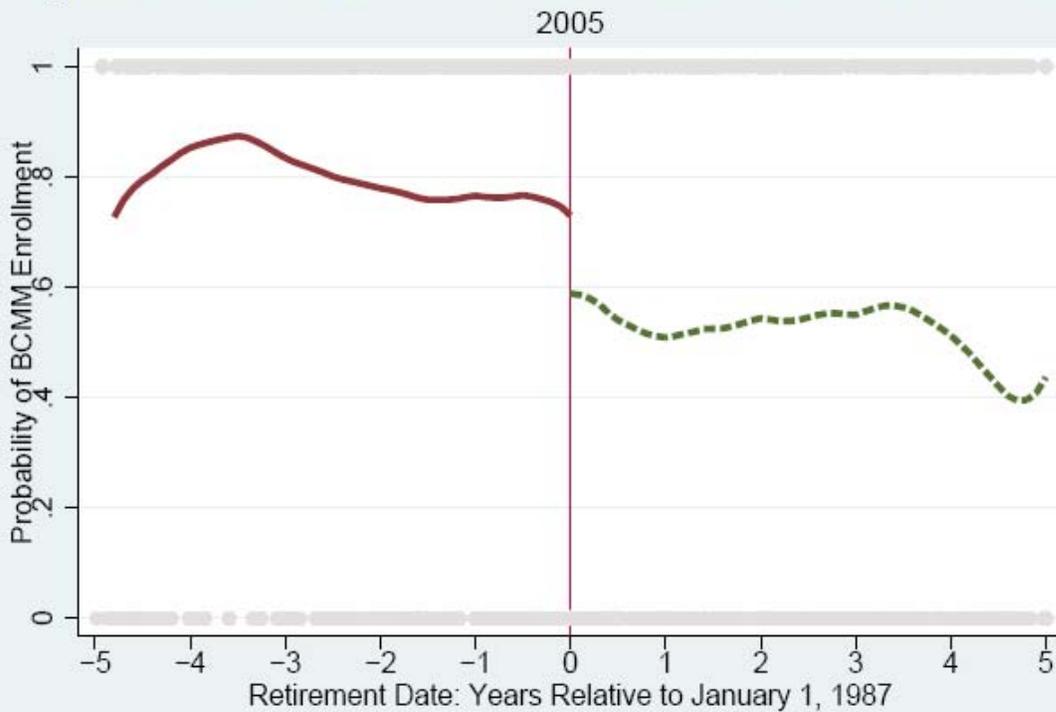
Figure 5. Change in BCMM Enrollment
2005 minus 2002
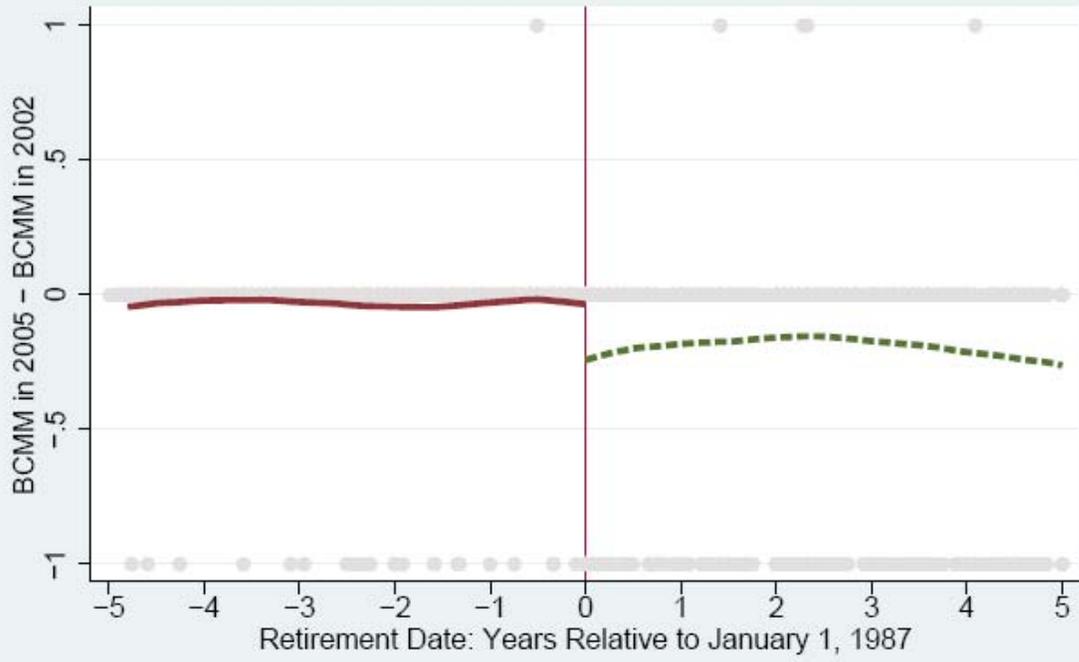
Table 1. Plan Offerings and Required Contributions, 2002-2005

		2002	2003	2004	2005
Blue Cross Major Medical	Single	0.00	0.00	16.30	42.60
	Two-Party	0.00	0.00	32.50	130.50
Blue Cross PPO	Single	NA	NA	NA	0.00
	Two-Party	NA	NA	NA	43.40
MCare HMO	Single	29.50	0.00	14.10	13.10
	Two-Party	65.50	0.00	28.20	71.40
MCare POS	Single	54.60	0.00	14.10	15.90
	Two-Party	115.70	0.00	28.20	77.20
MCare PPO	Single	NA	NA	NA	31.30
	Two-Party	NA	NA	NA	107.90
Care Choices HMO	Single	38.40	8.30	14.60	22.10
	Two-Party	83.20	16.50	29.30	89.50
HAP HMO	Single	114.80	15.60	14.80	15.90
	Two-Party	236.00	31.10	29.50	77.10
Comprehensive Major Medical	Single	NA	NA	15.20	20.60
	Two-Party	NA	NA	30.40	86.60

Notes: Contributions listed for 2002 and 2003 applied to all retirees. In 2004 and 2005, contribution amounts applied only to individuals who retired on or after January 1, 1987. Individuals retiring before this date could choose any plan without paying a monthly contribution.

Table 2. Distribution of Plan Choices by Year

	2002	2003	2004	2005
Full Sample				
(N =3,182)				
Blue Cross Major Medical	69.9%	69.9%	69.4%	57.8%
Blue Cross PPO	----	----	----	12.6
MCare HMO	19.0	17.1	16.3	15.6
MCare POS/PPO	3.2	5.1	5.4	5.4
Other Plans	7.9	8.0	8.2	7.9
Waived Coverage	0.0	0.0	0.6	0.7
Retired Before Jan 1 1987				
(N = 1,123)				
Blue Cross Major Medical	83.1%	82.6%	82.8%	80.7%
Blue Cross PPO	----	----	----	2.0
MCare HMO	11.8	11.1	10.7	10.2
MCare POS/PPO	1.1	2.1	2.1	2.7
Other Plans	4.0	4.1	4.3	4.5
Waived Coverage	0.0	0.0	0.0	0.0
Retired After Jan 1, 1987				
(N =2,059)				
Blue Cross Major Medical	62.7%	62.9%	62.1%	45.4%
Blue Cross PPO	----			18.4
MCare HMO	23.0	20.4	19.4	18.5
MCare POS/PPO	4.4	6.7	7.2	7.0
Other plans	10.0	10.0	10.4	9.7
Waived Coverage	0.0	0.1	0.9	1.1

Table 3. Regression Discontinuity Results

Dependent Variable	(1)	(2)	(3)
1. $BCMM_{2002}$	0.031	-0.023	-0.005
	(0.060)	(0.040)	(0.039)
2. $BCMM_{2003}$	0.045	-0.015	0.003
	(0.070)	(0.041)	(0.039)
3. $BCMM_{2004}$	0.012	-0.039	-0.021
	(0.070)	(0.042)	(0.040)
4. $BCMM_{2005}$	-0.180*	-0.160*	-0.141*
	(0.076)	(0.044)	(0.043)
5. $BCMM_{2005} - BCMM_{2002}$	-0.211*	-0.137*	-0.136*
	(0.053)	(0.032)	(0.032)

Notes: Each row represents separate regressions of BCMM enrollment in a particular year as a function of retirement date (R). The sample size is 3,182. The point estimates reported represent the discontinuity in the function at the retirement date of January 1, 1987. Estimates in column 1 are from local polynomial regressions (using a bandwidth of 2). In column, 2 we estimate separate quartic regressions on either side of the cutoff date. Column 3 adds the following covariates to the column 2 model: gender, marital status, surviving spouse status, residential location (dummies for living in Ann Arbor and living out of state) and the mean income in the person's ZIP code. Standard errors (bootstrapped in column 1, robust in columns 2 and 3) are in parentheses.
* = significant at the .05 level

Table 4. Testing for Discontinuities in Covariates

		(1)	**(2)**
1.	Age in 2002	-0.742	-0.482
		(0.658)	(0.525)
2.	Male	-0.201*	-0.047
		(0.079)	(0.046)
3.	Married	0.030	0.015
		(0.115)	(0.046)
4.	Surviving Spouse	0.002	-0.040
		(0.049)	(0.028)
5.	Lives in Ann Arbor in 2002	-0.072	0.031
		(0.078)	(0.047)
6.	Lives Out of State in 2002	0.021	-0.043
		(0.065)	(0.035)
7.	ZIP code average income	-1.687	1.109
		(2.040)	(1.215)

Notes: Estimates in column 1 are from local polynomial regressions (using a bandwidth of 2). The regression in column 2 fits separate quartic regressions on either side of the cutoff date. The sample size for all regressions is 3,182. Standard errors (bootstrapped in column 1, robust in column 2) are in parentheses.
* = significant at the .05 level

Table 5. Sample Characteristics by Date of Retirement

	All Retirees	Retired 1985-1986	Retired 1987-1988
Age	74.99	77.84	76.14*
Male	0.42	0.40	0.41
Married	0.47	0.40	0.44
Surviving Spouse	0.09	0.14	0.08*
Academic	0.25	0.23	0.27
Lives in Ann Arbor	0.46	0.43	0.49
Lives out of state	0.16	0.20	0.14*
ZIP code average income ($000)	42.09	36.23	40.13*
Number of observations	3,182	369	308

* = difference between pre- and post-1987 retirees is significant at the .05 level.

Table 6. Linear Probability Regression Results

	Full Sample	Retired 1985-1989
Price of BCMM	-0.0024*	-0.0025*
	(0.0002)	(0.0005)
Retirement date	0.0072	-0.3587
	(0.0095)	(0.7173)
Retirement date squared	-0.0002	0.0063
	(0.0002)	(0.133)
Age	0.0023	-0.0974
	(0.0195)	(0.0539)
Age squared	0.0000	0.0007
	(0.0001)	(0.0003)
Male	0.0007	0.0261
	(0.0163)	(0.0337)
Married	-0.0250	0.0482
	(0.0231)	(0.0475)
Surviving spouse	0.0456	0.0221
	(0.0254)	(0.0510)
Lives in Ann Arbor	-0.0640*	-0.1308*
	(0.0185)	(0.0418)
Lives out of state	0.1748*	0.0956*
	(0.0232)	(0.0517)
ZIP code average income ($000)	-0.0020*	-0.0021
	(0.0006)	(0.0015)
Two party coverage	0.0411	-0.0050
	(0.0224)	(0.0460)
Year = 2003	-0.0058*	-0.0131*
	(0.0029)	(0.0058)
Year = 2004	-0.0118*	-0.0260*
	(0.0049)	(0.0105)
Year = 2005	-0.0481*	-0.0637*
	(0.0091)	(0.0180)
Number of observations	12,644	2,700
R^2	0.147	0.109

Notes: Results are from a random effects model. The dependent variable equals one for individuals enrolled in BCMM and zero otherwise. Robust standard errors are in parentheses. * = significant at the .05 level.

Table 7. Estimated Premium Elasticities

	Full Sample	Single Coverage	Two-Party Coverage	Academic	Non-Academic
Marginal Price Effect	-0.0024	-0.0022	-0.0024	-0.0023	-0.0026
	(0.0002)	(0.0003)	(0.0002)	(0.0003)	(0.0002)
Enrollee-perspective elasticity					
At sample mean for all retirees	-0.036	-0.022	-0.059	-0.043	-0.035
At sample means for post-1987 retirees	-0.063	-0.043	-0.091	-0.066	-0.066
Insurer-perspective elasticity					
At sample means for all retirees	-1.53	-1.38	-1.59	-1.52	-1.64
At sample means for post-1987 retirees	-1.81	-1.65	-1.83	-1.71	-1.97
Sample size	12,644	8,399	4,245	3,236	9,408

Appendix. Figure A1. Percentage of Retirees Who are Male by Retirement Date

1