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Jaeun Shin
Sangho Moon

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HMO Plans, Self-Selection, and Utilization of Health Care Services

Jaeun Shin*, Sangho Moon

Abstract

This study examines the effect of health maintenance organizations (HMOs) on the use of health care services among the privately insured non-elderly population. Using data from the 2000 Medical Expenditures Panel Survey, we find that HMO members are not particularly healthier than non-HMO members. Still, endogenous health plan choice decisions cause attenuation bias in the utilization performance of HMOs. After controlling selection bias, HMO enrollment increases the uses of office-based services and hospital outpatient services. These findings imply that though HMOs in private insurance market intend to contain utilization, they, in fact, provide consumer incentive to use more of health care services.

Introduction

Since the HMO Act was passed in 1973, health maintenance organizations (HMOs) have become one of the most popular types of managed care plans. Faced with a dramatic increase in health care costs, HMOs implement utilization reviews, a tight authorization process, and a restricted choice of providers as means of managing utilization and quality.

By comparing health care service uses by HMO members and non-HMO members among the privately insured non-elderly population, this paper addresses three questions: do health conditions induce selective enrollment in HMOs?, does self-selection into HMOs cause any bias?, and do HMOs reduce the use of office-based service and hospital outpatient service?

* Correspondence: KDI School of Public Policy and Management, 207-43 Cheongnyangri2-Dong, Dongdaemoon-Gu, Seoul 130-868, Korea. Tel.: +822-3299-1037, Fax: +822-3299-1240, Email: jshin@kdischool.ac.kr. Sangho Moon, SungKyunKwan University, Graduate School of Governance, 53 Myeongnyun-Dong 3-Ga, Jongno-Gu, Seoul 110-745, Korea, Tel.: +822-760-0367, Email: smoon@skku.edu.

Trends and Relevance

During the last two decades, the number of HMO enrollees has proliferated from 9.1 millions (4 percent of total population) in 1980 to 76.1 millions (26.4 percent of total population) in 2001 (Source: Health, United States 2003). Between 1977 and 2001, the percentage of the U.S population under age 65 that joined private insurance HMOs increased dramatically from 3.7 to 27.9 percent (Table 1).

[Table 1]

Over the same period, national health expenditures per capita increased from \$1,067 to \$5,035, and total national health expenditures as percent of GDP rise from 8.8 percent to 14.1 percent. Out of total national health expenditures, the share of private expenditure decreased from 57.3 percent to 54.6 percent.

Motivated by relatively slow growth in private health care expenditures and the prevalence of HMOs in the private insurance market, we investigate the utilization performance of HMOs to understand whether HMOs contribute to limiting medical service utilizations relative to other insurance arrangements. There are two main complications for our empirical analysis; one is selection bias due to endogenous health plan choice decisions. Previous studies (Buchanan and Cretin 1986; Jackson-Beeck and Kleinman 1983) suggest that the utilization reduction effect of HMOs may be a consequence of the selective enrollment of a healthier population in HMO plans, not of the more efficient medical care delivery management of HMOs. Thus, we first estimate the probit model of health insurance plan choice decisions and test this hypothesis. The other complication is that the dependent variables are non-negative with high frequency of zero observations. The censored regression model enables us to consider this unique characteristic of dependent variables.

Literature on Utilization Performance of HMOs

Some studies have shown that HMOs are associated with lower hospitalization rates, shorter inpatient hospital days, and the same or more office visits (Cutler and Zeckhauser 2000; Glied 2000; Miller and Luft 1994). However, no conclusive evidence is provided on the hypothesis that HMOs effectively reduce the utilization of health care services. In regard to physician outpatient visits, a

comprehensive review is provided in Miller and Luft (1994). They report that among 14 observations from 10 studies, seven show lower physician service use (of which 3 results are statistically significant) while seven find higher use (of which five were statistically significant). With recent data, 9 of 10 observations document either higher or little difference in HMO plan office visits compared with conventional indemnity (or fee-for-service) plans. There is no evidence that compared to the behavior of indemnity plan members, substantially lower hospital use by HMO enrollees is accompanied by substantially higher use of physician services.

The dramatic changes in form among different managed care plans during the 1990's can be one reason for these seemingly unsettled conclusions. In addition, a statistical reason is discussed by Hunt-McCool, Kiker, and Ng (1994), who show that the sign and significance of the effects of HMOs on physician office visits and hospital inpatient care are sensitive to a choice of parametric specifications on the functional form of utilization. This sensitivity may be attributed to the ignorance of two data characteristics of observed health care utilization: (1) it is always non-negative, and (2) it contains a high frequency of zero events.

Literature on Endogenous Health Plan Choice

Another statistical aspect that brings ambiguity into the empirical literature is the endogeneity problem of health plan choice decisions jointly determined with utilization decisions (Cameron, Trivedi, Milne, and Piggott 1988; Gilleskie 1998). Evidence on self-selection in health plan choice varies across studies depending on data choice, definition of selection, and estimation specification. In most cases, the analysis is focused on the role of demographic, economic, and health-related factors in determining the health plan choice of an individual. Dowd, Feldman, Cassou, and Finch (1991) find that selectivity bias is small and insignificant. Similarly, Taylor, Beauregard, and Vistens (1995) suggest that HMO enrollees are younger but not much healthier than those in fee-for-service (FFS) plans, implying that self-selection based on health condition is not a major factor in the cost savings by HMO plans. On the other hand, Jackson-Beeck and Kleinman (1983) document that among FFS members, those who are younger and use less health care services switch into HMOs. Buchanan and Cretin (1986) report that younger populations

and families with lower income and lower annual medical expenditure prior to switching into HMO plan select HMOs. Evidence presented in Hunt-McCool, Kiker, and Ng (1994) is mixed: positive selection bias on hospital inpatient care, but negative bias on physician office visits. To avoid selection bias from a nonrandom sample, some studies (Ligon 1993; Ligon 1994; Manning, Newhouse, Duan, Keeler, and Leibowitz 1987) use experimental data of the RAND Health Insurance Experiment. However, the obsolescence of this experiment and the continuously changing health care system leave findings in these studies with little relevance.

Since it is not obvious that decisions on health plan choice is independent of decisions on health care service utilization, it is important to explicitly address the issue of self-selection in any empirical research on health care service utilization. Tu, Kemper, and Wong (1999) acknowledge the possible selectivity bias. Mello, Stearns, and Norton (2002) explicitly consider the issue of self-selection and find a substantial selection bias in effects of health insurance choice on utilization. By contrast, Dowd, Feldman, Cassou, and Finch (1991) find contradictory evidence that selectivity bias is neither large nor statistically significant in estimating the effect of HMO enrollment on utilization.

New Contribution

Acknowledging enormous variation in data, estimation methods, and results in the literature about selection and utilization performance of HMOs, we attempt to correctly evaluate the effects of HMO plans on the utilizations of different sites of medical services. First, our study uses recent and nationally representative data, the Medical Expenditures Panel Survey 2000. Combined, the household component and medical condition component provide comprehensive information about individuals' health-related condition and utilizations across various service sites as well as usual demographic and socioeconomic status. Subjective evaluation on the quality of health care gives us a way to understand the quality management of HMOs. Few of the previous studies use a nationally representative sample. The most recent one used in those studies, the National Medical Expenditure Survey, was collected in 1987. As the structure and enrollment of HMOs changed considerably over last decades, information revealed from recent data may have meaningful policy implications in health care reform debates.

Secondly, we explicitly deal with the problem of a non-trivial number of zero observations using the censored-at-zero maximum likelihood estimation (MLE) model. When ignored, a misspecification problem disqualifies the standard linear model associated with a normal distribution assumption to provide any reliable conclusions. With high frequency of zeros, a variable is unlikely to follow a normal distribution. Thus, we employ a censored MLE model, treating zero values as a consequence of the censoring-at-zero.

Finally, we control the possible bias from endogenous health plan choice decisions using the relatively simple method of correction of Vella (1993). Joint estimation of plan choice and utilization, respecting the unique data characteristic of observed utilization, has been an econometric challenge (Deb and Trivedi 2002; Kennel and Terza 2001), which usually requires computational intensity. By incorporating the method of Vella with the censored regression model, we are able to avoid the complex computation in implementing the analysis.

Estimation Model

We model the non-negativity and non-trivial number of zero observations for the dependent variables within the framework of the censored-at-zero regression. Let Y_i^* denote the value of the latent variable underlying the observed values of utilization, Y_i . The utilization equation is formulated as:

$$Y_i^* = X_i\beta + \delta HMO_i + u_i, \quad (1)$$

where X_i indicates exogenous variables, either continuous or discrete. HMO_i is a binary variable which is assumed to be endogenous. The censoring takes the form of $Y_i = \max\{0, Y_i^*\}$, that is,

$$Y_i = Y_i^* \text{ if } Y_i^* > 0 \text{ or equivalently } u_i > -\{X_i\beta + \delta HMO_i\} \quad (2)$$

and $Y_i = 0$, otherwise.

For the possible endogeneity, we assume that unobservable characteristics in equation (1) are correlated with the determinants of a binary explanatory variable, HMO_i . We follow a two-step estimation

method by Vella (1993) to obtain consistent estimates of δ . Let the latent variable denoted by H_i^* represent the indirect utility associated with insurance plan that an individual i has chosen (McFadden 1980). The value of H_i^* depends on some individual-specific and plan-specific characteristics, Z_i given as $H_i^* = Z_i\gamma + \varepsilon_i$. Then, the observed insurance choice indicator HMO_i is determined based on H_i^* as follows:

$$HMO_i = 1 \text{ if } H_i^* > 0 \text{ and } HMO_i = 0 \text{ if } H_i^* \leq 0. \quad (3)$$

In (2) and (3), errors, u_i and ε_i , are assumed to be jointly normally distributed with zero means, variances σ_u^2 , σ_ε^2 (normalized to 1) and covariance $\sigma_{u\varepsilon}$ expressed as $\begin{pmatrix} u \\ \varepsilon \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_u^2 & \sigma_{u\varepsilon} \\ \sigma_{u\varepsilon} & 1 \end{pmatrix}\right]$. In the first step procedure, we estimate the parameters from equation (3) using the probit model, and obtain $\hat{\gamma}$.

Now, we rewrite equation (2) in terms of its conditional expectation

$$E(Y_i|X_i, HMO_i) = X_i\beta + \delta HMO_i + E(u_i|X_i, HMO_i) \text{ if } Y_i^* > 0. \quad (4)$$

Note that $E(u_i|X_i, HMO_i) = E(u_i|HMO_i) \neq 0$ since u_i and ε_i are correlated. Under the bivariate normality assumption, the conditional expectation of u_i conditional on the endogenous binary variable can be expressed as:

$$E(u_i|HMO_i = 1) = E(u_i|\varepsilon_i > -Z_i\gamma) = \sigma_{u\varepsilon} \left[\frac{\phi(Z_i\gamma)}{\Phi(Z_i\gamma)} \right] \quad (5)$$

and

$$E(u_i|HMO_i = 0) = E(u_i|\varepsilon_i \leq -Z_i\gamma) = \sigma_{u\varepsilon} \left[\frac{-\phi(Z_i\gamma)}{1 - \Phi(Z_i\gamma)} \right], \quad (6)$$

where ϕ and Φ are the probability density function and the cumulative distribution function of the standard normal distribution. Evaluated at the consistent probit estimates $\hat{\gamma}$ of (3), the generalized residuals denoted as \hat{v} are given as:

$$\hat{v} \equiv \left[\frac{\phi(Z_i \hat{\gamma})}{\Phi(Z_i \hat{\gamma})} \right] \text{ if } HMO_i = 1 \quad (7)$$

and

$$\hat{v} \equiv \left[\frac{-\phi(Z_i \hat{\gamma})}{1 - \Phi(Z_i \hat{\gamma})} \right] \text{ if } HMO_i = 0. \quad (8)$$

Using equations (5)-(8), we rewrite equation (4) as:

$$E(Y_i | X_i, HMO_i) = X_i \beta + \delta HMO_i + \sigma_{u\varepsilon} \hat{v} \text{ if } Y_i^* > 0. \quad (9)$$

Then equation (1) can be rewritten as

$$Y_i^* = X_i \beta + \delta HMO_i + \sigma_{u\varepsilon} \hat{v} + e_i. \quad (10)$$

where the error, e_i , can be assumed to be uncorrelated with ε_i . The likelihood function for the censored regression model with endogeneity correction of equation (10) can be derived as follows:

$$L = \prod_{i=1}^n \Phi\left(-\frac{X_i \beta + \delta HMO_i + \sigma_{u\varepsilon} \hat{v}}{\sigma_u}\right)^{I(Y_i=0)} \bullet \frac{1}{\sigma_u} \phi\left(\frac{Y_i - \{X_i \beta + \delta HMO_i + \sigma_{u\varepsilon} \hat{v}\}}{\sigma_u}\right)^{I(Y_i>0)}. \quad (11)$$

The maximum likelihood estimation of equation (11) produces the consistent estimate of δ , indicating the effect of HMO_i on utilization. The coefficient of \hat{v} would give evidence about the role of self-selection in health plan choice.

Data

We use data from the 2000 wave of the Medical Expenditure Panel Survey (MEPS). The U.S. Agency for Health Care Policy and Research (AHCPR) and the National Center for Health Statistics (NCHS) collect this nationally representative data to provide information on demographic characteristics, health status, health insurance coverage, employment status and earnings, and various measures of health care utilization and expenditures for the U.S. civilian non-institutionalized population.

We limit our focus on the privately insured non-elderly (aged 18-64) sample. Individuals with Medicare, Medicaid or other types of public insurance are eliminated because this study intends to

understand the choice between HMO plans and non-HMO plans among individuals who make decisions in the private market for health insurance. The final sample includes individuals who are covered only by any private health insurance.¹ If individuals are covered by a private health insurance supplementing Medicare coverage, they are excluded from the final sample (N=7,474). The rate of HMO enrollment is 56.9 percent (4,252 in our final sample). Descriptions and summary statistics for the characteristics of HMO enrollees and non-HMO enrollees are presented in Tables 2-4.

Demographic Characteristics

Table 2 presents the demographic characteristics of HMO and non-HMO enrollees aged 18-64 who are covered by either type of health plan for all of 2000.² Comparisons show that HMO enrollees are younger; a higher percentage of HMO members are between 18 and 44 years old, while a smaller percentage of them are above age 45. A relatively smaller percentage of HMO members are white: 65 percent compared to 78 percent of non-HMO members. More blacks and hispanics are enrolled in HMO plans. HMO members are less educated; only 35.3 percent are more than high school educated, compared to 40.1 percent of non-HMO enrollees. People enrolled in HMO plans are likely to be from larger families and families with income no more than middle. High income families are more likely to enroll in non-HMO plans. HMO members are more likely to live in urban areas and in the Northeast or West, while non-HMO members mostly live in the Midwest and the South. This may be due to the different penetration rate of HMOs across regions.

Health Status and Insurance

Table 3 compares various measures of health status for HMO and non-HMO members in 2000. These data show little evidence that individuals enrolled in HMOs are relatively healthier than those in non-HMO plans. Self-rated health status, various measures of physical limitations and diagnosed diseases are similar for these two groups. However, people with certain chronic

[Table 2]

conditions are slightly less likely to enroll in HMOs than in non-HMOs. HMO members have a smaller number of conditions (ICD9codes³) and are less likely to suffer from a disease in the priority list.⁴ The percentage of enrollees with back problem, cancer, and emphysema is lower in HMOs. Other health problems such as ADL and depression are more prevalent among HMO

[Table 3]

members. There are no statistically significant differences in the percentage of HMO or non-HMO enrollees with arthritis, asthma, diabetes, gall bladder, hypertension, and ischemic heart diseases. HMO enrollment does not represent risk segmentation based on health status.

When we examine risk-taking behaviors such as ‘currently smoking’ and ‘likely to take risks’, there are no statistically significant differences. Regarding the attitudes towards health insurance and quality of health care, HMO members are more likely to appreciate their health insurance and medical care; they believe more strongly that health insurance is worth to the cost and that medical help is needed to overcome any illness. However, the evaluation of overall quality of health care is statistically significantly smaller among HMO members than non-HMO members, hinting the possibility of quality deterioration in HMO plans.

[Table 4]

Utilization and Cost Sharing

We consider two kinds of health services: office-based visits and hospital outpatient visits. Panel 1 of Table 4 documents the pattern of utilization by HMO members and non-HMO members. Utilization of each service is measured as total number of visits to service site during the entire year of 2000. A higher percentage of HMO members tend to make no use of both services. However, the average number of visits is statistically significantly smaller for HMO members for office-based visits. Importantly, the

frequency of zero visits ranges from 26 percent to 87 percent, indicating that uncensored normality may be a misspecification.

HMO plans features lower cost sharing. As shown in Panel 2 of Table 4, compared with non-HMOs, average amount of out-of-pocket payment per visit is only half in HMOs. Also, the ratio of total out-of-pocket payments to total medical expenditures is substantially lower in HMOs. These financial incentives for consumers in HMOs may encourage enrollees to use more of medical care services (Tu, Kemper, and Wong 1999). Given that health conditions are not significantly different between HMO and non-HMO members, and that HMO members are likely to have lower family income, self-selection into HMOs may occur based on the financial risk.

Results

Insurance Choice

To examine the marginal effect of various characteristics presented in Tables 2 and 3 on insurance plan choice, a probit regression is estimated and reported in Table 5. Many of the characteristics which are important in describing enrollment differences in Tables 2 and 3 remain important in the marginal effect analysis. For example, younger individuals prefer HMOs. Blacks and hispanics are more likely to be HMO members compared to whites and other ethnic groups. HMO members are more likely to be employed and less likely to be more than high school educated. Regional and MSA status also remains important in explaining the choice of health plan among non-elderly adults. People in the Northeast and West areas are more likely to enroll in HMOs, supporting the view that HMO enrollment rate is associated with geographical variations of the penetration rate based on region-specific conditions.⁵ Self-perceived health status and risk-taking behaviors remain insignificant. The negative significant effect of overall rating on health care suggests a negative correlation between HMO enrollment and customer satisfaction.

[Table 5]

In contrast to Tables 2 and 3, marital status, family size, and family income as poverty level lose their significance in affecting health plan choice. In addition, the presence of a chronic condition in the priority list and some chronic problems such as cancer and emphysema are no longer statistically significant. Smaller number of conditions is negatively correlated with HMO enrollment while depression and hypertension have positive effect on HMO enrollment. These results provide little evidence for the hypothesis that the utilization performance of HMOs would be contaminated by selective enrollment of healthier population in HMO plans.

Lower cost sharing makes people enroll in HMOs, confirming a possibility that consumer incentive in HMOs may raise the use of health care service among enrollees. It is also noted that HMO members agree more strongly with the statement that they do not need health insurance. At the same time, HMO members are likely to feel more need for medical care to overcome illness. These results together suggest that HMO enrollees are less willing to purchase health insurance but potentially more dependent on health care upon the occurrence of any sickness.⁶

Utilization, and Self-Selection Revisited

The potential endogeneity of health plan choice and the non-negativity associated with excess zero events of the dependent variable are our particular concern in estimation. For this reason, we try six set of regression models for comparison: (1) OLS results of level linear model accounting for neither endogeneity nor non-negativity; (2) OLS results of level linear model associated with Vella's correction accounting only for endogeneity; (3) OLS results of log-linear model accounting only for non-negativity; (4) OLS results of log-linear model with Vella's correction accounting only for endogeneity; (5) Censored MLE results without endogeneity correction; and (6) Censored MLE with endogeneity correction. In Tables 6 (office-based visits) and 7 (hospital outpatient visits), we report results of (5) and (6). Table A2 presents all other results of (1) to (4) to capture the importance of considering non-negativity and endogeneity.⁷

Office-Based Visits

As shown in Table 6, the effect of HMO enrollment is positive and highly significant only when correcting for self-selection. HMOs, which are usually seen as having strong restrictions on utilization, in fact encourage the use of office-based health care services. The negative and highly significant coefficient of the endogeneity correction term, \hat{v} , has an implication that unobserved factors, which increase the probability of being enrolled in HMOs, decrease the utilization by self-selected HMO members, relative to the utilization of the randomly assigned HMO members. That is, self-selection in health plan choice occurs in a favorable way for HMO plans. Considering the finding that HMO enrollment is not significantly affected by various health conditions, we suggest that the introduction of HMO plans does not succeed in revealing hidden health care needs and sorting populations into different plans accordingly. If a person is employed, she uses less medical services as her employment status indicates whether her health condition is good enough for her to afford to work. People of more than high school education are likely to use more health care services. Reasonably, more education people are concerned more with their health condition, because longer working life expectancy is important for them to compensate the opportunity cost they have paid for additional years in education. Racial minorities such as blacks and hispanics tend to depend less on office-based visits. This suggests that cultural differences or attitudinal discrimination of providers across ethnicity may be an important factor in determining utilization patterns. In regions where the higher percentage of HMO enrollees dwell (Table 2), utilization is relatively lower; the MSA, the Northeast, and the West show lower utilization. Notably, effects of age and income are not generally significant. Our sample consists of individuals with private health insurance coverage.

[Table 6]

Therefore, out of pocket payments for health care services are relatively small as a fraction of total expenditures and thus utilization is not elastic to income level.

While perceived health condition as being less than good, the number of conditions, and having any limitation in activity or a medical condition listed as priority lead to more utilization, some chronic

diseases have negative effects on utilization; as each type of disease requires different procedures and treatments in a specific way, having one kind of disease does not mean necessarily higher utilization of one specific type of health service. Visits to office-based health providers are affected by attitudes regarding health insurance; if a person believes more strongly that she needs a health insurance, she is likely to use more services. She may believe so because she expects possible future occurrence of some health conditions, which will require the financial establishment to pay for it. Not surprisingly, having routine medical check-ups and higher rating on overall quality of health care have significantly positive effects on the level of utilization.

Hospital Outpatient Visits

Similar to the case of office-based service, HMO enrollment increases the use of hospital outpatient services, and self-selection into HMO cause downward bias and insignificance in the utilization effect of HMOs. Age, and family income and size become statistically significant, giving intuitively probable signs: older people visit the hospital more often as outpatients. People from larger families and lower-income families seem to make a smaller number of visits. These findings can be explained by the relatively higher per-visit price of hospital outpatient services relative to office-based care, which should be financed from consumers' own resources; as shown in Table 4, among non-HMO members, the self-financed amount of per-visit to hospital outpatient services is on average \$79.7, which is much higher than the \$37.7 per-visit to office-based services. For HMO members, these amounts are \$30.5 and \$18.3, respectively. As the cost sharing portion of total payments is more burdensome on consumers, family size and family

[Table 7]

income constrain the use of hospital outpatient services. In the case of relatively cheap office-based services, these family budget constraints may not restrict utilization in a significant way. Similarly, only a

person who manages to accumulate some resources over time can afford to make a relatively expensive visit to the hospital.

Conclusion

In this study, we use the censored MLE method combined with endogeneity correction to jointly estimate the choice of health insurance plans and health care utilization respecting the possibility of self-selection into insurance plans, and the non-negativity and high frequency of zero events in utilization. We find significant evidence of favorable selection into HMOs; individuals who are more likely to enroll in HMOs are likely to utilize less health care services.

Analysis of health plan choice into HMO plans shows that demographic and health related factors are less important than generally expected. HMO enrollees are younger but not particularly healthier than enrollees in non-HMO plans. Health conditions seem to make no significant difference in individuals' decision on whether to have a HMO plan.

However, we find the negative selection bias of HMO enrollment attenuates the uncorrected effect of HMOs on utilization. This implies that factors other than health conditions are important for the selective enrollment in HMOs. We suggest the financial risk to be responsible for this selection. HMOs provide lower burden of cost sharing. Thus, people with lower willingness or capability to pay for health services are more likely to enroll HMOs and more likely to use less health care services; Younger people tend to be relatively optimistic regarding their health conditions and have relatively little resources to spend on health insurance and services, they are more likely to choose a HMO plan. However, once enrolled, HMO members have incentive to benefit from lower cost sharing and subsequently, use more health care services given an occurrence of a health problem, compared to non-HMO members. As a result, HMOs is found to encourage enrollees to use more of health care services. This suggests that HMOs do not contribute in managing utilization in any significant way. It is possible, however, that providers, not consumers, may be to blame for the ineffectiveness of HMOs. Providers have an incentive to provide more-than-necessary amount of care when the reimbursement arrangement is contracted with HMOs. In

this case, HMOs need to make improvement in monitoring providers' behaviors in their provision of medical services, rather than in restricting consumers' access to medical care. More analysis is required to understand which, either providers or consumers, is indeed responsible for the ineffective performance of HMOs in reducing utilization.

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Notes

1 We exclude individuals who have multiple coverage as the combination of private and public insurance because their utilization of health care services is reported as a total annual amount so that it is difficult to sort out what portion of the total annual number of visits to specific health services are associated with their coverage and choice of a private insurance plan. For a similar reason, being ‘privately insured’ is defined as being insured by any private insurance throughout the entire year 2000. Individuals may change their coverage status and insurance plan at any point within year. Hence, based on the monthly insurance status information, we figure the sample with only private insurance for every month in the year 2000.

2 We concentrate on the results for persons enrolled only in HMO and non-HMO plans for the entire calendar year. MEPS 2000 provides the enrollment status at three different points during a year. Based on this information, HMO enrollment in our analysis means that a person is reported to be enrolled in HMO plans throughout a year. Because a person may enroll in both types of plans by switching plans at some point during the year, any conclusions drawn from these statistics would be less meaningful and perhaps misleading.

3 The ‘number of condition’ variable is defines how many medical problems listed in ICD9codes are held by an individual. The list of ICD9codes is the ninth version of the International Classification of Diseases, a standardized list of 3 digits codes to identify a specific medical condition. This list is maintained by the National Center for Health Statistics and the Health Care Financing Administration. The entire list of ICD9codes is provided as Appendix 2 to the documentation for the Medical Condition component of MEPS 2000.

4 The priority list is constructed based on each condition's prevalence, importance in expense, and relevance to policy. The complete listing of priority conditions is provided by MEPS 2000 (the same documentation as above, Appendix 4). This list categorizes various diseases into three groups; long-term life-threatening conditions such as cancer, diabetes, emphysema, hypertension, and ischemic heart disease; chronic manageable conditions including arthritis, asthma, and gall bladder disease; in addition, some mental health issues such as depression are included.

5 *Health, United States 2003* reports the percent of population enrolled in HMOs by geographical region in year 2000; Northeast 36.5 percent, Midwest 23.2 percent, South 22.6 percent, West 41.7 percent. However, the number of HMO plans available in a region shows the opposite pattern; Northeast 98, Midwest 161, South 203, West 106. These data shows that the extent of popularity of HMO plans varies across regions reflecting regional variations in adopting new administrative health care systems and in need of managing quality and utilization.

6 To avoid potential bias to include individuals who do not have a choice as to whether to join an HMO, we replicate the health plan choice analysis using a more limited sample, restricting the population to those who have choices in selecting their health care plan. This reduces the sample size from 7,474 to 2,428. The results reported in Table A1 do not change the earlier conclusions. Many variables remain statistically significant except for age, being black, being employed, and having depression as a chronic condition.

7 Estimates of HMO effect in utilization are all insignificant and change signs across specifications and dependent variables. However, when the potential self-selection is controlled, the endogeneity correction term captures the negative correlation between utilization of health care services and the unobserved factors that determine the choice of a plan. Also, HMO enrollment has a positive and highly significant effect on utilization; a result consistent with the censored MLE cases. It is also clear that accounting for the non-negativity of the dependent variable and selection bias from the endogenous explanatory variable is important. This is illustrated by changes in the sum of squared residuals (SSR); the non-negativity correction reduces the SSR considerably and the additional endogeneity correction leads to even more

reduction in the SSR. Though the main results appear to be similar to results from the censored MLE regression, the test for normality on the dependent variable and estimated residual rejects the normal distribution assumption. Hence, we focus on discussing the results obtained from the censored MLE model, which account for non-negativity as well as endogeneity without losing observations as it would be the case when taking logs for the dependent variables.

References

- Buchanan, J. and S. Cretin. 1986. Risk Selection of Families Electing HMO Membership. *Medical Care* 24(1): 39-51.
- Cameron, A. C., P. K. Trivedi, F. Milne, and J. Piggott. 1988. A Microeconometric Model of the Demand for Health Care and Health Insurance in Australia. *Review of Economic Studies* 55: 85-106.
- Cutler, D. M., R. J. Zeckhauser. 2000. The Anatomy of Health Insurance. In *Handbook of Health Economics*, Culyer A. J. and J. P. Newhouse (eds). 563-644.
- Deb, P. and P. K. Trivedi. 2002. Gatekeeping, Self-Selection and Utilization of Curative and Preventive Health Care Services. Working paper. Hunter College.
- Dowd, B., R. Feldman, S. Cassou, and M. Finch. 1991. Health Plan Choice and the Utilization of Health Care Services. *Review of Economics and Statistics* 73(1): 85-93.
- Gilleskie, D. 1998. Dynamic Stochastic Model of Medical Care Use and Work Absence. *Econometrica* 66(1): 1-45.
- Glied, S. A. 2000. Managed Care. In *Handbook of Health Economics*, Culyer, A. J. and J. P. Newhouse (eds). 707-745.
- Hunt-McCool, J., B. F. Kiker, and Y. C. Ng. 1994. Estimates of the Demand for Medical Care under Different Functional Forms. *Journal of Applied Econometrics* 9(2): 201-218.
- Jackson-Beeck, M. and J. H. Kleinman. 1983. Evidence for Self-Selection among Health Maintenance Organization Enrollees. *Journal of the American Medical Association* 250(20): 2826-2829.
- Kennel, D. S. and J. V. Terza. 2001. The Effect of Physician Advice on Alcohol Consumption: Count Regression with an Endogenous Treatment Effect. *Journal of Applied Econometrics* 16: 165-184.
- Ligon, J. 1993. The Effect of Health Insurance Cost Sharing within Episodes of Medical Care. *Journal of Risk and Insurance* 60(1): 105-118.

- _____. 1994. Fee-For-Service versus HMO Outpatient Expenditure Patterns. *Journal of Risk and Insurance* 61(1): 96-106.
- Manning, W. G., J. P. Newhouse, N. Duan, E. B. Keeler, and A. Leibowiz. 1987. Health Insurance and the Demand for Medical Care: Evidence from a Randomized Experiment. *American Economic Review* 77(3): 251-277.
- McFadden, D. 1980. Econometric Models for Probabilistic Choice among Products. *Journal of Business* 53: S13-29.
- Mello, M., S. Stearns, and E. Norton. 2002. Do Medicare HMOs still Reduce Health Services Use after Controlling for Selection Bias? *Health Economics* 11: 323-340.
- Miller, R. and H. Luft. 1994. Managed Care Plan Performance Since 1980: A Literature Analysis. *Journal of the American Medical Association* 271(19): 1512-1519.
- Taylor, A. K., K. M. Beauregard, and J. P. Vistnes. 1995. Who Belongs to HMOs: A Comparison of Fee-For-Service versus HMO Enrollees. *Medical Care Research and Review* 52(3): 389-408.
- Tu, H. T., P. Kemper, and H. J. Wong. 1999. Do HMOs Make a Difference? Use of Health Services. *Inquiry-The Journal of Health Care Organization Provision and Financing* 36(4): 400-410.
- Vella, F. 1993. A Simple Estimator for Simultaneous Model with Censored Endogenous Regressors. *International Economic Review* 34: 441-457.

Table 1. Trends in private health insurance: HMO enrollment 1977-2001 (under age 65)

Percentage	1977	1987	1998	2001
with Private Insurance	79.4	77.7	72.3	71.5
with Private Health Insurance HMO	3.7	17.1	30.5	27.9

(Source: *Health, United States 2003*; Taylor, Beauregard, and Vistnes 1995)

Table 2. Demographic characteristics (age 18-64, privately insured)

	Total	HMO	Not HMO
Total	7474	4252	3222
Percentage	100.0	56.9	43.1
Age			
18-24	.100	.108*	.091
25-44	.473	.492*	.449
45-54	.263	.258*	.271
55-64	.163	.143*	.190
Race/Gender/Marital Status			
White	.706	.650*	.780
Black	.115	.131*	.094
Hispanic	.149	.181*	.106
Male	.473	.469	.478
Married	.688	.677*	.704
Employed		.884*	.858
Education			
Less than High School	.149	.156*	.140
High School Graduates	.477	.490*	.459
More than High School	.374	.353*	.401
Poverty Status of Family Income			
Poor	.026	.025	.028
Near Poor	.014	.016*	.011
Low	.083	.088*	.077
Middle	.341	.348*	.331
High	.536	.523*	.554
Family size			
1	.123	.126	.119
2	.282	.258*	.314
3	.205	.203	.207
4+	.390	.413*	.360
Place of residence			
Urban (MSA)	.801	.854*	.730
Northeast	.171	.205*	.127
Midwest	.251	.190*	.332
South	.366	.323*	.391
West	.222	.276*	.150

^a * indicates that the estimate is statistically different from the corresponding estimate for the non-HMO sample.

Table 3. Health status (age 18-64, privately insured)

	Total	HMO	Not HMO
Perceived Health Status			
Excellent/Very Good/Good	.931	.929	.934
Fair/Poor	.068	.071	.065
Number of Conditions (ICD9codes) (Mean)	3.03	2.92*	3.16
Number of Conditions (ICD9codes) (%)			
0	16.2	16.4	15.9
1-2	36.4	37.1	35.3
3+	47.5	46.5	48.8
Priority List	.315	.304*	.330
Functional Limitation			
IADL	.005	.005	.006
ADL	.003	.004*	.002
Social Limitation	.016	.014*	.020
Cognitive Limitation	.009	.010	.007
Unable to Do Activity	.013	.012	.014
Any Limitation	.138	.132*	.145
Diagnosed Chronic Conditions			
Arthritis	.011	.010	.012
Asthma	.041	.043	.038
Back Problem	.136	.127*	.147
Cancer	.036	.033*	.039
Depression	.133	.139*	.125
Diabetes	.052	.052	.053
Emphysema	.049	.042*	.059
Gallbladder	.010	.010	.009
Hypertension	.151	.151	.151
Ischemic	.027	.025	.030
Health Risks/Attitudes			
Current Smoker	.191	.190	.193
Likely to Take Risks	2.13	2.14	2.12
No Need for Health Insurance ^a	1.44	1.45	1.42
Insurance No Worth Of Cost ^a	2.03	2.01*	2.06
Overcome Illness without Medical Help ^a	2.17	2.14*	2.20
Receiving Routine Medical Care	.705	.706	.703
Overall Quality of Health Care	8.07	7.93*	8.25
Presence of Gatekeeper			.247
Out-of-Pocket Payment			
Amount	415.8	358.6*	491.4
Ratio of Total Payment	.339	.313*	.373

^a ^ indicates that the measurement is the following; 1 disagree strongly, 2 disagree somewhat, 3 uncertain, 4 agree somewhat, and 5 agree strongly.

Table 4. Utilization of health care services (age 18-64, privately insured)

Panel 1		Utilization				
The Number of Visits	Total		HMO		Not HMO	
	Zero (%)	Nonzero	Zero (%)	Nonzero	Zero (%)	Nonzero
Office-Based	26.8	6.34	27.4	6.17*	26.0	6.57
Hospital Outpatient	85.4	2.58	87.1	2.73	83.3	2.41
Panel 2		Cost of Utilization : Out-of-Pocket Expenditure				
Rate of Cost Sharing	Office-Based	.257	.210*		.318	
	Hospital	.123	.083*		.210	
	Outpatient					
Out-of-Pocket Unit	Office-Based	26.8	18.3*		37.7	
Price of Service	Hospital	54.8	30.5*		79.7	
(In dollars)	Outpatient					

^a The rate of cost sharing is obtained as total annual out-of-pocket payments for the service divided by total annual medical expenditures. The out-of-pocket unit price of service is defined as total annual amount of out-of-pocket payments for the use of a type of service divided by total number of visits to that service.

Table 5. Probit estimation of binary health insurance plan choice

Variable	Coefficient	Std. Dev.	Marginal Effect
Constant	.530	.211	
Age	-.005	.002	-.0019**
Black	.232	.072	.0893***
Hispanic	.164	.067	.0638**
Male	-.032	.044	-.0127
Married	-.041	.052	-.0161
Employed	.202	.060	.0799***
Less than High School	-.083	.066	-.0328
More than High School	-.140	.044	-.0552***
Family Income	.014	.025	.0069
Family Size	.018	.017	.0053
Urban	.302	.050	.1197***
Northeast	.398	.059	.1509***
Midwest	-.210	.050	-.0829***
West	.454	.057	.1720***
Fair/Poor Health Status	.059	.079	.0231
Number of Conditions (ICD9codes)	-.029	.008	-.0113***
Priority List	-.021	.046	-.0082
Diagnosed Chronic Conditions			
Arthritis	.177	.174	.0695
Asthma	.104	.090	.0409
Cancer	.055	.091	.0218
Depression	.114	.052	.0447**
Diabetes	-.132	.083	-.0520
Emphysema	-.098	.080	-.0387
Gall Bladder	.027	.166	.0108
Hypertension	.137	.057	.0539**
Ischemic	.035	.101	.0136
Health Risks/Attitudes			
Current Smoker	.030	.053	.0119
Likely to Take Risks	.003	.018	.0011
No Need for Health Insurance	.057	.028	.0226**
Insurance No Worth of Cost	-.018	.018	-.0070
Overcome Illness without Medical Help	-.057	.018	-.0226***
Receiving Routine Medical Care	.058	.066	.0229***
Overall Quality of Health Care	-.056	.012	-.0222***
Out-of-Pocket Payment/Total Payment	-.532	.080	-.2093***
Log-Likelihood		-2790.4	

Table 6. Censored regression of utilization: office-based services

Variable	Uncorrected		Corrected	
	Coefficient	Std. Dev.	Coefficient	Std. Dev.
HMO Enrollment	-.076	.314	17.2***	2.87
$\hat{\nu}$ (Endogeneity Correction)	-	-	-10.7***	1.77
Constant	-.855	1.58	-10.5***	2.33
Age	-.014	.016	.015	.017
Black	-1.04*	.542	-2.60***	.610
Hispanic	-.683	.496	-1.64***	.535
Male	-.587*	.331	-.320	.333
Married	-.155	.392	-.022	.396
Employed	-.261	.454	-1.60***	.509
Less than High School	.779	.501	-.092	.513
More than High School	.362	.333	1.28***	.367
Family Income	.011	.187	-.120	.189
Family Size	.076	.126	-.010	.128
Urban	.562	.386	-1.51***	.518
Northeast	-1.35***	.447	-1.42**	.643
Midwest	.546	.390	1.81***	.444
West	-.013	.434	-2.99***	.660
Fair/Poor Health Status	1.44**	.575	1.04*	.579
Number of Conditions (ICD9codes)	1.42***	.062	1.54***	.067
Priority List	.238	.351	.443	.353
Any Limitation	2.44***	.431	2.57***	.431
Diagnosed Chronic Conditions				
Arthritis	-1.54	1.32	-2.57*	1.33
Asthma	-2.15***	.673	-2.70***	.679
Cancer	.974	.691	.355	.694
Depression	.635*	.387	.052	.401
Diabetes	-.252	.624	.461	.637
Emphysema	-1.17*	.608	-.495	.625
Gall Bladder	-1.26	1.22	-1.37	1.26
Hypertension	-1.20***	.437	-2.17***	.458
Ischemic	-1.15	.773	-1.46*	.770
Health Risks/Attitudes				
Current Smoker	-.209	.601	-.331	.606
Advised to Quit Smoking	-.802	.733	-.961	.737
Likely to Take Risks	.040	.137	.032	.137
No Need for Health Insurance	-.345*	.203	-.561***	.207
Overcome Illness without Medical Help	-.257*	.138	.121	.153
Receiving Routine Medical Care	2.03***	.504	1.45***	.514
Overall Quality of Health Care	.012	.087	.343***	.103
Out-of-Pocket Payment/Total Payment				
Log-Likelihood	-15537.1		-15366.5	

Table 7. Censored regression of utilization: hospital outpatient services

Variable	Uncorrected		Corrected	
	Coefficient	Std. Dev.	Coefficient	Std. Dev.
HMO Enrollment	-.395	.282	29.4***	2.95
\hat{v} (Endogeneity Correction)	-	-	-18.4***	1.82
Constant	-8.70***	1.49	-26.8***	2.41
Age	.065***	.015	.125***	.016
Black	-.455	.525	-3.28***	.602
Hispanic	.396	.461	-1.53***	.502
Male	-.774**	.307	-.486	.309
Married	.562	.367	.818**	.372
Employed	-.585	.389	-2.92***	.455
Less than High School	.121	.452	.933**	.465
More than High School	-.306	.302	1.33***	.343
Family Income	-.173	.171	-.348**	.173
Family Size	-.161	.122	-.340***	.124
Urban	-.719**	.337	-4.24***	.487
Northeast	1.86***	.404	-2.86***	.615
Midwest	1.76***	.348	4.05***	.422
West	-.144	.412	-5.23***	.653
Fair/Poor Health Status	.541	.474	-.013	.478
Number of Conditions (ICD9codes)	.562**	.051	.837***	.059
Priority List	.250	.309	.532*	.311
Any Limitation	.480	.367	.662*	.368
Diagnosed Chronic Conditions				
Arthritis	2.39***	.925	.619	.926
Asthma	-.495	.542	-1.39***	.544
Cancer	2.14***	.527	1.15**	.529
Depression	-.272	.323	-1.40***	.344
Diabetes	-.737	.530	.580	.546
Emphysema	-.889*	.512	.127	.535
Gall Bladder	2.20**	.909	2.00**	.922
Hypertension	-.619*	.373	-2.12***	.403
Ischemic	.701	.599	.257	.593
Health Risks/Attitudes				
Current Smoker	-1.22**	.594	-1.52**	.598
Advised to Quit Smoking	1.38**	.698	1.11	.703
Likely to Take Risks	-.057	.125	-.106	.126
No Need for Health Insurance	-.279	.200	-.698***	.206
Overcome Illness without Medical Help	-.084	.127	.611***	.146
Receiving Routine Medical Care	.552	.497	-.165	.507
Overall Quality of Health Care	-.081	.078	.499***	.097
Out-of-Pocket Payment/Total Payment				
Log-Likelihood	-4161.3		-4061.2	

Appendix

Table A1. Probit estimation of HMO enrollment during the entire calendar year 2000 for those having a choice of plans

Variable	Coefficient	Std. Dev.	Marginal Effect
Hispanic	.237	.112	.0849**
More than High School	-.210	.069	-.0784***
Urban	.147	.088	.0559*
Northeast	.667	.101	.2201***
West	.640	.092	.2169***
Number of Conditions (ICD9codes)	-.032	.014	-.0120**
Hypertension	.157	.091	.0586*
No Need for Health Insurance	.097	.043	.0362**
Overall Quality of Health Care	-.082	.020	-.0306***
Out-of-Pocket Payment/Total Payment	-.398	.135	-.1485***
Log-Likelihood		-1077.8	

^a In the regression, exactly same set of regressors are included. Variables reported in this table are those which have at least 10% level of statistical significance for concision.

Table A2. Alternative specifications of utilization

Panel 1				
Total office-based visits				
Variable	Linear OLS		Log-Linear OLS	
	Uncorrected	Corrected	Uncorrected	Corrected
HMO Enrollment	-.045 (.292)	12.9 (2.5)***	.007 (.028)	2.14 (.243)***
\hat{v} (Endogeneity)	-	-8.03 (1.55)***	-	-1.32 (.150)***
SSR	388615.3	384742.4	2972.0	2902.9
Adjusted R ²	.178	.178	.277	.291
Panel 2				
Total hospital outpatient visits				
Variable	Linear OLS		Log-Linear OLS	
	Uncorrected	Corrected	Uncorrected	Corrected
HMO Enrollment	.015 (.076)	3.39 (.657)***	-.021 (.049)	1.78 (.475)***
\hat{v} (Endogeneity)	-	-2.09 (.405)***	-	-1.13 (.295)***
SSR	26501.0	26297.2	451.6	442.9
Adjusted R ²	.056	.062	.095	.110