DOES SPENDING ON MEDICAL SERVICES CHANGE AS HMOs GROW AND MATURE?

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ABSTRACT

This research examines the cost structure of a nationally representative sample of HMOs from 1991-1994 to determine whether cost savings achieved through enrollment growth and age of the plan are shared with any of the factors of production. The data are obtained from Health Care Investment Analysts. A generalized translog cost function is used to derive factor share equations for four intermediate groups of inputs used by an HMO: physician services, other medical provider services, hospital services and administrative services. We estimate the system of annual factor shares using seemingly unrelated regression analysis and find that both plan size and age have a significantly positive effect on the level of plan expenditure on physicians, other medical providers and hospitals. Examination of the changes in factor shares over time, however, indicates that large changes in membership have no significant effect on the amount of resources dedicated to physicians. Only hospitals see a significant increase in the change in factor share at the expense of administrative services.

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Does Spending on Medical Services Change as HMOs Grow and Mature?

Recent empirical research has identified at least three sources of cost savings achieved by managed care organizations (MCOs), and in particular health maintenance organizations (HMOs). First, studies have shown that HMOs have been able to reduce health care costs by restricting utilization of hospital services and expensive medical technology (Manning et al., 1984; Miller and Luft, 1994; Grumback & Bodenheimer, 1995). Second, by increasing their market buying power, HMOs are able to negotiate more favorable contracts with physicians (Kwon, 1996; Inglehart, 1994) and possibly with hospitals and other health care providers. Third, by increasing enrollment, recent studies have shown that some HMOs experience declining administrative cost per member per month (Wholey et al, 1996; Given 1996). Given that HMOs are able to achieve these cost savings, many have begun to ask what HMOs are doing with the extra money they've been able to save. Does the money get poured back into administration of the plan and its administrators, does the money get dispersed to the owners of the HMO, does the money get used to lower premiums, or do plans increase their payments to the providers of health services?

It is a widely held belief that providers, and in particular physicians, are made worse off under a system of managed care because they are forced to accept lower payments for their services and do not benefit from the cost savings achieved by the MCOs. Indeed these claims appear to be validated by evidence showing declining physicians' earnings (Simon and Born, 1996). It is not entirely clear, however, that all physicians must be made worse off financially when practicing in a mature managed care setting, particularly if the number of patients they see increases by more than the decrease in their discounted FFS or capitated payment. In fact, recent evidence shows that the earnings gap is closing among primary care and specialty physicians due in large part to MCOs higher utilization of primary care physician services (Simon and Born, 1996; Born and Simon, 1997).

This research examines the cost structure of organizations providing health care services. Using a nationally representative sample of HMOs during the years 1991-1994, we examine whether cost savings achieved through enrollment growth and age of the plan are shared with any of the factors of production. A generalized translog cost function is used to derive factor share equations for four intermediate groups of inputs used by an HMO: physician services, other medical provider services, hospital services and administrative services. We estimate the system of annual factor shares using seemingly unrelated regression analysis to identify important determinants of each and find that both plan size and age have a positive and significant effect on the level of expenditure on physician services, other medical providers, and hospital services. Examination of the changes in factor shares over time, however, indicates that large changes in membership have no significant effect on the amount of resources dedicated to physicians. Only hospitals see a significant increase in the change in their factor share at the expense of administrative services.

I. Background

Limited research has been conducted on the cost structure of HMOs and how this structure has changed as manage care markets and individual firms mature. The basic presumption is that as HMOs face stiffer competition, they have greater incentive to look for ways to cut costs and reduce moral hazard.[1] The most often cited source of cost savings is reduced utilization of hospital services, measured both as admissions and length of stay. Manning et al. (1984) found in a clinical trial that a prepaid group practice was able to reduce a single measure of hospital admissions and hospital days by 40% compared to a free fee-for-service plan, even after controlling for population and plan benefits. Further, they found that overall health care expenditure in the group health plan was 25% lower than the free fee-for-service (FFS) plan. In their review of the literature since 1980, Miller and Luft's (1994) report similar

[1] Several recent studies have found that increased competition actually leads to higher costs incurred by HMOs. See Given (1996) and Schlesinger, Blumenthal, and Schlesinger (1986).

savings among HMOs when compared to traditional indemnity plans. They conclude that HMOs have hospital lengths of stay anywhere from 1 to 20% shorter than traditional indemnity plans.

The second major source of cost savings for HMOs as they grow over time is economies of scale. Recent evidence suggests that HMOs are able to achieve some economies of scale in specific functional areas. Analyzing data from approximately 80 HMOs in 1983, Schlesinger, Blumenthal and Schlesinger (1986) found evidence of economies of scale for ambulatory and administrative costs. They did not, however, find economies of scale for hospital costs. Given (1996) also found economies of scale in a sample of California HMOs from 1986-1992, but these economies were small and existed only for firms with at least 100,000 enrollees. Wholey, Feldman, and Christianson (1995) estimated a multiproduct cost function on a nationally representative sample of HMOs from 1988-1991 and also found that economies of scale exist, but are exhausted when HMO enrollment reaches 50,000 members. No economies of scope were found for HMOs offering Medicare managed care plans in addition to their regular plans.

As enrollment in managed care continues to grow and profits rise, public health researchers have become increasingly concerned with how HMOs choose to spend the cost savings they are able to achieve from restricting care. There is some evidence that HMOs in highly competitive managed care markets pass some of their cost savings on to consumers in the form of lower premiums (Wholey et al., 1995). Alternatively, it is possible that some HMOs choose to use these savings to reward their physicians and other health care providers. A key source of concern to many policy makers is whether or not the bulk of these savings is passed on to shareholders instead of being spent on providing better medical care. This concern is fueled by the recent growth of for-profit organizations in the financing of medical care and the increase in conversions from non-profit to for-profit status.

In this paper, we try to determine where cost savings are spent by examining variations in factor shares across plans with different characteristics. Our research expands the work that has been done this far in a number of significant ways. First, by simultaneously estimating the input factor shares we are

able to identify which of the competing inputs to production benefit the most from the recent growth and profitability of HMOs. Thus, we address the question regarding who benefits the most from HMO growth and the overall penetration of managed care. Second, we employ a large, nationally representative data set of HMO financial information for the period 1991-1994. Existing research has been limited to either a smaller, state-level sample, or an earlier time period.

II. Model Specification

Like Wholey et al (1996) and Given (1996), we view HMOs as producing a joint product of health insurance and health care services. Physician services as well as administrative services, therefore, can be thought of as intermediate goods used by the HMO in its production of this joint product, simply thought of as member months of HMO coverage. For simplicity, we assume that all of the inputs to production for an HMO can be grouped into four intermediate categories: physicians (P), other professional providers (N), hospitals (H), and administrators (A). These four inputs combine to produce a single general health services output (Y). Following Wholey et. al (1996), we employ a generalized translog cost function to derive the HMO factor input shares. The generalized translog cost function can be used to represent the local approximation of any arbitrary cost function in terms of a second-order Taylor's series in logarithms. Its general flexible form offers several distinct advantages over other cost function specifications.[2] In particular, the generalized translog form does not impose any specific economies of scale nor does it impose partial elasticities of substitution between inputs of unity. The specific form of the generalized translog cost function employed in this analysis is given by:

$$\ln C_t = \alpha_0 + \alpha_P \ln w_{Pt} + \alpha_N \ln w_{Nt} + \alpha_H \ln w_{Ht} + \alpha_A \ln w_{At} + \frac{1}{2}\sum_i \sum_j \gamma_{ij} \ln w_{it} \ln w_{jt} +$$

(1)

$$\beta_0 \ln y_t + \frac{1}{2}\beta_1 (\ln y_t)^2 + \sum_i \delta_i \ln w_{it} \ln y_{it} + \phi X_t + \psi Z_t \qquad \text{for } i,j = P,N,H \text{ and } A.$$

where C = total cost of the HMO in period t,

w_{Pt} = input price of physicians in period t,

w_{Nt} = input price of other professional health service providers in period t,

w_{Ht} = input price of hospital providers in period t,

w_{At} = input price of administrators in period t,

y_t = number of enrollees in period t

X_t = a matrix of firm specific factors that influence the cost of producing health services at time t,

Z_t = a matrix of market characteristics that influence the cost of producing health services at time t.

The current form assumes that the firm specific factors and market characteristics do not influence the elasticities of substitution between inputs and the effect of output on costs.

The four factor input shares can be obtained from the cost function by differentiating equation (1) with respect to $ln\ w_j$ for $j = P, N, H,$ and A, and then using Shepherd's Lemma to substitute the quantity of input j for $\frac{\partial C}{\partial w_j}$. Letting P, N, H and A represent the number of physician inputs, other professional health service provider inputs, hospital inputs and administrative inputs employed, respectively, the resulting factor input shares are:

$$(2)\quad S_{pt} = \frac{Pw_P}{C} = \alpha_P + \sum_j \gamma_{Pj} \ln w_{jt} + \delta_{PP} \ln Y_t + \phi_P X_t + \psi_P Z_t$$

$$(3)\quad S_{Nt} = \frac{Nw_N}{C} = \alpha_N + \sum_j \gamma_{Nj} \ln w_{jt} + \delta_{NN} \ln Y_t + \phi_N X_t + \psi_N Z_t$$

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[2] A further advantage of the generalized translog form, important for multiproduct firms, is that it does not constrain the cost function to be homothetic. It, therefore, is possible for the ratio of inputs to vary over the full product range. For a quick review of the assumptions regarding the translog cost function, see Intrilligator, et al (1996).

(4) $S_{Ht} = \frac{Hw_H}{C} = \alpha_H + \sum_j \gamma_{Hj} \ln w_{jt} + \delta_{HH} \ln Y_t + \phi_H X_t + \psi_H Z_t$

(5) $S_{At} = \frac{Aw_A}{C} = \alpha_A + \sum_j \gamma_{Aj} \ln w_{jt} + \delta_{AA} \ln Y_t + \phi_A X_t + \psi_A Z_t \qquad for\ j = P, N, H, A$

For the cost function to be consistent with economic theory, several restrictions must be imposed on these factor share equations. First, the sum of all the factor shares must sum up to one. Second, the cost function must be symmetric and negative semidefinite. Third, the cost function must be homogeneous of degree one in input prices. These three restrictions are imposed upon the cost shares, respectively, by requiring that:

(6) $\sum_i S_i = 1 \quad for\ i = P, N, H, A$

(7) $\gamma_{ij} = \gamma_{ji} \quad \forall\ i \neq j$

(8) $\sum_j \gamma_{ij} = 0 \quad for\ i, j = P, N, H, A$ and $\sum_i \alpha_i = 1$.

No further restrictions are placed on the model we estimate. Since the cost shares sum to one, only three of the share equations are linearly independent so one of the equations may be excluded from estimation.[3] After imposing the homogeneity restriction and eliminating the redundant administration factor share equation, the model reduces to:

(9) $S_{Pt} = \alpha_P + \sum_j \gamma_{Pj} \ln(w_{jt} / w_{At}) + \delta_{PP} \ln Y_t + \phi_P X_t + \psi_P Z_t$

(10) $S_{Nt} = \alpha_N + \sum_j \gamma_{Nj} \ln(w_{jt} / w_{At}) + \delta_{NN} \ln Y_t + \phi_N X_t + \psi_N Z_t$

(11) $S_{Ht} = \alpha_H + \sum_j \gamma_{Hj} \ln(w_{jt} / w_{At}) + \delta_{HH} \ln Y_t + \phi_H X_t + \psi_H Z_t \qquad for\ j = P, N, and\ H$

with equation (7) still acting as a restriction on the system.

[3] Intrilligator et al. (1996) explains that parameter estimates will be invariant to the choice of the equation deleted so long as maximum likelihood procedures are employed.

A stochastic specification of the cost shares is assumed in our analysis since it is likely that there exists parameters that influence these cost shares that are known to the firm but unobserved by the econometrician. Multivariate normally distributed error terms with a mean vector of zero and constant covariance matrix Ω^* are added to equations (2) - (5). The equations that we estimate are the factor share equations, (9)-(11) with an additional error term in each equation. To examine the effects of enrollments on changes in these cost shares over time, we take a first difference of equations (9) – (11) and estimate these using maximum likelihood methods while imposing the restriction given by equation (7).

III. The Data

A. Total Costs

The primary data on individual HMOs were obtained from Health Care Investment Analysts (HCIA), Inc., which collects information on U.S. HMOs from filings of annual statements to state regulators. The information provided in these annual statements includes financial information, enrollee characteristics, and various firm attributes. Over 460 HMOs are included in the data set for the years 1991-1994, representing over 80 percent of the HMO industry for these years. These data, therefore, make up the most complete compilation of HMO financial information available. It is from these data that we are able to obtain the total annual costs for each HMO in addition to a breakdown of costs into our four intermediate inputs.

Physician expense includes all payments for physician services provided under contractual arrangement to the HMO, salaries and fringe benefits paid to physicians who are employed by the HMO, capitated payments paid by the HMO to physicians who subscribe with the HMO, and fees paid by the HMO to physicians on a fee-for-service basis (this includes capitated referrals). Physicians services obtained through outside referrals are also included in this category. Other professional expense includes compensation, as well as fringe benefits, paid by the HMO to non-physician providers engaged in the

delivery of medical services, such as dentists, psychologists, optometrists, podiatrists, extenders, nurses, and clinical personnel such as ambulance drivers, technicians, paraprofessionals, quality assurance analysts, administrative supervisors, secretaries to medical personnel and medical record clerks. Hospital expense includes all inpatient hospital costs of routine and ancillary services in addition to emergency room and out-or-area expenses for other health delivery services. It further includes the amount of depreciation and amortization expense which is directly associated with the delivery of medical services.

Administrative expense, the omitted category in our regression analysis, represents the costs associated with the overall management and operation of the HMO and includes all expenses for administrative services: net periodic post-retirement benefit costs, compensation and fringe benefits for personnel time devoted to or in direct support of administration, marketing expenses, interest on loans, and the amount of depreciation and amortization that is directly associated with administrative services.

In addition to this detailed cost information, the HCIA data include firm-specific information regarding the structure of the HMO, such as its profit status, chain affiliation, model, age, total membership, and the proportion of its total revenues that come from Medicare and Medicaid. Figure 1 presents the median distribution of total costs into the four factor shares for each year of data.[4] The median share of costs paid to physicians by all HMOs appears to be falling slightly from 1991 to 1994 along with the hospital share. Payments to other medical providers and administrative expenses, on the other hand, appear to have risen slightly over the period. Because we are curious to learn whether maturity affects the size of these factor shares, we divide our sample into three age groups: 0-4 years, 5-9 years, and 10 or more years. Figure 2 reveals some interesting patterns in input utilization across HMOs in each age group. The oldest group of HMOs appears to have higher physician factor shares and other medical provider shares than firms that are less than 5 years old. The share of costs going to

[4] We present medians instead of means in our descriptions to more accurately describe the general tendency. The means of our cost shares are strongly influenced by outliers.

administration, on the other hand, is higher for the younger firms than for the older firms in all four years. This pattern suggests that older HMOs dedicate more resources to the provision of care and less to the tasks of administration. This may be possible because of learning and standardization of processes that occur as the HMO becomes more established in the business. It may also reflect economies of scale, if plans are growing as they are aging.

We are also interested in examining differences in factor shares by size of the firm to see if efficiencies obtained from economies of scale translate into larger factor shares for physicians and other medical providers. Figure 3 shows how cost shares have changed over time among plans of different sizes. Looking across the figures one can see that physician expenses and other professional medical expenses both rise as firm size increases from less than 10,000 members to 30-50,000 members, but these increases level off for plans with more than 50,000 members. Hospital related expenses remain fairly consistent across years and size of the firm. Administrative expenses, however, do fall initially as size of the firm increases from < 10,000 members to the next size category. There are no further dramatic declines in the administrative expenses. This is consistent with the findings of Wholey et al (1996) who found that economies of scale are realized only for small firms and are completely exhausted once membership reaches 50,000 members.

B. Prices

Since most of the HMOs operate in multiple markets and it is impossible to identify in which markets HMOs are experiencing the greatest enrollment growth, we employ state level aggregate measures of input prices. To capture the cost of using physician services we constructed the state average fee for a physician visit from the American Medical Association's (AMA) Socioeconomic Monitoring System (SMS) core surveys of nonfederal, patient care physicians for 1992-1995. The SMS

survey contains annual responses regarding practice characteristics, fees, income, and expenses for roughly 4,000 physicians annually, representing about one percent of the physician workforce.[5]

The price of other professional services (N), is represented by the professional medical services medical CPI, which is a composite measure of the cost of physician services and other professional medical providers. This index was created by averaging the monthly professional medical services CPI, reported in the Bureau of Labor Statistic's *CPI: Detailed Report*, on a state-by-state basis for the years 1991-1994. We were unable to obtain a medical CPI for other professional medical providers alone on a state-by-state basis. There is some overlap, therefore, in the prices we employ for both physician services and other medical services. However, we do not believe that this overlap will substantially influence our results for two reasons. First, these two prices are not highly correlated, indicating that movements in the Medical CPI will, in fact, be indicative of changes in the cost of other medical providers.[6] Second, the focus of our analysis is not how changes in the price of inputs influences the utilization of factor shares, but rather how growth and age of the HMO influences changes in the relative factor shares.

To capture the input cost of hospital services to an HMO, we use the state-level average cost per day to a community hospital per patient, which is available from the American Hospital Association and published annually in *Hospital Statistics*. Although the HMOs in our sample do not exclusively contract with community hospitals, the majority of contracts written with hospitals are with community hospitals. This is not surprising since 81% of all hospitals in the United States in 1993 were community hospitals.[7]

We assume that most of the administrative tasks are similar to those performed in similar financial industries, and constructed a measure of the average cost for administration using the

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[5] Several states were dropped from our analysis because the number of physicians surveyed was not sufficient to generate a reliable price. States with less than 20 observations per year, but more than 20 observations for 91-94 were assigned the four-year average price. Since this average does not change over time, these states are dropped in the analysis of changes in factor shares.

[6] The correlation between the Medical CPI and our physician cost variable was about 0.36.

[7] Source: American Hospital Association, *Hospital Statistics* 1994 Table 5.A.

Department of Commerce's data on earnings and employment in the one-digit industry code for Finance, Insurance and Real Estate.[8] We were unable to obtain a more disaggregated measure of earnings and employment from the Department of Commerce data for all fifty states. By dividing state total earnings for the industry by state total employment in that industry, we obtain a measure of the average earnings per job in the industry.

C. Market Characteristics

Many market characteristics can influence the price an HMO has to pay for inputs or the relative use of particular inputs. For example, the degree of managed care penetration can have a dramatic influence on the negotiating power an HMO has with physicians and hospitals. To account for this influence in our analysis, we once again make use of the AMA's SMS surveys to construct a measure of state-level managed care penetration. The measure is defined as the average share of physician earnings obtained through all managed contracts (including HMOs, PPOs, and IPAs) in each year, and therefore represents the extent to which physicians deal with managed care plans.[9] A higher average share of earnings coming from managed care contracts on a state level would indicate a relatively more developed managed care market place. In addition, we have included measures of the availability of different inputs in the markets. Information on the number of primary care physicians (PCPs) per 1000 people in the state was obtained from the American Medical Association's Physician Master File. Further, we include a measure of per capita admissions to hospitals, which was obtained from the American Hospital Association's *Hospital Statistics*.

Factors that may influence the relative demand for managed care, and therefore the overall costs of a particular HMO, include the age distribution of the population in the market, per capita income and unemployment. To capture these influences in our analysis we obtained state-level information of the

[8] This information is published in Woods and Pool's "MSA Profiles".

percent of the population over 65, the percent of the population under 15, per capita income and the unemployment rate for all four years from the Department of Commerce.

Descriptive statistics for the variables employed in this analysis are presented in Table 1. The average HMO in our sample has a physician cost share of almost 36%. Hospital services make up the second largest category of expenses, representing 28.5% of total costs, and administrative costs represent about 16.8% of total cost, on average.

The mean size of all HMOs included in our sample is 92,000 enrollees and the average age is 8 years old. Almost two-thirds of the HMOs in our sample are for-profit and 62 percent are IPA model plans. Participation in public programs is still low: the average HMO wrote about 5 percent of its business in Medicare and another 5-6 percent in Medicaid. However, there is a great deal of variation across plans in their participation. Many plans do not participate at all, while others are almost solely involved in these programs.

V. Empirical Results and Discussion

Table 2 records the results from estimating equations (9)-(11) simultaneously, imposing the constraints, using maximum likelihood techniques. Surprisingly, we find that higher physician costs relative to administrative costs leads to a significantly higher physician share and lower hospital share. One interpretation of this finding is that in the short run, HMOs are unable to substitute physician inputs with other inputs, so total expenditure on physicians rises. Increases in enrollment lead to higher utilization of physicians, hospitals and other medical providers, implying that the share of total costs going to administrative services declines as a plan grows. Once network affiliation is accounted for, profit status only significantly influences the share of total costs paid to other medical providers. For profit HMOs pay a smaller share of total costs to other medical providers than not-for-profit HMOs.

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[9] For further information on this measure, and an example of its use, see Simon and Born (1996), and Simon et al (1997).

Staff model HMOs have significantly lower physician and hospital factor shares than any of the other models but higher than other provider shares. Older HMOs have significantly higher physician and hospital shares than young HMOs (less than 5 years old) even after other factors are controlled for, possibly indicative of learning that occurs in the industry. Firms operating in markets with a larger managed care presence have significantly lower physician factor shares and significantly higher other provider shares then firms operating in markets with low levels of managed care.

The regressions presented in Table 2 only capture the effects of enrollment and maturity on expenses through variation across plans at a particular point in time. It would also be interesting to see how these factor shares change in response to growing enrollment and maturity. For example, how would physicians' share of costs change if there is a 10 percent increase in enrollment. To answer this question we need to examine how these factor shares change over time. To the extent that plans do not all report their expenses in the same way, an analysis of changes over time will also help to control for any correlation between plan characteristics and how expenses are reported. For example, expenses that support the operation of a group practice or a clinic may be included as medical expenses because these costs are paid to a medical entity and would be reflected in claims that other providers would make to health plans. Such expenses might be largely administrative in nature. Thus, we would expect variations in medical and administrative expense ratios across HMOs with different organizational structures.

When we calculate plan-specific changes in the cost factor shares, we find that, on average, these changes are fairly small. Table 3 presents the sample average changes in the cost shares for the three years separately, and across the sample period, 1991-1994. Over the three years in our sample, none of the shares changed by more than a percentage point. Not surprisingly, the hospital share declined while the other shares rose. The share of costs going toward administration was the most volatile, on average. These data suggest that cost structures change very little over the life of the health plan, regardless of how the plan grows.

Table 4 shows the results from estimating changes in factor shares over the period 1991-1994 Here we find that enrollment growth only significantly influences the change in the hospital factor share. Because the average hospital share is declining, the positive sign implies that the factor share declines by a smaller amount when enrollment rises. This suggests that although plans may be successful at moving patients from inpatient to outpatient settings for care, large changes in enrollment make it difficult for plans to do so immediately. Furthermore, since changes in enrollment do not significantly influence the change in share of total costs going to physicians or other medical providers, one could interpret this result as implying that economics of scale on the administrative end are at least partially transferred to hospital inputs. This does not mean to imply that hospitals are paid more on a per diem or per case basis, however. It only means that overall payments to the hospital are larger.

We find that few other covariates significantly influence the changes in factor shares over time. Higher physician costs relative to administrative costs significantly reduced the increase in physician factor share while they increase the change in other medical providers. This implies that HMOs are able to substitute inputs over time. Similarly, when the cost of hiring other medical providers rises, the physicians share of total costs rises. Interestingly, higher hospital costs result in smaller declines in the hospital share over time, implying that plans are unable to completely move enrollees out of the hospital setting. An increase in the average number of primary care physicians has a negative and significant effect on the change in total costs paid to hospitals and other medical professionals although it has no significant effect on the change in physician factor share. Increases in average per capita income lead to larger increases in the share of total costs paid to other medical providers while increases in per capita number of hospital admissions leads to a smaller decline in the share of total costs going to hospitals and a smaller increase in the share of total costs going to other medical providers. [10]

[10] Regressions of changes in factor shares broken out by age or growth rates reveal that there are some differential effects. Increases in membership for younger firms lead to significantly larger changes in the share of costs going to other professionals and hospitals relative to administration, but there are no significant different changes for middle age firms or older firms. Similarly, firms experiencing relatively little or no growth (growth rates between –5 %to

VII. Conclusions

Our examination of factor shares from 1991-1994 provides some new insight into the recent changes that have been occurring in HMOs. First, we find that older HMOs spend proportionately more on physician and hospital services than young HMOs even after other factors are controlled for, suggesting gains to experience, or learning, in the industry. Furthermore, higher enrollment are associated with a higher level of spending on physicians, hospitals and other medical providers, implying that the share of total costs going to administrative services declines as a plan grows. However, big changes in enrollment over time do not lead to significantly larger increases in the factor shares dedicated to physicians and other medical professionals. Changes in enrollment only significantly influence the changes in the hospital factor share over time. Finally, we find that plans operating in markets with a larger managed care presence have significantly lower physician factor shares and significantly higher other provider shares then firms operating in markets with low levels of managed care.

There are several shortcoming of the paper in its current form. First, the study employs state level measures of input costs instead of a more local measure of input prices. Although we can identify the counties in which the HMOs operate, we were unable to obtain local average prices for physician services, extender services, hospital services, and administration services. The aggregation is likely to add noise to the regressions. We plan to continue investigating alternatives for our price measures. Second, we have not yet controlled for HMOs that merged or had been acquired during 1991 to 1994, a period of rapid consolidation in the HMO industry. Future versions of the paper will include a dummy variable to account for those extreme outliers that may be skewing our results. Finally, this analysis may not adequately control for changes in enrollment that are due to dramatic expansions into the Medicare

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+5%) have significantly larger changes in costs dedicated to other medical professionals, but significantly smaller changes in costs dedicated to hospitals. Again, the changes in shares dedicated to physicians, however, are not

and Medicaid markets. Our ongoing analysis will explore alternative methods of accounting for participation in these markets.

significantly different than those dedicated to administration for firms experiencing large changes in membership.

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Figure 1
Median Distribution of Total Costs by Factor Share

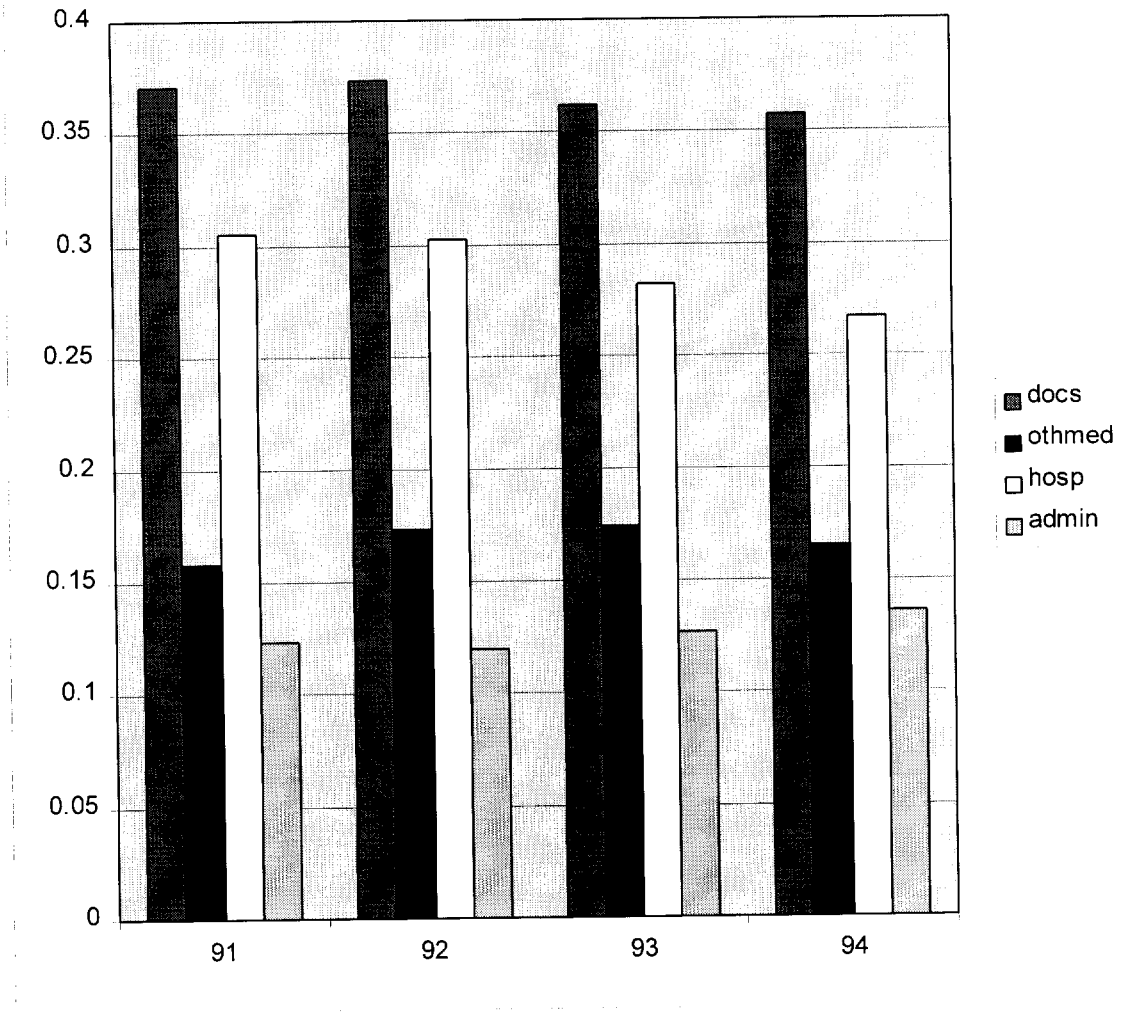
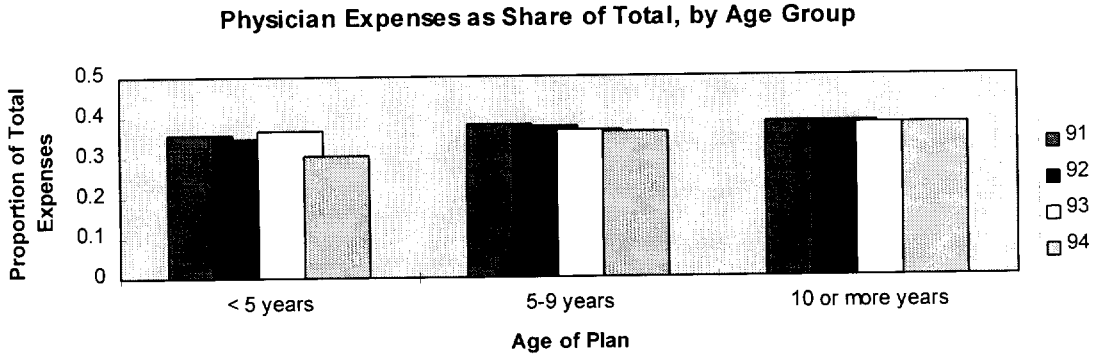
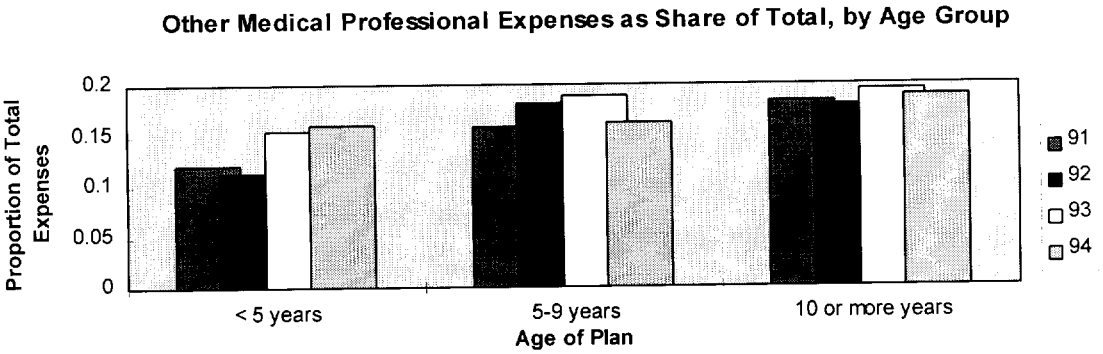
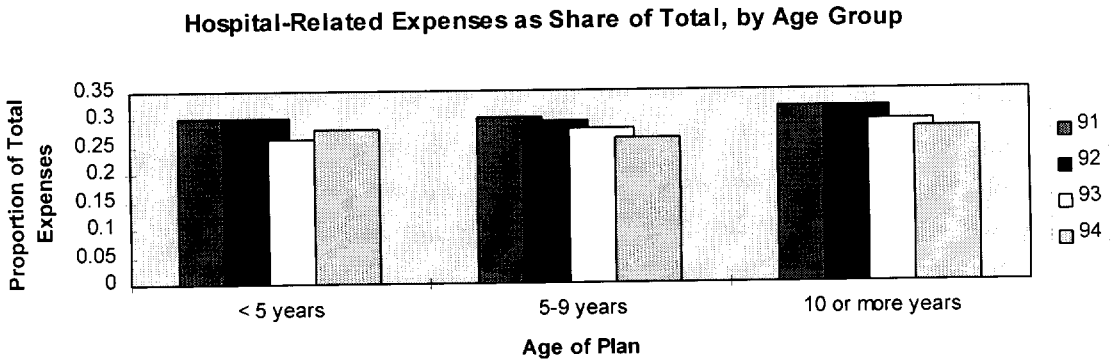


Figure 2
Factor Shares by Age Group







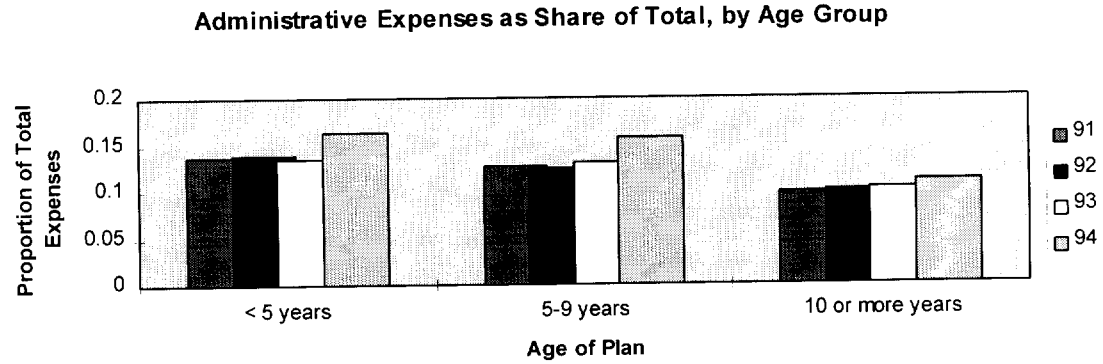
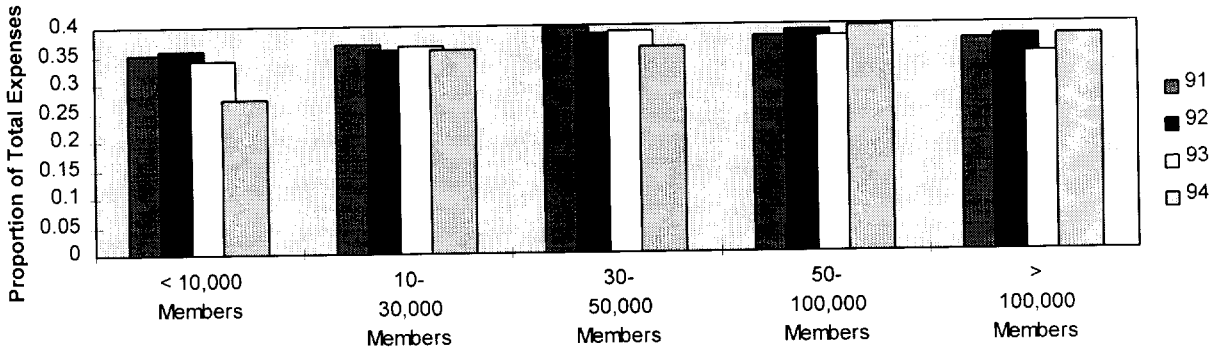
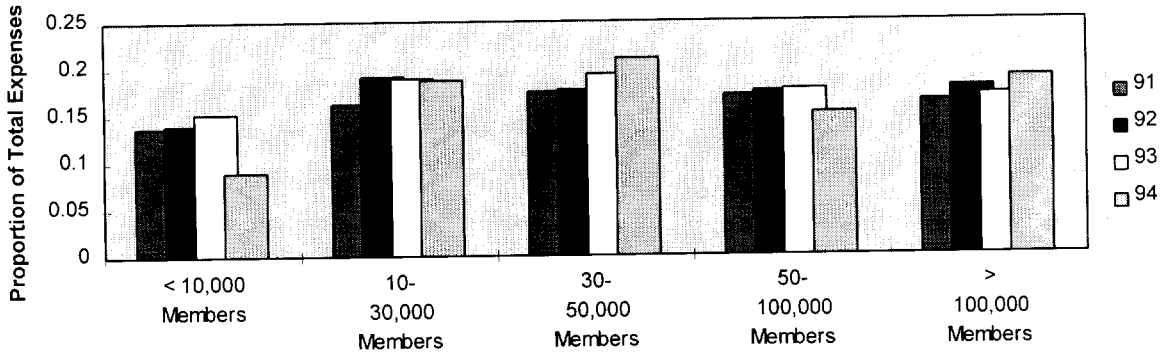


Figure 3
Factor Shares by Size of Plan

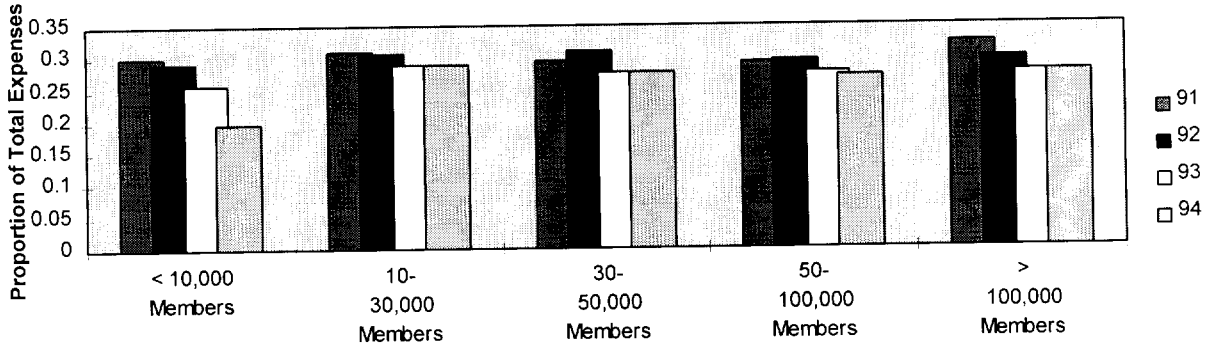
Physician Expenses as Share of Total, by Enrollment Size



Other Professional Medical Expenses as Share of Total, by Enrollment Size



Hospital-Related Expenses as Share of Total, by Enrollment Size



Administrative Expenses as Share of Total, by Enrollment Size

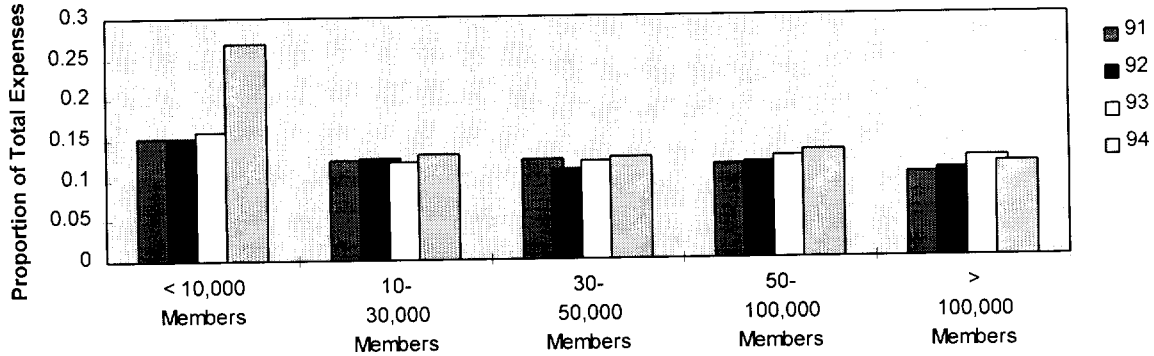


Table 1
Sample Characteristics
N=1990

Variable	Mean	Std. Dev
Plan Performance Measures		
Physician Cost Share	0.359	0.200
Other Prof. Cost Share	0.188	0.299
Hospital Cost Share	0.285	0.166
Admin. Cost Share	0.168	0.208
Prices		
Log(Physician Cost)	3.734	0.190
Log(Other Med. Prof. Cost)	5.192	0.065
Log(Hospital Cost)	6.753	0.184
Log(Admin. Cost)	2.981	0.247
Other Plan Characteristics		
Total Revenue ($millions)	141.000	504.000
Total Members (millions)	0.092	0.274
Age	7.996	5.316
For profit	0.666	0.472
Staff HMO	0.080	0.271
Group HMO	0.082	0.274
IPA HMO	0.621	0.485
Network HMO	0.120	0.325
Mixed model	0.097	0.296
Prop. Medicare	0.050	0.132
Prop. Medicaid	0.057	0.179
Growth (1991-1994)	1.175	4.221
# Counties in Operation	9.886	6.546
Market Control Variables		
Managed Care Penetration	19.777	7.786
Per Capita Hosp. Admissions	0.130	0.019
Doctors per capita	1.732	0.327
PC Doctors per capita	0.580	0.093
Population >65	0.128	0.020
Population <15	0.220	0.021
Pop in services industry	0.159	0.026
State Unemployment rate	6.529	1.359
1991	0.239	0.427
1992	0.247	0.431
1993	0.267	0.443
1994	0.247	0.431

Table 2
Factor Shares
SUR Results: Full Sample

Variable	Physician Share Coeff	Std Err		Oth. Prof. Share Coerr	Std Err		Hospital Share Coeff	Std Err	
constant	0.84264	0.16435	***	0.44146	0.19939	**	0.15065	0.15061	
log wp/wa	6.34E-02	2.24E-02	***	1.20E-02	2.55E-02		-6.67E-02	1.60E-02	***
log wo/wa	1.20E-02	2.55E-02		-7.45E-02	5.46E-02		-7.45E-02	5.46E-02	
log wh/wa	-6.67E-02	1.60E-02	***	5.08E-02	2.94E-02	*	-3.29E-02	2.51E-02	
log members	1.45E-02	2.84E-03	***	1.35E-02	3.07E-03	***	7.36E-03	2.33E-03	***
For Profit	7.99E-03	8.68E-03		-1.61E-02	9.44E-03	*	1.68E-03	7.20E-03	
Group	0.10728	1.78E-02	***	-0.14007	1.92E-02	***	5.48E-02	1.46E-02	***
IPA	9.07E-02	1.43E-02	***	-0.12198	1.55E-02	***	3.39E-02	1.17E-02	***
Network	8.44E-02	1.68E-02	***	-0.11742	1.82E-02	***	4.94E-02	1.38E-02	***
Mixed	7.53E-02	1.74E-02	***	-9.21E-02	1.88E-02	***	1.50E-02	1.42E-02	
Middle Aged	3.48E-02	1.09E-02	***	-5.69E-03	1.18E-02		2.65E-02	8.93E-03	***
Old	3.15E-02	1.31E-02	**	8.62E-04	1.42E-02		3.28E-02	1.08E-02	***
Medium MC Pen	-4.18E-02	9.97E-03	***	4.70E-02	1.11E-02	***	-5.73E-03	8.41E-03	
High MC Pen	-5.89E-02	1.39E-02	***	0.11557	1.55E-02	***	-5.21E-02	1.22E-02	***
# Counties Operation	5.21E-04	6.06E-04		-1.28E-03	6.55E-04	*	-1.68E-04	4.97E-04	
Prop. Medicare	5.14E-02	2.96E-02	*	-0.19324	3.20E-02	***	0.11395	2.43E-02	***
Prop. Medicaid	-5.45E-02	2.07E-02	***	-8.09E-02	2.23E-02	***	0.14256	1.69E-02	***
PC Physicians per cap	0.22458	7.01E-02	***	-0.12313	7.83E-02		-6.48E-02	5.99E-02	
Pop > 65	2.93E-02	0.26596		-0.41625	0.28754		1.48E-02	0.21562	
Pop < 15	-0.31607	0.3284		-0.57863	0.35371		0.59551	0.26694	**
Real Per Cap Income	-1.12E-05	2.59E-06	***	1.37E-06	2.93E-06		1.27E-06	2.17E-06	
Unemployment rate	-1.45E-02	3.24E-03	***	1.05E-02	3.82E-03	***	2.09E-03	2.85E-03	
Per cap admissions	-0.46847	0.34538		0.27945	0.37809		0.17261	0.28953	
Network Affiliation	-2.75E-02	7.82E-03	***	3.78E-03	8.44E-03		1.85E-02	6.40E-03	***

N	1415
Log Likelihood-Restr	3479.280
Log Likelihood-Unres.	3488.610
Likelihood Ratio Test	18.663

Table 3
Changes in Factor Shares: Sample Means

	1991-1992	1992-1993	1993-1994	1991-1994
Change in Physician Share	0.0017	0.0007	0.0058	0.0027
	(0.0401)	(0.0477)	(0.0470)	(0.0449)
Change in Other Prof. Share	0.0085	0.0092	-0.0021	0.0053
	(0.0433)	(0.0459)	(0.0474)	(0.0458)
Change in Hospital Share	-0.0028	-0.0115	-0.0103	-0.0081
	(0.0404)	(0.0437)	(0.0480)	(0.0442)
Change in Admin. Share	-0.0074	0.0015	0.0066	0.0000
	(0.0404)	(0.0387)	(0.0453)	(0.0419)

Table 4
Changes in Factor Shares
All HMOs

SUR Results

(excluding outliers)

Variable	Physician Share Coeff	Std Err	Other Prof. Share Coeff	Std Err	Hospital Share Coeff	Std Err
dlog wp/wa	-2.64E-02	1.47E-02 *	4.37E-02	1.48E-02 ***	-1.65E-02	1.33E-02
dlog wo/wa	4.37E-02	1.48E-02 ***	2.68E-03	5.35E-02	-2.77E-02	3.96E-02
dlog wh/wa	-1.65E-02	1.33E-02	-2.77E-02	3.96E-02	5.89E-03	3.74E-02 *
dlog memb	3.12E-03	2.72E-03	1.76E-03	2.77E-03	5.06E-03	2.62E-03 **
dcntys	8.90E-04	8.29E-04	-2.35E-04	8.44E-04	-5.36E-04	8.00E-04
dmedicare	7.88E-02	3.62E-02 **	-2.08E-02	3.68E-02	2.83E-02	3.49E-02
dmedicaid	-1.49E-02	3.96E-02	-3.03E-02	4.03E-02	3.48E-03	3.82E-02
dpc docs	8.12E-02	0.10818	-0.32401	0.11515 ***	-4.56E-02	0.10693 **
dmnrev	2.11E-04	2.85E-04	-5.93E-05	2.94E-04	-2.77E-04	2.78E-04
dunemp	-1.59E-03	1.82E-03	1.54E-03	2.16E-03	3.25E-03	1.95E-03
dapcinc	2.05E-06	3.90E-06	1.08E-05	4.45E-06 **	-5.55E-06	4.00E-06
dpcacdm	4.20E-03	0.49414	-0.87081	0.51948 *	1.442	0.49971 ***

N	958
Log-Likelihood-Restr.	5203.650
Log-Likelihood-Unres.	5207.000
Likelihood Ratio Test	6.698