Does Managed Care Matter?

Hospital Utilization in the U.S. Between 1985 and 1993

by

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ABSTRACT

This paper examines the effect of HMO market development on hospital utilization in short term general hospitals in the U.S. between 1985 and 1993. HMO penetration does not explain the majority or even a substantial minority of the variation in hospital utilization. Among seven measures of hospital utilization, the association between inpatient days per capita and variation in HMO penetration is the strongest, and even for that measure, just 21% of the 9% decrease in inpatient days is attributable to HMOs. The association between HMO penetration and other utilization measures is even smaller. The results suggest that change in hospital utilization over the period 1985 to 1993 was attributable more to factors such as technological change than directly to HMOs.

Key Words: Hospital Utilization, HMOs, Hospital Days, Ambulatory Visits, Occupancy Rates, Hospital Admissions

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0. INTRODUCTION

Over the last decade, significant changes have taken place in the way Americans utilize health care services. For instance, between 1985 and 1993, inpatient days per thousand in short term general hospitals decreased by 9.02% whereas outpatient visits per thousand increased by 71.4%. Capacity in the form of staffed beds per capita, as well as utilization have also been decreasing. These changes in hospital capacity and use have been accompanied by substantial changes in the health care industry. Examples include the growth of health maintenance organizations (HMOs), institutional changes such as the Medicare Prospective Payment System (PPS), and technological changes such as the ability to provide more surgical procedures on an outpatient basis.

Health care literature has placed significant emphasis on the contribution of managed care and the introduction of PPS to changes in hospital utilization and expenditures. There is evidence suggesting that managed care reduces costs (Melnick and Zwanziger, 1995; Zwanziger, Melnick, and Bamezai, 1994. Zwanziger and Melnick, 1996). Managed care has also been associated with decreases in length of stay, hospital admissions, hospital occupancy rates, hospital inpatient days and staffed beds (Miller and Luft, 1994). Further, it is maintained that though managed care accelerates the substitution of outpatient visits for inpatient services, markets with high HMO penetration have had a slower increase in outpatient visits compared to markets with lower HMO penetration (Robinson, 1996).

Though these claims may be true in certain markets (for example California and Minnesota), their generalizability to the rest of the U.S., and more importantly, the magnitude of the effect is unclear. Much of the earlier research has focused on the effect of HMOs on HMO enrollees. However, the effect of HMOs on overall hospital use may differ, particularly if the observed HMO effects are due to favorable selection. In this paper, we examine the generalizability and magnitude of the effect of HMOs on hospital use by studying the effect of HMOs on overall hospital utilization.

We estimate the amount of variation in hospital utilization across markets that is associated with the growth of HMOs. The results from multivariate OLS regressions show that the magnitude of association between HMO penetration and hospital utilization is small. Among seven measures of hospital utilization, the association between inpatient days per capita and variation in HMO penetration is the strongest. Even then, variation in HMO market structure only contributed 20.6% of the observed decrease in inpatient days. If HMO penetration stayed at its 1985 level, inpatient days per capita would have still decreased by approximately 7.2%. The association between HMOs and the other six measures of hospital utilization was even smaller. These results come as a surprise given the emphasis in the literature, of the effect of HMOs on hospital utilization. Our research shows that changes in hospital utilization are largely associated with unobserved time varying factors. Such variation over time might be explained by changes in technology, physician practices, insurance rates and PPS. Of course it is possible that these time factors capture indirect effects of HMOs. Even so, it is remarkable that the estimates of HMOs direct effects are so small.

The paper is organized as follows. Section one provides an overview of changes in the health care industry and reviews literature that investigates the relationships of these changes to hospital utilization. Section two describes the data and provides a summary of trends over time and compares them cross-sectionally. Section three provides the results of multivariate analysis on seven dependent variables: inpatient days per capita, outpatient visits per capita, (log of) occupancy rates, (log of) admissions per capita, (log of) beds per capita, and two measures of inpatient vs. outpatient activity. This section also explores some “scenarios” for hypothetical HMO penetration levels for the U.S. as a whole, and for Pennsylvania and California. Finally, this section describes the amount of variation in the dependent variables that can be associated with the independent variables. The last section summarizes the findings.

1. LITERATURE REVIEW

The health care literature identifies various factors that are associated with changes in hospital utilization. Among these factors, the effects of managed care, changes in technology, and the introduction of PPS have been emphasized.

1.1 MANAGED CARE

An important institutional change over the past twenty years in the health care industry has been the rapid growth of "health maintenance organizations" (HMOs) (Christianson et al., 1991). Managed care includes all those plans that involve a network of providers such as HMOs, preferred provider organizations (PPOs), and point of service plans (POS). The traditional indemnity, fee-for-service (FFS) plan, which includes Medicare FFS, differs from managed care. HMOs, for example, integrate the health insurance and health care services functions by providing consumers with a specified set of health services in exchange for a premium. Because HMOs face the risk of losing money if health care consumption is high, they attempt to manage the use of inputs such as inpatient days and ambulatory visits by using administrative techniques such as utilization reviews and shifting risk to providers.

Miller and Luft (1994) show that hospital utilization is lower for HMOs compared to the indemnity plans. They summarize the performance of HMO versus indemnity plans since 1980 from 54 studies along 15 different measures, including (a) hospital admission rates, (b) hospital length of stay (LOS), and (c) hospital days per enrollee. Seven studies are documented with eleven observations[1] that compare admissions rates under various HMO to indemnity plans. For eight of these observations, admission rates were lower for HMO plans. Of fifteen observations of LOS from thirteen studies, fourteen showed shorter LOS for HMOs. Similarly, for hospital days per enrollee, Miller and Luft document eight observations from six studies. All eight observations show that HMO plans had lower hospital days per enrollee.

Recent research shows comparable differences in hospital utilization under FFS and HMO enrollees. Robinson [1996] shows that admission rates and hospital length of stay sharply decreased between 1983 and 1993 in California. He analyzed hospital utilization in markets with the highest and lowest HMO penetration and found that the decline in the number of hospitals was similar in both types of markets, but the decline in inpatient utilization was more pronounced in markets with high HMO penetration. Robinson concluded that HMOs contributed to the substitution of outpatient for inpatient surgery.

Studies that analyze differences in hospital utilization among HMO and FFS enrollees are often subject to the “selection bias” problem. This occurs when the population enrolling in HMOs is systematically different from the one enrolling in indemnity FFS plans (Wilensky and Rossiter, 1986), and the differences in population characteristics are not properly controlled for. If unobserved personal characteristics are correlated with the choice of the health care plan and hospital utilization, then the estimated regression coefficients on the health plan when the dependent variable(s) is a measure of hospital utilization are likely to be biased upwards. If so, the true impact of HMOs on hospital utilization is likely to be smaller than that often reported in

[1] In Miller and Luft [1994], an “observation” refers to a comparison of utilization between a given type of HMO and the indemnity plan.

literature. For instance, among all the studies chosen by Miller and Luft in their 1994 review, only one used randomly selected control groups (Martin et al., 1989). All other studies employed econometric techniques to control for selection bias. However, as Dowd et al. [1991] point out, it is unlikely that unobserved characteristics such as propensity to seek medical intervention at given levels of discomfort, across the FFS and HMO enrollees, can be controlled for easily.

It is important to point out that the studies mentioned above do not measure the effect of the growth of HMOs on overall hospital utilization, nor do they consider the competitive effects of HMO growth. They compare hospital usage among FFS and HMO enrollees. Selection bias criticism not withstanding, the *inferences* drawn from the studies covered by Miller and Luft [1994] and the more recent results of Robinson [1996] have a common theme, i.e., that HMOs are significantly responsible for a decline in hospital utilization - length of stay, occupancy rates, staffed beds, admissions, inpatient days, outpatient visits - and, that they are also responsible for substituting inpatient activity with more outpatient services. This paper investigates the validity of such claims in the health care industry.

One study that stands out from the literature on managed care and hospital utilization is by Luft, Maerki, and Trauner [1986]. They consider the competitive effects of managed care in their case study of decline in hospital utilization in Rochester, New York, Minneapolis/St. Paul, Minnesota, and Hawaii. In all three areas they discuss hospital utilization before and after the entry of HMOs. They conclude,

> *"Careful review of the available data often identifies internal inconsistencies and contradictions, but in none of the three sites is there a reduction in hospital use that is most plausibly attributed to HMO competition. Instead, the reported reductions are in each case attributable to other factors - including biases in data, long-term trends predating HMOs, indirect effects of other policy changes, and other forms of competition." [Luft, Maerki, and Trauner, 1986: pg. 625]*

This paper, in keeping with Luft, Maerki, and Trauner's findings, shows that shifts in hospital utilization from inpatient to outpatient visits, as well as reduction in other utilization measures are not associated in any significant way with the increase in HMO penetration, but rather with unobserved time varying factors. Such variation over time might be explained by changes in technology, physician practices, insurance rates and the base rate of PPS.

1.2 Technological Change

Since the second world war and while the insurance market was still largely dominated by traditional FFS plans, the adoption and diffusion of any life enhancing innovation was the norm, i.e., any new technology that increased the technical boundary of treatment regardless of its effects on direct or indirect costs was adopted (Weisbrod, 1991; Neumann and Weinstein, 1991; Holmes, 1992). Rising health care expenditures brought about two institutional responses to contain costs, growth of HMOs and the introduction of PPS. This has led hospitals to become cautious about the type (and extent) of new technology that they adopt (Laubach, 1995). In particular, fiscal pressures on hospitals favor the adoption of technologies that reduce direct or indirect costs, rather than those that enhance technical boundaries (Weisbrod, 1991; Moody, 1992; Gelijns and Rosenberg, 1994; Gelijns and Rosenberg, 1995). Weisbrod [1991] cites numerous examples of product and process innovations that were either life enhancing or cost reducing. He argues that changes in the structure of the insurance market are closely linked to hospital incentives to adopt a given type of technology (and consequently determine the direction of Research and Development). The literature on technology adoption in healthcare suggests that as the insurance market switched from retrospective (cost-based) reimbursement to prospective (price per discharge) payment, cost minimizing incentives forced hospitals to adopt cost efficient technologies as opposed to those that necessarily increased the technical boundaries of treatment. More importantly, the new cost efficient technologies are being largely adopted in the outpatient domain (Holmes,1992). A conclusion of this literature is that as more cost efficient technology is adopted for outpatient services, more patients will be shifted from inpatient to ambulatory care.

1.3 MEDICARE AND PPS

In 1965, Title XVIII and Title XIX of the Social Security Act established Medicare and Medicaid as an intervention to provide medical assistance to the elderly and the poor. Medicare, which consists of two parts, Hospital Insurance (Part A) and Supplementary Hospital Medical Insurance (Part B), prior to 1983, was reimbursed on a "reasonable cost" basis. Rising costs of health care prompted the introduction of the Prospective Payment System (PPS). Under this system, hospitals are paid a predetermined amount based upon the patient's diagnosis within a "diagnosis related group" (DRG) for providing medical services during a patient's hospital stay. This payment, based on diagnosis, shifts the risk for managing hospital days to the hospital thus encouraging them to reduce days.[2] Since ambulatory charges are still reimbursed on a cost based system, there is an incentive to shift patient care there.

Early research showed that the immediate effect of PPS was a reduction in Medicare inpatient days, length of stay, and discharges, and an increase in outpatient visits (Sloan, Morrisey, and Valvona, 1988; Hadley, Zuckerman, and Feder, 1989). However, some researchers found that PPS did not have an effect on some of the hospital utilization variables.

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[2] PPS payment formula is calculated using seven variables: base payment, DRG weight, labor costs, urban/rural location, indirect teaching costs, disproportionate share adjustments, and outlier status. In addition, base payment has an annual update factor. In 1984, the update factor was around 4% but fell below 2% by 1986. Since then, the update factor increased steadily reaching 4% again in 1990 and then started decreasing again. Also, see Hodkin and McGuire [1994].

For example, DesHarnais, Chesney, and Fleming [1988] found that PPS did not reduce LOS but decreased Medicare discharges. Further, it is believed that PPS will not have a long term effect on reducing hospital utilization. Hadley, Zuckerman, and Feder [1989] found that hospitals that were in their *second year* of PPS in 1985 showed a smaller reduction in length of stay than the hospitals that were in their *first year* of PPS. Outpatient visits in hospitals that were in their second year of PPS also had a smaller increase than those hospitals that were in their first year of PPS. Their study concluded that PPS provided an initial rather than a continuing opportunity for profits to hospitals, and that after the initial years PPS would have no continued effect on reducing Medicare inpatient days and LOS, or on increasing ambulatory visits. Similarly, Muller [1993] found that PPS was effective in reducing hospital utilization during the first decade of its implementation, but at a reduced rate over time.

2. DATA

Data for the study come from four sources and cover the entire U.S. for the years 1985 through 1993. The primary data sources were: (i) the Area Resource File (ARF) for 1996 compiled by the Office of Research and Planning, Bureau of Health Professions; (ii) the Regional Economic Information System (REIS) 1969-94 CD by U.S. Department of Commerce; (iii) the County Business Patterns (CBP) data downloaded from the University of Virginia Social Sciences Data Center web site[3]; and, (iv) HMO enrollment data by counties from measures constructed and provided by Wholey, Feldman and Christianson [1995]. The data were extracted at the county levels for the years 1985-93 and then merged into a panel set.[4] The

[3] http://www.lib.virginia.edu/socsci/cbp/cbp.html

[4] At the county level there were 3082 observations for each of the 9 years. The state of Alaska is reported as one county. Thus, there are only nine observations for Alaska, one for each year.

data were aggregated up to Hospital Service Areas (HSA) as defined by Makuc et al. [1991a and b]. Makuc et al. used 1988 Medicare hospital discharge data to define an HSA as a group of counties such that the flow of hospital patients across HSAs is minimized.[5] Thus, based on patient flows, HSAs provide a better measure of hospital markets compared to say counties or Metropolitan Statistical Areas (MSA). There are 803 HSAs, so there are 803 times 9 units of observations (after aggregating the county level data up to the HSA level). HMO enrollment measures developed by Wholey, Feldman and Christianson [1995] correct for enrollment reported in the county of the head office location of the individual HMOs.[6]

This paper uses seven measures of hospital utilization as dependent variables. These are: (log of) occupancy rates, (log of) beds per capita, (log of) admissions per capita, inpatient days per capita, outpatient visits per capita, ratio of admissions to outpatient visits, and ratio of inpatient days to outpatient visits per 365. Occupancy was measured as the ratio of inpatient days to 365 times the number of beds.

Data were obtained for five major groups of independent variables: (i) Social and economic factors; (ii) Demographic factors; (iii) Hospitals; (iv) Physicians[7], and (v) HMOs. The number of hospitals and other hospital utilization variables are only for short term general

[5] They develop an algorithm to cluster counties into a group such that the distance between counties is minimized, where the distance is defined as 1 - total flow of hospital flows between the two counties divided by the total stays in the county with fewer stays.

[6] The HMO enrollment data provided by Wholey, Feldman and Christanson [1995] is based on InterStudy Censuses (1985 to 1995), InterStudy reports on MSAs served by HMOs, and GHAA Directories (1988 to 1991). The measure that they construct prorates the enrollment of an HMO over all the counties served by that HMO using county population as prorating weights. The information on an HMO's enrollment in an MSA comes from the survey report by InterStudy (1994, 1995). Thus, in their measure, if an HMO operates in two counties with populations of 100,000 and 200,000 then 1/3 of the HMO’s enrollment would be reported in the smaller of the two counties and 2/3 would be reported in the larger one.

[7] Non-Surgical Patient Care MDs is calculated as the total number of Patient Care MDs in an HSA minus the total number of surgeons from all sub-specialties in Patient Care.

hospitals.[8] A complete list of all the variables and their definitions is given in Appendix 1, Table A1.

2.1 Descriptive Statistics

Table 1 gives the descriptive statistics for all the independent and dependent variables used in the analysis as well as the percentage change in the mean value between 1985 and 1993. Outpatient visits between 1985 and 1993 increased by about 71%. All other hospital utilization variables, beds per 1000, occupancy rates, inpatient days, and hospital admissions per 1000 have been decreasing. Also, the ratio of admissions to outpatient visits and the ratio of inpatient days to outpatient visits have been decreasing, suggesting that hospital services are moving to the outpatient domain. The decline in hospital utilization and the shift from inpatient to outpatient activity is accompanied by both an increase in the number of HMOs operating in the HSAs, and the total enrollment per 1000 people in the HMOs. Figure 1 shows the time trends for selected variables: Outpatient visits, total beds, total inpatient days, and total HMO enrollment in the U.S. (Note that the totals in Figure 1 are absolute totals, not totals divided by population.)

[TABLE 1 ABOUT HERE]

There is a lot of cross-sectional variation in the variables. Figure 1A in the appendix is a bar graph of (average[9]) HMO enrollment per 100 by state. A detailed table giving the breakdown of HMO enrollment per 100 by state and year is also given in Table A2 in the

[8] American Hospital Association defines Short Term General Hospitals as those hospitals that provide non-specialized general medical and surgical service and for which the majority of patients are admitted for fewer than 30 days.

[9] For each state, the average is calculated over nine years, 1985-1993.

appendix. As seen from Figure 1A , California has the largest number and highest proportion of people enrolled in HMOs (about 28 persons per 100), and Pennsylvania is about the median state (about 10 persons per 100). As a further comparison of cross-sectional differences Figure 2 below compares inpatient days per 10 people, outpatient visits per 10 people, beds per 1000 persons, and HMO enrollment per 100 in California and Pennsylvania. Figures 1 and 2 are consistent with the common wisdom; the higher the HMO penetration the lower is hospital utilization, and the fewer the beds and inpatient days per capita. In fact, though the paper does not show time trend and cross-sectional comparison graphs for other utilization variables (occupancy, admissions etc.) they also appear to support the common notion that an increase in HMO penetration is accompanied by a decrease in hospital utilization as well as a shift from inpatient to outpatient activity.

[Figure 1 and 2 here]

3. ANALYSES

For the analyses, multivariate fixed effects OLS regressions were run on a panel data set for seven different dependent variables: Inpatient days per capita, outpatient visits per capita, (log of) occupancy rate, (log of) beds per capita, (log of) admissions per capita, ratio of admissions to outpatient visits, and ratio of inpatient days to outpatient visits per 365 days. Various functional forms were tried, including logged versus non-logged for each of the dependent variables and some of the independent variables, and the choice of including non-linear independent variables. By analyzing the distributions of the dependent variables and the results from initial regressions, only occupancy, beds per capita and admissions per capita were logged among the list of dependent variables, and the number of hospitals were logged in the list of independent variables. The decision to keep or omit the square of an independent variable in the final regressions was based on the p-value of the coefficient in the earlier regressions with all the squared terms in the models.

For all regressions, there were two types of fixed effects: time invariant HSA-specific effects and time fixed effects. In addition to these fixed effects, an additional dummy variable was introduced for observations that did not have any HMOs for a given year. This variable was introduced to capture any systematic variation in the dependent variables that is associated with the HSAs with no HMOs. Coefficients were estimated for the following form

$$Y_{it} = \sum_k \beta_k X_{kit} + \sum_j^{802} \alpha_j HSA_{it}^j + \sum_l^{8} \gamma_l T_{it}^l + Flag_{it} + U_{it}$$

where i $\in$ [1,...,803] indexes HSAs, t $\in$ [1...9] indexes years, and $X_{k\,i\,t}$ is the k^{th} variable's observation for the i^{th} HSA in year t. Similarly, $HSA^j_{\,i\,t}$ are 802 dummy variables such that $HSA^j_{\,i\,t} = 1$ if j = i; otherwise it is 0, and $T^l_{\,i\,t}$ are 8 dummy variables such that $T^l_{\,i\,t} = 1$ if l = t; otherwise it is 0. Last, $Flag_{\,i\,t}$ is a dummy variable which takes the value 1 if the number of HMOs in a given observation is 0, (i.e. $Flag_{\,i\,t} = 1$ if $X_{(HMO)\,i\,t} = 0$). $U_{\,i\,t}$ is the error term assumed to be un-correlated with the RHS variables.[10] Also, note that in the case of occupancy, beds per capita, and admissions per capita, Y is the log of these variables.

The OLS models should not be interpreted as necessarily implying causality between the independent and the dependent variables. The results estimate the amount of variation in the dependent variable that can be associated with any given independent variable. At the risk of repetition, the reader is cautioned that the regression models control for <u>time-invariant</u> HSA-

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[10] The coefficients were not estimated by actually introducing 802 dummy variables for HSAs . The data were sweeped for HSA fixed effects by de-meaning them around the HSA specific means. However, the dummies were introduced for each year. The omitted time dummy is for the year 1985.

specific effects with the 802 HSA dummies, and that the time fixed-effects are controlled for by the 8 time dummies, but any time-varying HSA-specific effects are not controlled for in the models. If there are any time-varying HSA-specific effects, they are in the error term (and may be correlated with the independent variables), and since they have not been controlled for, they may be a source of endogeneity in the regression models. Hence the models should not be interpreted as necessarily implying causality.[11]

The results of the OLS regressions (the coefficients and the t-values) and the analysis of variance are given in the appendix Table 2A.[12] The reported F-test in the analysis of variance is the joint F-test for all the RHS variables excluding the 802 HSA dummies. In Table 2A, "----" appears in cells where the squared term of an independent variable (given in rows) was not used in the regression model for that particular dependent variable (given in columns). Except for the dependent variables, (i) (log) of occupancy rates, and (ii) the ratio of inpatient days to outpatient visits, the "fits" were reasonable. The models explain 43% of the variation in log of occupancy rates; 69% of variation in outpatient visits per capita; 67.3% of the variation in inpatient days per capita; 70.2% of the variation in log of admissions per capita; 75.3% of the variation in log of beds per capita; 63% of the variation in the ratio of admissions to outpatient visits, and 38.9% of the variation in the ratio of inpatient days to outpatient visits.

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[11] Technically, the interaction term between the HSA dummies and the time dummies, $HSA^{j} * (f(time))$, may be present in the RHS variables in the "true" model. Since we have "omitted" this term from RHS, it is present in the error term and if correlated with the rest of the independent variables, may cause endogeneity in the regression model. An example of this might be that HMOs selectively enter HSAs with low hospital utilization which has been changing over time within HSAs.

[12] Analysis of variance and the t-statistic for the regression coefficients are adjusted for the loss of another 802 degrees of freedom for the HSA-specific effects which are not accounted for when estimating the regression coefficients on de-meaned data. See footnote 10.

In the HMO-related variables in Table 2A, note that the coefficient on the dummy variable for no HMOs (FLAG1), never has an absolute t-statistic greater than 1.94 except in the case of the dependent variable inpatient days per capita, where the t-statistic is 2.68. In this case the coefficient is positive, i.e., inpatient days per capita are higher in HSAs with no HMOs. This finding is consistent with traditional wisdom. [13] Looking at the coefficients on the number of HMOs and HMO enrollment, it is not clear from this table alone what their association is with the dependent variable(s) since the squared term and the interaction terms were included in the regressions. To help understand the relationship of these (and other independent variables) to the dependent variables, Table 2 provides the calculated elasticities and changes in the level of dependent variables associated with a unit change in the independent variables. Note that in Table 2, the calculated elasticities and changes are for the levels of occupancy rate, admissions per capita and beds per capita and not the logs of these variables. For all dependent variables, where necessary, the elasticities and change in levels are calculated at the sample means. An asterisk (*) implies that the joint F-test for an explanatory variable and it's square had a p-value less than 0.05.

[TABLE 2 ABOUT HERE]

The pattern seen in Table 2 is that the coefficient of correlation on the HMO variables has the "correct" sign (i.e., the one suggested by conventional wisdom), but is often not statistically significant. Also, the magnitude of the coefficient is "small" compared to the coefficients on some of the other variables (the magnitude is analyzed systematically in the next

[13] Though the t-statistic is not greater than 1.94 for the other six dependent variables, it is interesting to note the sign of the coefficients, which are positive in the case of (log of) occupancy, (log of) admissions per capita, and (log of) beds per capita, and negative for outpatient visits per capita and ratio of admissions to outpatient visits. The signs on these coefficients are also consistent with traditional wisdom.

section). For instance, Table 2 shows that a unit increase in the number of HMOs in an HSA is associated with a decrease in inpatient days per capita of -0.0145. Similarly, a unit increase in HMO enrollment per 1000 decreased the days per capita by -0.0002 days. Observe that for neither is the p-value less than 0.05. An increase in the number of HMOs and HMO enrollment per 1000, is associated with a decrease in beds per capita (p-value < 0.05 for both), inpatient days per capita (p-value not less than 0.05), and outpatient visits per capita (p-value not less than 0.05). However, an increase in admissions per capita is associated with increases in the number of HMOs and enrollment per 1000 (admissions per capita increase by 7.11×10^{-4} and 1.72×10^{-6} respectively, but for neither is the p-value less than 0.05). Further, with a unit increase in either the number of HMOs or HMO enrollment per 1000, the ratio of admissions to outpatient visits increases and has a p value less than 0.05 (this is consistent with the earlier results that show that an increase in HMOs is associated with an increase in admissions and a decrease in outpatient visits). Note also that whereas independently, neither the increase in admissions per capita, nor the decrease in outpatient visits per capita had a p-value less than 0.05, the ratio of the two has a p-value less than 0.05. Similarly, the ratio of inpatient days to outpatient visits also increases as either the number of HMOs increase, or the HMO enrollment per 1000 increases (but the p-value is not less than 0.05). Since individually, HMOs are associated with a decrease in both the inpatient days per capita as well as outpatient visits per capita, an increase in the ratio suggests that a larger decrease in inpatient days is associated with an increase in HMOs compared with the decrease in outpatient visits. Thus, the increase in the number and enrollment of HMOs is associated with an overall decrease in hospital utilization variables (inpatient days, outpatient visits, etc.) and a shift from inpatient to outpatient activity. Further, note that except in the case of ratio of admissions to outpatient visits, and beds per capita, the HMO variables (number and enrollment per 1000) were not statistically significant. The variable “Flag1” is also never statistically significant except in the case of inpatient days per capita. Lastly, note that most of the values appearing in the column under occupancy are not marked by an asterisk, whereas most of the values in the columns for beds per capita as well as inpatient days per capita are marked by asterisks.

The picture that emerges by looking at Table 2 is that a single HMO in a market does not reduce hospital utilization in any significant way. One anomalous result of Table 2 is that a unit increase in either the number of HMOs or HMO enrollment per 1000 is associated with an increase in admissions per capita. However, it must be noted that in these cases, the p-value is not less than 0.05. As for the occupancy rates, neither HMO-related variables, nor any of the other variables used in the OLS regression seem to explain much variation in occupancy rates. This is evidenced from both the small number of asterisks appearing in the column for occupancy rates, as well as the joint F-test for the non HSA-specific variables reported in the analysis of variance.

The most striking effect on the change in levels of the dependent variables is of the time dummies. Not only are they statistically significant (except in the case of occupancy rates), but also their magnitude is relatively large, especially in comparison to the magnitude of the HMO-related variables. For instance, the magnitude of change in outpatient visits per capita associated with HMO enrollment per 1000 is only -0.0001 and that of the same with the number of HMOs is -0.0254 (though neither is statistically significant). However, time varying factors between 1985 and 1988 alone are associated with an increase in 0.211 visits per capita and are statistically significant. Similarly, the time varying factors between 1985 and 1993 are associated with 0.6302 visits per capita increase in ambulatory care. Both these numbers are orders of magnitude larger than the change in outpatient visits per capita associated with the change in HMO enrollment. Further, this difference in order(s) of magnitude is also prevalent in the other dependent variables. Thus, though HMOs do seem to have an effect on hospital utilization variables, they are far from the most dominant factor in explaining variation in the dependent variables.

The large association of hospital utilization with time varying factors might be understood in terms of changes in the technology frontiers of hospitals as well as changes in physician practices. For instance, the decrease in hospital days may partially be explained by changes in technology. As technology advances, more patients are shifted to relatively cheaper outpatient practice thus reducing overall inpatient days.

3.1 Scenarios

In order to better see the "effect" of HMO related variables on hospital utilization variables, this section examines some "what if" scenarios for hypothetical HMO levels. It adjusts for observable differences by forming best linear predictors for hospital utilization given that different HMO levels were observed. In particular, this section provides answer(s) to questions of the following type, "if forces that were responsible for changes in dependent variables remained the same, but the HMO related variables were different, then what would the dependent variables have looked like?"

Four basic types of scenarios have been analyzed for all the seven dependent variables (inpatient days per capita, occupancy rates, beds per capita, etc.):

(i) If for each HSA, the HMO variables had been observed to remain at their 1985 levels for all the nine years;

(ii) If for each HSA, the HMO variables had been observed to remain at their 1993 levels for all the nine years;

(iii) If all the HSAs in the U.S. had been observed to have the same year-by-year HMO levels as the average HMO levels in California; and,

(iv) If all the HSAs in the U.S. had been observed to have the same year-by-year HMO levels as the average HMO levels in Pennsylvania.

The four basic scenarios were computed at three levels each: for the entire U.S., California, and Pennsylvania.[14] The results of these scenarios are provided in Figure 3. For comparison, the actual values of the (average) dependent variables for the U.S., California (CA) and Pennsylvania (PA) are also graphed. Note that the scenarios are provided for Inpatient days per capita, beds per capita, and occupancy rates and not the log of these variables. For the sake of brevity, scenarios for the remaining dependent variables are given in appendix in table 3A. In Figure 3, the first column is for the U.S. and the second column for the two selected states.

[Figure 3 about Here]

Observe that even though HMO penetration increased between 1985 and 1993 (for example, HMO enrollment per 1000 increased by about 150% and HSAs with no HMOs decreased by 63% (see Table1)), the actual hospital inpatient days per capita is not very different from the forecast hospital days per capita at 1985 and 1993 HMO levels (Figure 3.1a). Further, as shown in Figure 3.1a, hospital days per capita would have decreased the least if HMO penetration had remained at its 1985 levels and would have decreased the most at the California HMO levels. In Figure 3.1b, observe that the actual hospital days per capita in Pennsylvania are more than the actual days per capita in California. Although this difference would have been less if their HMO levels were switched, it would not have disappeared

[14] The choice of the states was based primarily on the rank order position of these states on the average HMO enrollment per capita as shown in Figure 2 in the text: California ranking number one and Pennsylvania as approximately the median state.

completely. In fact, as figure 3.1b shows, switching the HMO levels between California and Pennsylvania would have left the hospital days per capita in the two states virtually the same.

Similarly, Figures 3.3a and 3.3b compare the actual and forecast occupancy rates for the U.S. and between California and Pennsylvania. A peak in occupancy rates is observed around 1990 (the average for the U.S. is around 57.5%).[15] The California occupancy rates fluctuate around 61% whereas Pennsylvania occupancy rates fluctuate around 68%. Further, observe that switching the HMO penetration levels between these two states has almost no effect on their occupancy rates. Comparing across the list of other dependent variables from Table 3A in the appendix, it is evident that that switching HMO levels between CA and PA has almost no effect on closing the gap in the utilization variables between the two states.

These scenarios illustrate one thing very clearly: differences in HMO penetration explain at most, a very modest share of the variation in the dependent variables. Thus, the traditional wisdom, which has typically credited the decline in hospital utilization levels to the emergence of HMOs, needs to be revisited.

These results raise the question, that if changes in HMO penetration are not associated in any empirically relevant way with variation in hospital utilization levels (inpatient days per capita, occupancy rates, admissions per capita, etc.) then what is substantially associated with these changes?

[15] It is worth noting that the peak year, 1990, in occupancy rates coincides with the year in which the PPS base rate was at a maximum of approximately 4% .

3.2 Factor Decomposition

The scenarios in the previous section show that variation in HMO penetration levels is not substantially associated with variation in the dependent variables. In order to gain some insight about which factors are substantially associated with changes in the dependent variables, this section provides factor decomposition by variables and major groups for all seven dependent variables. In particular, this section quantifies the variation in a dependent variable that can be associated with a given independent variable. The years chosen for the factor decomposition analysis are 1985 and 1993, i.e., the results presented in this section account for the total variation between these two years using data regression coefficients estimated earlier from the entire data set.[16]

The reader is advised to keep in mind that in the case of occupancy rates, admissions per capita and beds per capita, the factor decomposition is for the log of these variables. Table 3 provides the amount of variation in a dependent variable that can be associated with a given variable. It also provides the variation in a dependent variable associated with any major group of factors.[17] An asterisk appears in the table when the joint F-test has a p-value less than 0.05.

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[16] Technically, factor decomposition between 1985 and 1993 amounts to calculating the percentage of the total change in the dependent variable that can be associated with any given independent variable. Thus, for example, if AFDC (X_1) and Square of AFDC (X_2)were both used in the regression, and their estimated coefficients were β_1 and β_2 respectively, then the percentage change in Y due to AFDC is

$$\beta_1 * (\Delta X_1 / ABS(\Delta Y) + \beta_2 * (\Delta X_2 / ABS(\Delta Y))$$

where Δ refers to the change in the variable between the chosen years.

[17] Classification of variables by major groups, and the names of these 'major' groups is somewhat arbitrary. For instance, this paper refers to the variables, non-surgeons, surgeons and teaching MDs as "Physicians", and to the number of hospitals as "Hospitals". Another equally suitable classification may have been "Supply side Factors" which would be a composite of all the variables in the "Physician" and the "Hospitals" groups. The point is that since (i) the regression models were linear in parameters (though not in variables), and (ii) Table [4] provides breakdown by variables after taking into account the squared terms, the readers can easily adjust the results to their own a priori classifications, e.g., say the "Supply side factors".

Thus, an asterisk in front of "TOTAL" for the demographic group implies that the p-value in a joint F-test for the four variables, births per 1000, HSA population and their squares, was less than 0.05. Figure 4 provides graphical results of Table 3 for Inpatient days per capita by major groups. The graphs for the remaining dependent variables are given in the appendix in Figure 4A.

[TABLE 3 and FIGURE 4 about Here]

Table 3 shows that between 1985 and 1993, Inpatient days per capita decreased by 9.02%, and of this total decrease, HMOs contributed 20.65%. Similarly, as log of occupancy increased by 2.65% (i.e., when occupancy decreased by 0.79%), HMOs offset the increase in log of occupancy rates by 10.85%. Outpatient visits per capita increased by 71.41% and the net effect of HMOs was to offset this increase by 1.36%. Log of admissions per capita increased by 10.96% (admissions per capita decreased by 18.66%) and HMOs contributed towards the increase in log of admissions per capita by only 0.51% (i.e., HMOs offset the increase in admissions per capita). Similarly, log of beds per capita increased by 2.56% (beds per capita decreased by 9.56%) and HMOs offset the increase in log of beds per capita by 11.22% (i.e., contributed towards an overall decrease in beds per capita). Similar interpretations should be made for the two ratio measures, admissions to outpatient visits and inpatient days to outpatient visits.

The numerical results are consistent with the findings in the scenarios section, as well as the elasticity results in Table 2. However, the calculations in Table 3 clearly show that the variation in the dependent variables is not substantially associated with HMO-related variables. In fact, yearly fixed effects (labeled as "time" in Table 3 and Figure 4A) explain the largest amount of variation in the dependent variables. The bar graphs in Figure 4A show that the group labeled "social and economic factors" ranks second in explaining the amount of variation in all the dependent variables, except for the log of occupancy rates and the ratio of inpatient days to outpatient visits. The group labeled "hospitals"[18] ranks second in explaining the variation in the log of occupancy rates. Further, hospitals rank as number three (or higher) in explaining the amount of variation in all dependent variables except in the two ratio measures of inpatient versus outpatient activities. Ranking different groups of variables in this way shows that HMOs are not the most important group of variables in explaining the amount of variation in the dependent variables. In fact, yearly fixed effects, social and economic factors and even the number of hospitals are more important.

The main findings of this section are that neither the changes in hospital utilization rates (hospital days per capita, occupancy rates, admissions per capita etc.), nor the shift from inpatient to ambulatory activity in hospitals are strongly associated with changes in HMO penetration levels in the U.S. Yearly fixed effects explain the most amount of variation in hospital utilization and shift from inpatient to outpatient activity. As Table 3 shows, time fixed effects account for -125.87% of the total (-9.02%) decrease in inpatient days per capita between 1985 and 1993. Similarly, 94.28% of the total (71.41%) increase in outpatient visits per capita is associated with time fixed effects.

The results indicate that decision makers who are interested in forecasting hospital demand need to focus more on social and economic, demographic and other time varying factors in their local markets, rather than the growth of HMOs. Similarly, policy makers may need to reevaluate the long term effects of time varying factors on hospital use rather than assuming that it is necessarily the growth of managed care that is responsible for the decline in utilization.

[18] Note that the independent variable, hospitals, is the log of number of hospitals.

To the extent that the decline in hospital utilization is strongly associated with variation in time varying factors, only further research can explain what these factors may be and how they effect utilization. One plausible speculation is that the introduction of PPS and the rapid growth of HMOs changed the types of technology that hospitals would adopt, thus bringing about changes in utilization. The adoption and diffusion of cost reducing technologies is in sharp contrast to life enhancing technologies of the pre-PPS era [Weisbrod, 1991]. An example of such a technology would be the widespread use of less invasive and less expensive laparoscopic cholecystectomy by 1991, used for the treatment of gall-bladder disease [Parente, Gaynor and Bass, 1996]. Use of cost-efficient and less invasive technologies decreased hospital admissions, hospital days and directed more patients towards the outpatient domain. In turn it lead to an increase in the average length of stay because, for instance, patients for whom less invasive surgery was available, were shifted to ambulatory services leaving behind a pool of patients who required more invasive procedures.

4. SUMMARY

This paper analyzes hospital utilization data on short term general hospitals in the U.S. between 1985 and 1993. Much of the previous empirical research on managed care and hospital utilization focused on the decrease in hospital usage *within* HMOs. Often the inferences drawn from the literature on the effects of managed care and hospital utilization suggest that the decline in hospital usage may be largely due to the growth of HMOs. This paper measures the decline in hospital utilization in *markets* as HMO presence rises. The latter includes both, hospital utilization within HMO enrollees, and the “spill-over effects” onto non-HMO patients. The results show that the decline in hospital utilization and the shift from inpatient to outpatient care is not strongly associated with the rapid growth of health maintenance organizations. Other variables, such as demographic changes, social and economic factors and unobserved time varying factors explain far more variation in hospital utilization. The time varying factors might be changes in the insurance market, technology or PPS base rates. This paper does not control for these individual time varying factors and hence no conclusions about their role can be drawn.

The main results of this analysis, i.e., the small association between HMOs and hospital utilization, and the large association between hospital utilization and time varying factors come with two caveats. These are: (i) any measurement error in the HMO variables would bias the results towards zero, and (ii) HMO-related variables may be endogenous which would bias the estimates, perhaps towards zero.

In terms of policy implications, the results suggest that decision makers may be able to better predict hospital demand by forecasting demographic, social and economic, and other time varying factors. At the same time, it is also important for both the policy makers and hospital decision makers to identify the role of technology and competitive effects in managed care. Given that the results in this paper show a strong association between time varying factors and variation in hospital utilization, an important question arises about the direction and magnitude of any causality between them. The limitations of this research to answer such questions suggest a possible direction for future work. Empirically testing predictions that are robust across a large class of structural models of the competitive effects of HMOs and technology adoption on hospital utilization might be a useful direction to pursue. This in turn would require detailed micro level data on individual hospitals and HMOs as well as technology measures.

Tables and Figures

Table 1

Variable	Mean	Standard Deviation	% Change between 1985-1993
Independent Variables			
AFDC per capita	43.26	33.81	6.19%
Large Establishments per 1000	220	37.9	9.67%
Income per capita ($)	11668	2363	11.22%
Medicare Enrollment per 1000	152.44	36.77	10.66%
Unemployment Rate	7.11	2.86	-19.07%
Births per 1000	7.79	3.80	-4.10%
HSA Population	308436	670070	7.91%
Hospitals	6.97	9.45	-10.08%
Non-Surgical Patient Care MDs per 1000	0.94	0.56	12.85%
Surgeons per 1000	0.28	0.13	3.28%
Teaching MDs per 1000	0.011	0.024	-3.77%
Flag When No HMO's in a HSA-Year	0.42	0.49	-63.42%
Weighted Number of HMOs	2.18	3.45	218.99%
HMO Enrollment per 1000	46.58	77.96	149.43%
Dependent Variables			
Occupancy Rate	57.52%	12.73%	-0.79%
Beds per 1000	4.61	2.30	-9.56%
Admissions per 1000	125	34.68	-18.66%
Inpatient Days per 1000	977	589	-9.02%
Outpatient Visits per 1000	1249	726	71.41%
Ratio of Admissions to Outpatient Visits	0.13	0.07	-56.68%
Ratio of Inpatient Days to Outpatient Visits	0.003	0.002	-51.95%

Table 2

Elasticity at the Sample Mean

With Respect To:	Occupancy	Outpatient Visits per capita	Inpatient Days per capita	Ratio of Admissions to Outpatients	Ratio of Inpatient Days to Outpatient Visits	Admissions per capita	Beds per capita
AFDC per capita (in 1000 $)	-0.0279	0.0406	0.0259 *	-0.2191 *	0.0296	-0.0020	0.0322 *
Large Establishments per 1000	-6.57E-02	0.1895 *	-0.1414 *	0.2671 *	0.0440 *	2.02E-02	-0.0391 *
Income per capita	0.1440 *	0.1931	0.2944 *	-0.2822 *	-0.7833 *	0.1283 *	0.0823 *
Medicare Enrollment per 1000	-0.1179	0.3428 *	0.6739 *	0.1106 *	-0.1860 *	0.1690 *	0.7014 *
Unemployment Rate	-0.0065	-0.0461	-0.0543 *	0.1093 *	0.0441	-0.0105	-0.0389 *
Births per 1000	-0.0219 *	0.0658	-0.1691 *	0.2250	0.3426	0.1289 *	-0.0090 *
HSA Population in 1000	-0.0203	-0.3479 *	-0.1072 *	0.3540 *	0.0744	-0.0025	-0.1217 *
Hospitals	-0.0884 *	0.3126 *	0.4548 *	-0.0419	0.1993	0.2094 *	0.4936 *
Non-Surgical Patient Care MDs per 1000	-0.0217	0.0415	-0.0683 *	0.1904 *	-0.1724 *	0.1408 *	0.0685 *
Surgeons per 1000	-0.0058	-0.0315	0.0003	0.1554 *	0.0389	0.0452 *	0.0083 *
Teaching MDs per 1000	0.0080	-0.0018	0.0057	0.0130	0.0050	6.18E-05	0.0012
Flag When No HMO's in a HSA-Year	0.0014	-0.0007	0.0080 *	-0.0046	0.0008	0.0015	0.0031
Weighted Number of HMOs	-0.0026	-0.0444	-0.0323	0.0754 *	0.0327	1.24E-02	-0.0376 *
HMO Enrollment per 1000	-1.93E-03	-2.11E-03	-7.94E-03	2.88E-02 *	2.18E-02	6.40E-04	-6.34E-03 *
Dummy for 1986	-0.0018 *	0.0049 *	-0.0055 *	-0.0235 *	-0.0149 *	-0.0065 *	-0.0037 *
Dummy for 1987	-0.0018 *	0.0106 *	-0.0086 *	-0.0432 *	-0.0273 *	-0.0123 *	-0.0073 *
Dummy for 1988	-0.0008	0.0188 *	-0.0077 *	-0.0603 *	-0.0364 *	-0.0150 *	-0.0087 *
Dummy for 1989	0.0003	0.0227 *	-0.0088 *	-0.0696 *	-0.0409 *	-0.0183 *	-0.0114 *
Dummy for 1990	0.0019 *	0.0282 *	-0.0083 *	-0.0774 *	-0.0441 *	-0.0196 *	-0.0132 *
Dummy for 1991	0.0014	0.0359 *	-0.0085 *	-0.0861 *	-0.0531 *	-0.0221 *	-0.0144 *
Dummy for 1992	0.0007	0.0483 *	-0.0107 *	-0.0954 *	-0.0595 *	-0.0246 *	-0.0163 *
Dummy for 1993	-0.0016	0.0560 *	-0.0132 *	-0.1032 *	-0.0678 *	-0.0273 *	-0.0178 *

Change in Levels at the Sample Mean

With Respect To:	Occupancy	Outpatient Visits per capita	Inpatient Days per capita	Ratio of Admissions to Outpatients	Ratio of Inpatient Days to Outpatient Visits	Admissions per capita	Beds per capita
AFDC per capita (in 1000 $)	-0.3704	1.1720	0.5859 *	-0.6400 *	0.0018	-0.0058	0.0034 *
Large Establishments per 1000	-0.0002	0.0011 *	-0.0006 *	0.0002 *	5.26E-07 *	1.15E-05	-8.19E-07 *
Income per capita	7.10E-06 *	2.07E-05	2.47E-05 *	-3.06E-06 *	-1.77E-07 *	1.38E-06 *	3.25E-08 *
Medicare Enrollment per 1000	-0.0004	0.0028 *	0.0043 *	0.0001 *	-3.21E-06 *	0.0001 *	2.12E-05 *
Unemployment Rate	-0.0005	-0.0081	-0.0075 *	0.0019 *	0.0000	-0.0002	-2.52E-05 *
Births per 1000	-0.0016 *	0.01	-0.02 *	0.0037	0.0001	0.0021 *	0.0000 *
HSA Population in 1000	0.0000	-0.0014 *	-0.0003 *	0.0001 *	6.35E-07	-1.02E-06	-1.82E-06 *
Hospitals	-0.0073 *	0.0561 *	0.0638 *	-0.0008	7.53E-05	0.0038 *	0.0003 *
Non-Surgical Patient Care MDs per 1000	-0.01	0.06	-0.07 *	0.03 *	-0.0005 *	0.0189 *	0.0003 *
Surgeons per 1000	-0.01	-0.14	0.0011	0.07 *	0.0004	0.0204 *	0.0001 *
Teaching MDs per 1000	0.41	-0.20	0.50	0.15	0.0012	0.0007	0.0005
Flag When No HMO's in a HSA-Year	0.0019	-0.0021	0.0186 *	-0.0014	0.0000	0.0004	3.46E-05
Weighted Number of HMOs	-0.0007	-0.0254	-0.0145	0.0044 *	3.94E-05	7.11E-04	-7.93E-05 *
HMO Enrollment per 1000	-2.39E-05	-0.0001	-0.0002	7.83E-05 *	1.23E-06	1.72E-06	-6.27E-07 *
Dummy for 1986	-0.0092 *	0.0555 *	-0.0484 *	-0.0268 *	-0.0004 *	-0.0073 *	-0.0002 *
Dummy for 1987	-0.0091 *	0.1192 *	-0.0753 *	-0.0492 *	-0.0006 *	-0.0139 *	-0.0003 *
Dummy for 1988	-0.0042	0.2110 *	-0.0676 *	-0.0686 *	-0.0009 *	-0.0170 *	-0.0004 *
Dummy for 1989	0.0013	0.2556 *	-0.0773 *	-0.0792 *	-0.0010 *	-0.0206 *	-0.0005 *
Dummy for 1990	0.0097 *	0.3170 *	-0.0728 *	-0.0881 *	-0.0010 *	-0.0221 *	-0.0005 *
Dummy for 1991	0.0074	0.4033 *	-0.0751 *	-0.0979 *	-0.0013 *	-0.0249 *	-0.0006 *
Dummy for 1992	0.0035	0.5435 *	-0.0939 *	-0.1085 *	-0.0014 *	-0.0277 *	-0.0007 *
Dummy for 1993	-0.0083	0.6302 *	-0.1162 *	-0.1173 *	-0.0016 *	-0.0308 *	-0.0007 *

*** p-value < 0.05**

Table 3

Factor Decomposition by Variables (& Major Groups)

	Occupancy Rate	Outpatient Visits Per Capita	Inpatient Days Per Capita	Ratio of Admissions to Outpatient Visits	Ratio of Inpatient Days to Outpatient Visits	Admissions Per Capita	Beds Per Capita
	Logged? Yes	Logged? No	Logged? No	Logged? No	Logged? No	Logged? Yes	Logged? Yes
Total % Change Dependent Variable between 1985 and 1993:--------->	**2.65%**	**71.41%**	**-9.02%**	**-56.68%**	**-51.95%**	**10.96%**	**2.56%**
Total % Change in LEVEL of Dependent Variable between 1985 and 1993:--------->	**-0.79%**	**71.41%**	**-9.02%**	**-56.68%**	**-51.95%**	**-18.66%**	**-9.56%**
Social & Economic							
AFDC per capita (in $1000)	-14.72%	0.60%	0.90% *	-2.15% *	0.24%	-0.05%	1.38% *
Large establishments per 1000	-38.08%	3.37% *	-12.81% *	2.41% *	-0.02% *	0.85%	-2.26% *
Per capita income	98.32% *	3.81%	32.63% *	-3.20% *	-10.87% *	6.16% *	6.06% *
Medicare enrollment per 1000	-75.72%	6.89% *	73.17% *	0.91% *	-3.65% *	7.79% *	50.95% *
Unemployment rate	4.26%	1.57%	9.22% *	-2.74% *	-1.34%	1.08%	5.13% *
TOTAL	**-25.94% ***	**16.24% ***	**103.11% ***	**-4.78% ***	**-15.65% ***	**15.82% ***	**61.26% ***
Demographic							
Births per 1000	-2.62% *	-0.56%	7.54% *	-0.72%	-1.17%	-2.49% *	0.84% *
HSA population	-8.98%	-4.15% *	-7.03% *	2.64% *	0.77%	-0.09%	-5.54% *
TOTAL	**-11.60%**	**-4.71% ***	**0.51% ***	**1.92% ***	**-0.41%**	**-2.58% ***	**-4.71% ***
Hospitals	**56.22% ***	**-5.69% ***	**-48.19% ***	**0.45%**	**-2.75%**	**-9.50% ***	**-35.04% ***
Physicians							
Non-surgical patient care MDs per 1000	-10.05%	0.93%	-8.68% *	2.63% *	-2.80% *	7.77% *	3.95% *
Surgeons per 1000	-4.80%	0.29%	0.01%	-0.13% *	0.17%	0.67% *	1.37% *
Teaching MDs per 1000	1.35%	0.01%	-0.24%	-0.06%	-0.03%	0.00%	-0.04%
TOTAL	**-13.51%**	**1.23%**	**-8.91%**	**2.45% ***	**-2.66%**	**8.44% ***	**5.28% ***
HMO's							
Flag when no HMO's in an HSA-year	-9.30%	0.14%	-8.67% *	0.55%	-0.11%	-0.70%	-2.33%
Weighted number of HMOs	9.86%	-0.50%	-4.13%	3.19%	1.65%	-0.52%	-3.46% *
HMO numbers and enrollment interaction	-12.37%	-2.56%	-8.52%	1.43%	0.66%	1.91%	-6.55% *
HMO enrollment per 1000	0.96%	1.57%	0.68%	1.65% *	1.82%	-0.18%	1.12% *
TOTAL	**-10.85%**	**-1.36%**	**-20.64% ***	**6.83% ***	**4.02%**	**0.51%**	**-11.22% ***
Time	**-94.33% ***	**94.28% ***	**-125.87% ***	**-106.89% ***	**-82.55% ***	**-112.69% ***	**-115.58% ***

Figure [1]

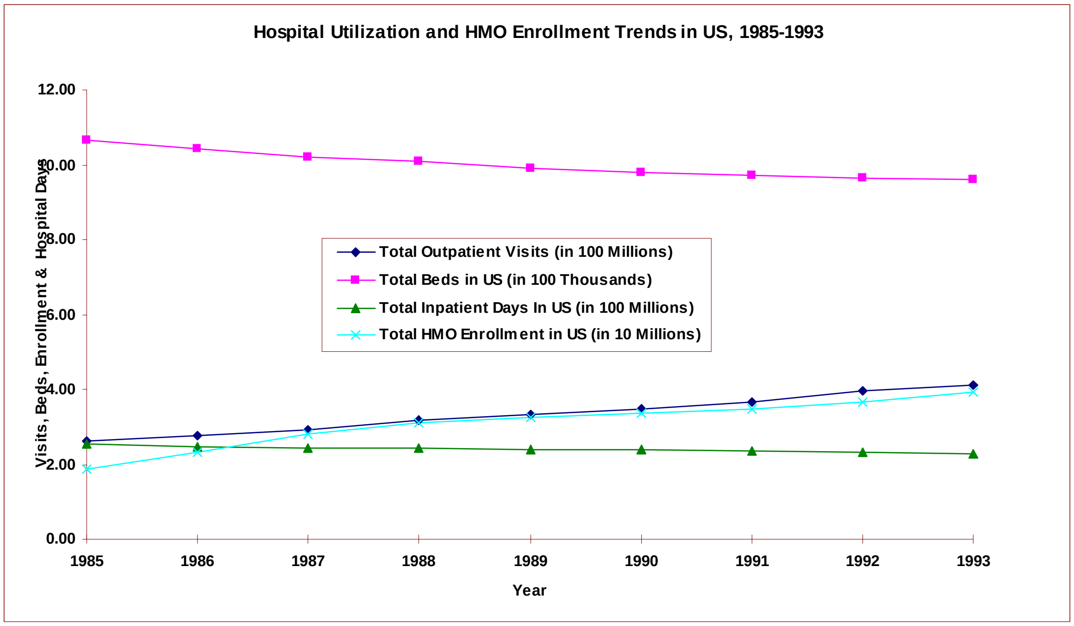


Figure [2]

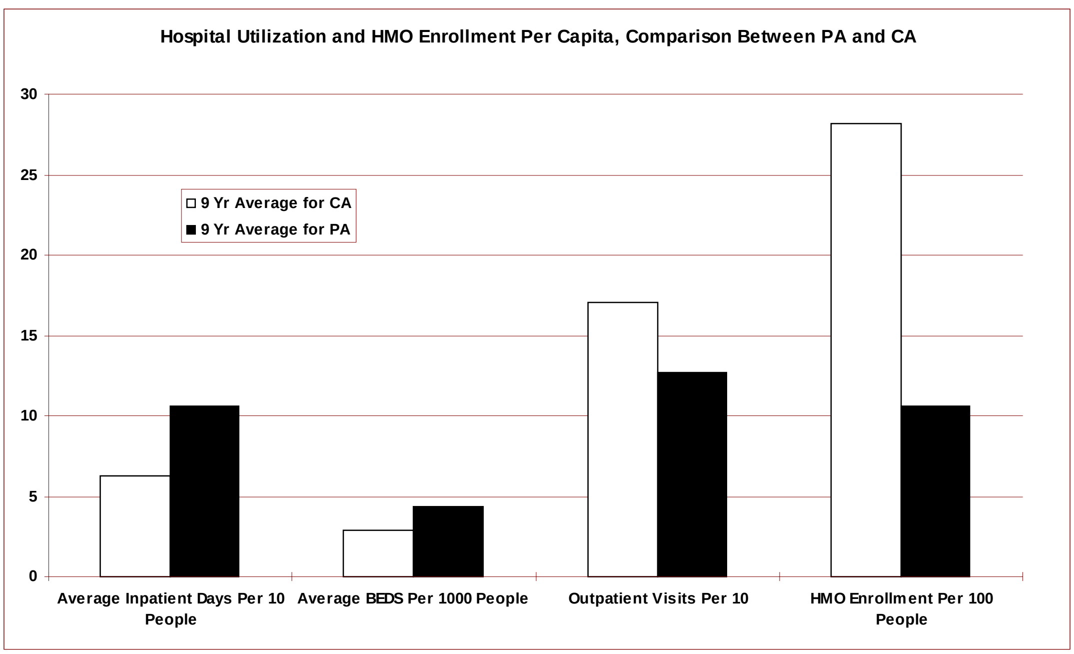


Figure 3.1a

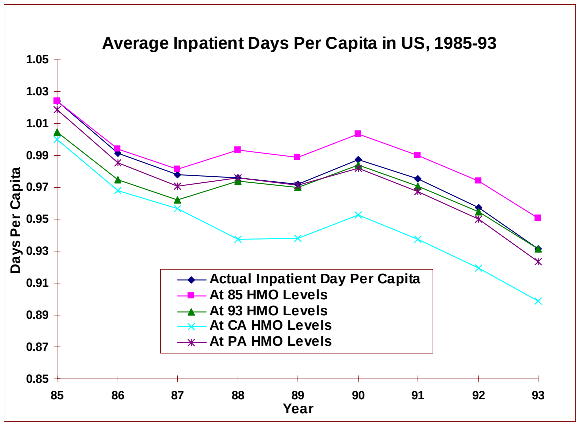


Figure 3.1b

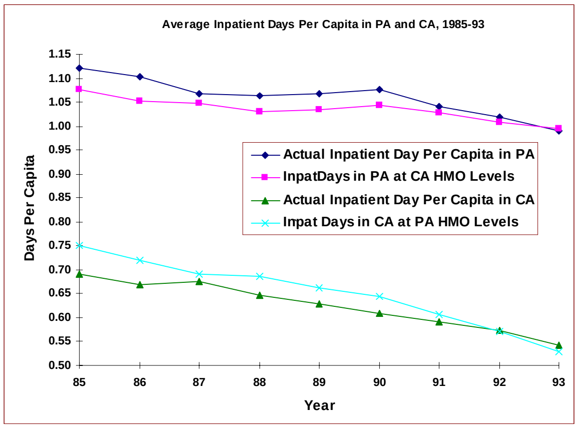


Figure 3.2a

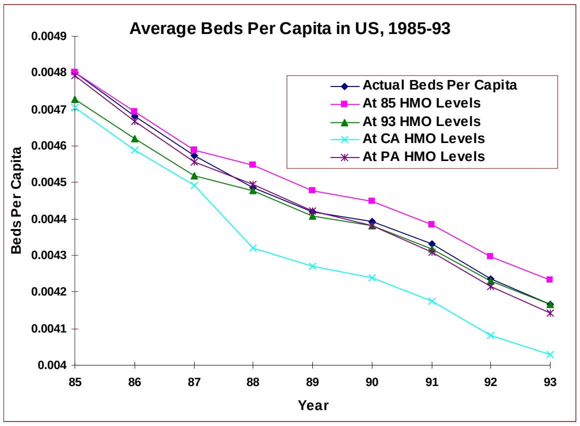


Figure 3.2b

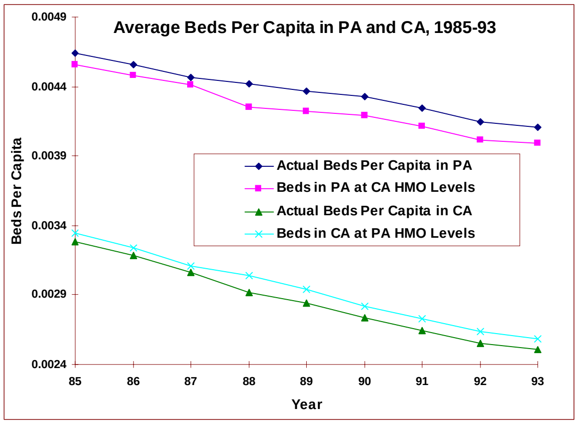


Figure 3.3a

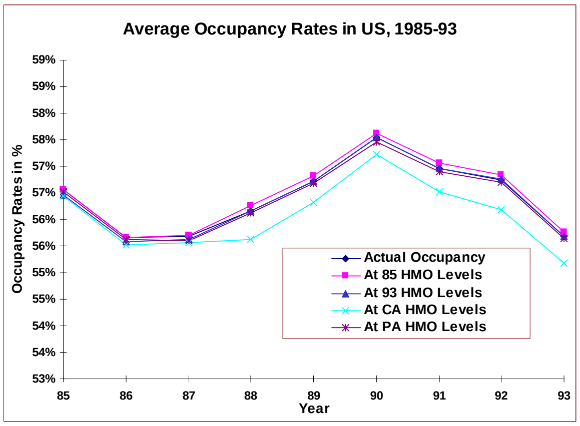


Figure 3.3b

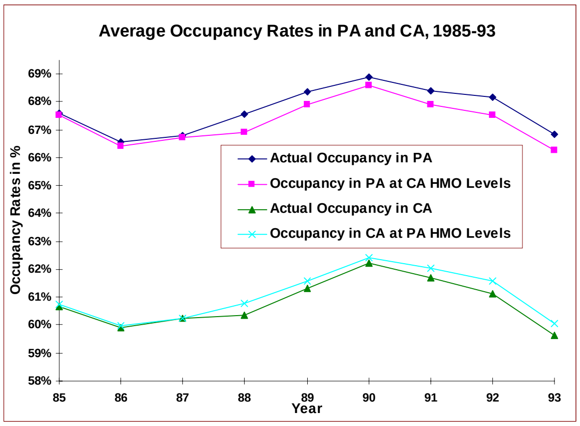
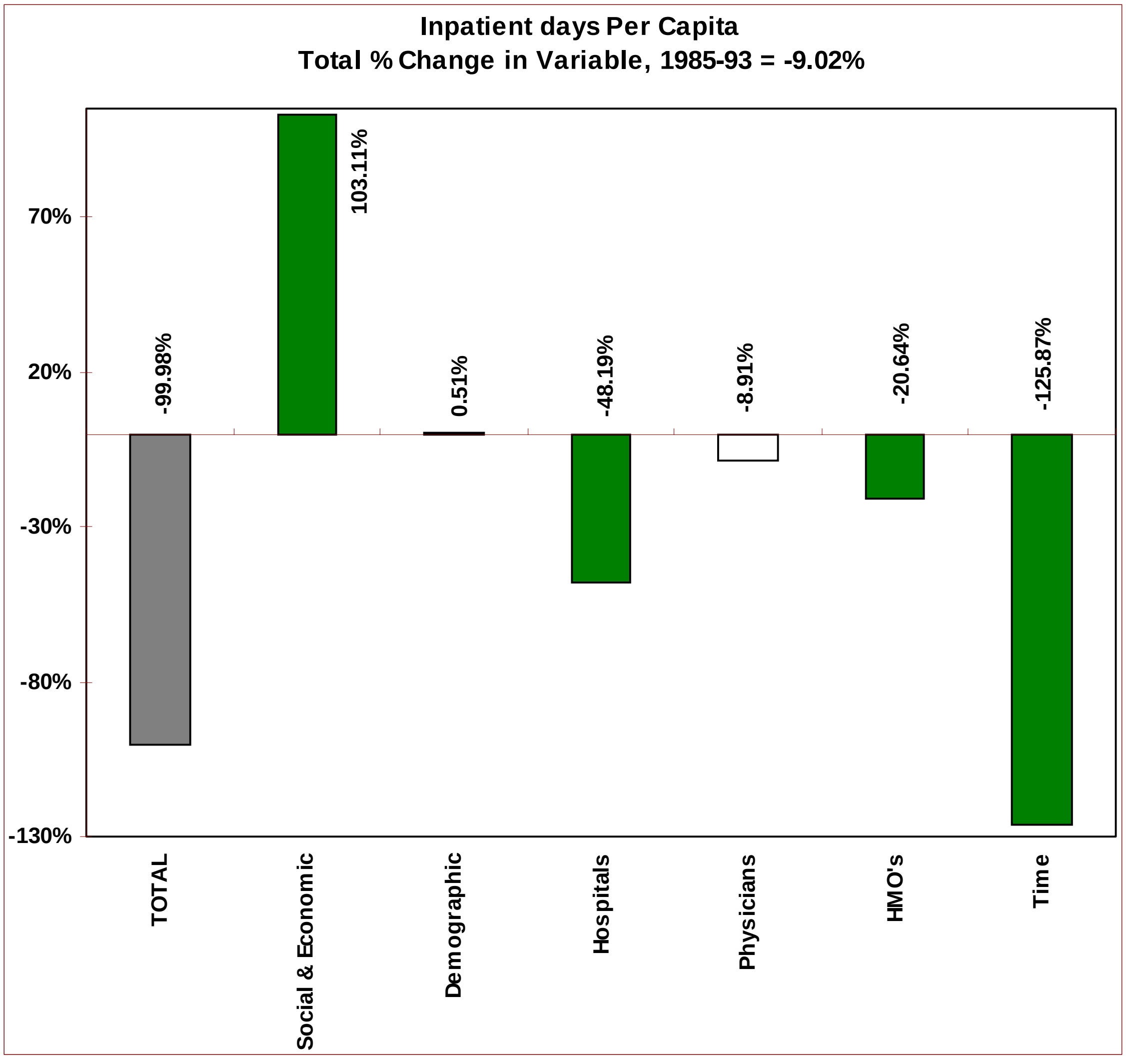


Figure [4]


Inpatient days Per Capita
Total % Change in Variable, 1985-93 = -9.02%
70%
20%
-30%
-80%
-130%
-99.98%
103.11%
0.51%
-48.19%
-8.91%
-20.64%
-125.87%
TOTAL
Social & Economic
Demographic
Hospitals
Physicians
HMO's
Time

REFERENCES

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APPENDIX

MISSING OBSERVATIONS

Data were not available for some variables for certain years. These missing observations were interpolated using simple methods. All interpolations were done at the county level, before aggregating up to the HSA levels. For Teaching MDs, Patient Care MDs and Surgeons, observations were not available for 1987 and 1991. These observations were estimated using a simple average from the surrounding years. For example, Teaching MDs for 1987 for a given county were calculated as the average of the teaching MDs in that county in 1986 and 1988. Similarly, population estimates for 1989 were computed as the simple average of the estimate of 1988 and the census figure for 1990.

Medicare Enrollment (part A and/or B) was not available for 1992 and 1993. This was estimated by a slightly different method. For each county, the ratio of Medicare enrollment to population over age 65 was computed for 1991. This ratio was multiplied by the population over age 65 in 1992 (1993) to get an estimate of Medicare enrollment for 1992 (1993) for each county.

Birthrates for 1993 were also missing and were calculated using simple exponential smoothing for each county using it's data from 1985 through 1992.[19] Last, data for unemployment rates for 1993 were also estimated. Since unemployment rates are subject to erratic changes, a slightly more sophisticated approach was used. First, data were obtained for unemployment rates for years 1985 through 1993 at the state level. Then, for each county and year from 1985 through 1992, the ratio of county to state unemployment rate was calculated. This ratio was forecast (using exponential smoothing) for 1993. The forecast value of the ratio (for each county) was then multiplied by the actual 1993 state level unemployment rate to get an estimate of county unemployment for 1993.

[19] For both, birth rates and the ratio of county to state unemployment rates, an alpha value of 0.9 was used in the exponential smoothing forecast method. Various other values for alpha were also tried. Trial and error showed that any value of alpha above 0.5 did not change the forecast up to 4 decimal places. An alpha value of 0.9 gives more weight to more recent years observations in the forecast than to the early years.

Table 1A: Variable Definitions and Measurement

Variable Name	Definition
HSA population	Sum of county populations
AFDC per capita (Aid to Families with Dependent Children)	Total* payments as AFDC in constant 1983-84 dollars divided by HAS population.
Large establishments per capita	Total* number of establishments in a HSA with 100 or more employees divided by HSA population
Income per capita	Total** income per capita, where income per capita was reported as total personal income of the residents of a county divided by the county population. Income per capita is in constant 1983-84 dollars.
Medicare enrollment per 1000	Total* Medicare Part A and/or B enrollment in an HSA divided by HAS population
Unemployment rate	Total** unemployment rate for persons over the age of 16. Unemployment rate = (number unemployed) divided by (civilian labor force)*100.
Births per capita	Total** live births in an HSA divided by the HSA population. Note that the number of live births for a county are based on the place of residence of the mother.
Hospitals	Total* number of short term general hospitals (STGH). STGH are defined as hospitals that provide non-specialized care and the majority of their patients stay for fewer than thirty days.
Non-Surgical patient care MDs per capita.	Computed as the (total* (non-federal total patient care MDs) - total* (surgeons)) divided by HSA population. Total patient care MDs include office and hospital based physicians, as well as hospital residents and clinical fellows. For definition of “surgeons”, see below.
Surgeons per capita	Total* (Non-federal patient care office-based surgical specialties total) divided by HSA population. Surgical specialties total includes the following subspecialties: Colon/Rectal surgery, General surgery, Neurological surgery, Obstetrics-Gynecology (general + subspecialties), Ophthalmology, Orthopedic surgery, Otolaryngology, Plastic surgery, Thoracic surgery and Urology.
Teaching MDs per capita	Total* non-federal teaching physicians in medical schools, hospitals, nursing schools, or other institutions of higher learning, divided by HAS population.
Flag1	Binary dummy with value one if the total* number of HMOs in an HSA is zero.
Weighted number of HMOs	Total** number of HMOs in an HSA.
HMO enrollment per capita	Total* HMO enrollment in an HSA divided by the HSA population. For HMO enrollment in a county, see text.
Occupancy Rate	Ratio of total* inpatient days divided by (365 the total* number of beds)
Beds per capita	Total* number of “available” beds in STGH divided by HSA population. Number of beds is reported as the sum of total number of available beds each day divided by the number of days in the reporting period.
Admissions per capita	Total* admissions in STGH divided by HSA population
Inpatient days per capita	Total* inpatient days in STGH divided by HAS Population
Outpatient visits per capita	Total* outpatient visits divided by HSA population.
Ratio of admissions to outpatient visits	Computed as total* admissions divided by total* outpatient visits.
Ratio of inpatient days to outpatient visits	Computed as total* inpatient days divided by (365 total* outpatient visits).

* implies that the sum is over all the counties in the HAS

** implies weighted sum over all the counties, where the weighting factor is the county population.

Table 2A

Statistic Name	Analysis of Variance						
	Occupancy Rate	Outpatient Visits per capita	Inpatient Days per capita	Ratio of Admissions to Outpatient Visits	Ratio of Inpatient Days to Outpatient Visits	Admissions per capita	Beds per capita
Model DF	36	34	32	34	30	27	33
Error DF	7191	7193	7195	7193	7197	7200	7194
U Total DF	7227	7227	7227	7227	7227	7227	7227
Model SS	48.37	589.9	287.6	470.9	6.16E-03	89.26	159.1
Error SS	63.29	262.8	138.6	273.4	9.56E-03	37.60	51.82
U Total SS	111.7	852.6	426.2	744.3	0.016	126.9	210.9
Model Mean Square	0.058	0.706	0.345	0.563	7.41E-06	0.108	0.191
Error Mean Square	9.91E-03	0.041	0.022	0.043	1.50E-06	5.88E-03	8.11E-03
Root MSE	0.100	0.203	0.147	0.207	1.22E-03	0.077	0.090
Dep Mean	0	0	0	0	0	0	0
C.V.	----	----	----	----	----	----	----
R-square	0.433	0.692	0.675	0.633	0.392	0.704	0.754
Adj_R-sq	0.430	0.690	0.673	0.631	0.390	0.703	0.753
F-Test (Excluding HSA Du	5.293	194.2	48.88	322.2	67.05	213.9	119.6

Table 2A (Continued) Regression Coefficients and t-values

	Independent		Dependent Variable						
Long Names	Variable	Type	Occupancy Rate	Outpatient Visits per capita	Inpatient Days per capita	Ratio of Admissions to Outpatient Visits	Ratio of Inpatient Days to Outpatient Visits	Admissions per capita	Beds per capita
			(Logged? Yes)	(Logged? No)	(Logged? No)	(Logged? No)	(Logged? No)	(Logged? Yes)	(Logged? Yes)
AFDC per capita	AFDC_N	Coefficient	-0.959	1.702	0.243	-1.010	0.002	-0.046	0.745
(in 1000 $)		T For H0, B=0	-2.363	1.400	0.402	-6.606	0.797	-0.329	4.500
	AFDC2_N	Coefficient	3.642	-6.126	3.959	4.275	----	----	----
		T For H0, B=0	1.716	-0.964	1.249	5.349	----	----	----
Births per capita	BIRTH_N	Coefficient	-14.43	7.985	-21.22	7.222	0.249	16.55	5.639

Long Names	Variable	Type	Occupancy Rate	Outpatient Visits per capita	Inpatient Days per capita	Ratio of Admissions to Outpatient Visits	Ratio of Inpatient Days to Outpatient Visits	Admissions per capita	Beds per capita
			(Logged? Yes)	(Logged? No)	(Logged? No)	(Logged? No)	(Logged? No)	(Logged? Yes)	(Logged? Yes)
		T For H0, B=0	-1.806	0.334	-4.975	2.403	2.552	7.602	0.781
	BIRTH2_N	Coefficient	746.2	165.4	----	-229.3	-8.570	----	-436.6
		T For H0, B=0	2.562	0.189	----	-2.092	-2.405	----	-1.663
Large Establishments	EMP14_2N	Coefficient	-1.504	-8.775	-8.330	4.540	0.113	----	-4.702
per capita (i.e., more		T For H0, B=0	-0.932	-1.816	-3.455	7.475	5.720	----	-3.244
than 100 employees)	EMP14_N	Coefficient	0.363	4.936	3.036	-1.844	-0.049	0.092	1.891
		T For H0, B=0	0.537	2.438	3.002	-7.240	-5.923	0.760	3.106
Flag When No HMOs	FLAG1	Coefficient	3.33E-03	-2.14E-03	0.019	-1.40E-03	5.18E-06	3.54E-03	7.50E-03
in a HSA-Year		T For H0, B=0	0.716	-0.154	2.678	-0.800	0.091	0.998	1.786
HSA Population	HSAPOP	Coefficient	-6.72E-08	-1.45E-06	-3.51E-07	1.49E-07	6.35E-10	-8.11E-09	-4.07E-07
		T For H0, B=0	-0.950	-6.850	-3.323	5.610	1.087	-0.222	-6.362
	HSAPOP2	Coefficient	2.11E-15	6.76E-14	1.86E-14	-6.43E-15	----	----	2.01E-14
		T For H0, B=0	0.422	4.525	2.494	-3.422	----	----	4.465
Income per capita ($)	INCOME	Coefficient	1.03E-05	8.93E-06	2.56E-05	-1.89E-05	-4.94E-07	1.32E-05	2.43E-05
		T For H0, B=0	1.000	0.292	1.687	-4.910	-3.969	1.701	2.610
	INCOME2	Coefficient	8.68E-11	5.03E-10	-4.17E-11	6.77E-10	1.36E-11	-9.49E-11	-7.38E-10
		T For H0, B=0	0.238	0.467	-0.078	4.997	3.108	-0.347	-2.240
Log of Hospitals	LHOSP	Coefficient	-0.097	0.456	0.296	-9.27E-03	1.70E-04	0.190	0.512
		T For H0, B=0	-3.460	5.444	7.083	-0.881	0.496	8.859	20.30
	LHOSP2	Coefficient	2.71E-03	-0.021	0.048	1.29E-03	1.15E-04	6.42E-03	-6.07E-03
		T For H0, B=0	0.273	-0.710	3.255	0.346	0.944	0.847	-0.679
Medicare Enrollment	MED_N	Coefficient	-1.610	-10.30	-1.936	1.858	0.091	1.109	4.601
per capita		T For H0, B=0	-1.909	-4.088	-1.537	5.865	8.885	5.135	17.82
	MED2_N	Coefficient	2.744	43.00	20.52	-5.794	-0.309	----	----
		T For H0, B=0	1.238	6.482	6.191	-6.946	-11.44	----	----
Non-Surgical	NSPCMD_N	Coefficient	-37.32	55.51	-71.40	25.73	-0.485	150.6	110.1
Care MD's per capita		T For H0, B=0	-1.265	0.929	-2.473	3.428	-2.054	10.28	4.159
	NSPCMD2N	Coefficient	7.55E+03	----	----	----	----	----	-1.97E+04
		T For H0, B=0	0.999	----	----	----	----	----	-2.933
Weighted Number	NHMO	Coefficient	1.99E-03	-2.78E-03	-5.49E-03	2.74E-03	2.82E-05	4.86E-04	-7.25E-03
of HMOs		T For H0, B=0	0.859	-0.402	-1.589	3.146	1.004	0.278	-3.470
	NHMO2	Coefficient	-1.35E-04	1.28E-04	3.92E-04	-1.17E-04	-1.40E-06	-1.07E-04	5.30E-04
		T For H0, B=0	-0.916	0.292	1.783	-2.112	-0.782	-0.957	3.990
HMO Enrollment	PHMO_N	Coefficient	-0.050	-0.091	-0.197	0.079	1.25E-03	-0.014	-0.151

Long Names	Variable	Type	Occupancy Rate	Outpatient Visits per capita	Inpatient Days per capita	Ratio of Admissions to Outpatient Visits	Ratio of Inpatient Days to Outpatient Visits	Admissions per capita	Beds per capita
			(Logged? Yes)	(Logged? No)	(Logged? No)	(Logged? No)	(Logged? No)	(Logged? Yes)	(Logged? Yes)
per capita		T For H0, B=0	-0.589	-0.364	-1.568	2.494	1.217	-0.214	-1.995
	PHMO2_N	Coefficient	0.216	1.541	0.864	-0.115	-1.09E-03	0.011	0.782
		T For H0, B=0	0.858	2.044	2.292	-1.213	-0.354	0.056	3.440
Interaction Term for	NPHMO_N	Coefficient	-5.54E-03	-0.050	-0.023	4.59E-03	3.72E-05	0.012	-0.026
HMOs		T For H0, B=0	-0.505	-1.517	-1.396	1.110	0.277	1.440	-2.663
Surgeons	SURGS_N	Coefficient	95.85	-818.7	1.113	235.1	0.370	163.2	-313.0
per capita		T For H0, B=0	0.878	-2.566	0.014	5.859	0.567	3.993	-3.167
	SURGS2_N	Coefficient	-2.11E+05	1.22E+06	----	-2.96E+05	----	----	6.19E+05
		T For H0, B=0	-1.165	2.377	----	-4.590	----	----	3.784
Teaching MDs	TMD_N	Coefficient	814.2	-197.7	500.1	147.4	1.184	5.565	1.12E+02
per capita		T For H0, B=0	2.443	-0.263	1.332	1.561	0.385	0.029	0.493
	TMD2_N	Coefficient	-4.36E+06	----	----	----	----	----	----
		T For H0, B=0	-2.313110383	----	----	----	----	----	----
Unemployment	UNEMP	Coefficient	-3.05E-03	-0.015	-0.017	2.19E-03	1.63E-05	-1.48E-03	-9.85E-03
Rate		T For H0, B=0	-1.049	-1.673	-3.803	2.004	1.142	-1.654	-3.752
	UNEMP2	Coefficient	1.50E-04	4.54E-04	6.38E-04	-1.75E-05	----	----	3.08E-04
		T For H0, B=0	1.103	1.113	3.130	-0.341	----	----	2.505
Dummy for 1986	Y86	Coefficient	-0.016	0.056	-0.048	-0.027	-3.52E-04	-0.058	-0.033
		T For H0, B=0	-2.996	3.493	-6.120	-13.40	-5.418	-14.35	-6.848
Dummy for 1987	Y87	Coefficient	-0.016	0.119	-0.075	-0.049	-6.46E-04	-0.111	-0.066
		T For H0, B=0	-2.721	6.834	-8.710	-22.41	-9.072	-25.00	-12.46
Dummy for 1988	Y88	Coefficient	-7.27E-03	0.211	-0.068	-0.069	-8.62E-04	-0.135	-0.078
		T For H0, B=0	-1.063	10.31	-6.651	-26.66	-10.38	-26.14	-12.68
Dummy for 1989	Y89	Coefficient	2.31E-03	0.256	-0.077	-0.079	-9.70E-04	-0.165	-0.103
		T For H0, B=0	0.306	11.33	-6.868	-27.91	-10.60	-28.78	-15.15
Dummy for 1990	Y90	Coefficient	0.017	0.317	-0.073	-0.088	-1.05E-03	-0.177	-0.119
		T For H0, B=0	2.023	12.72	-5.847	-28.10	-10.33	-27.96	-15.82
Dummy for 1991	Y91	Coefficient	0.013	0.403	-0.075	-0.098	-1.26E-03	-0.199	-0.129
		T For H0, B=0	1.546	16.16	-6.022	-31.19	-12.47	-31.56	-17.26
Dummy for 1992	Y92	Coefficient	6.04E-03	0.544	-0.094	-0.108	-1.41E-03	-0.221	-0.147
		T For H0, B=0	0.668	20.10	-6.962	-31.91	-12.91	-32.45	-18.11
Dummy for 1993	Y93	Coefficient	-0.015	0.630	-0.116	-0.117	-1.61E-03	-0.246	-0.160
		T For H0, B=0	-1.529	22.20	-8.215	-32.88	-14.00	-34.32	-18.77

Table 3A

Occupancy Rates

	Yearly Average Values for US					Yearly Average Values for PA and CA			
Year	Actual occupancy rates	At 85 HMO Levels	At 93 HMO Levels	At CA HMO Levels	At PA HMO Levels	Actual occupancy rates in PA	Occupancy in PA at CA HMO Levels	Actual occupancy rates in CA	Occupancy in CA at PA HMO Levels
ALLYRS	56.41%	56.48%	56.39%	56.06%	56.36%	67.68%	67.30%	60.80%	61.05%
1985	56.55%	56.55%	56.46%	56.44%	56.52%	67.61%	67.51%	60.68%	60.75%
1986	55.65%	55.67%	55.58%	55.53%	55.63%	66.56%	66.43%	59.92%	59.99%
1987	55.68%	55.70%	55.61%	55.56%	55.60%	66.81%	66.73%	60.25%	60.25%
1988	56.16%	56.26%	56.17%	55.62%	56.11%	67.55%	66.93%	60.38%	60.79%
1989	56.73%	56.82%	56.73%	56.31%	56.67%	68.35%	67.88%	61.30%	61.59%
1990	57.55%	57.63%	57.54%	57.22%	57.46%	68.90%	68.58%	62.24%	62.42%
1991	56.97%	57.05%	56.97%	56.52%	56.90%	68.38%	67.90%	61.71%	62.03%
1992	56.75%	56.85%	56.76%	56.18%	56.70%	68.16%	67.52%	61.10%	61.57%
1993	55.68%	55.77%	55.68%	55.19%	55.65%	66.83%	66.27%	59.63%	60.04%

Inpatient days per capita

	Yearly Average Values for US					Yearly Average Values for PA and CA			
Year	Actual inpatient days per capita	At 85 HMO Levels	At 93 HMO Levels	At CA HMO Levels	At PA HMO Levels	Actual inpatient days per capita in PA	Inpatient days in PA at CA HMO Levels	Actual inpatient days per capita in CA	Inpatient days in CA at PA HMO Levels
ALLYRS	0.977	0.989	0.970	0.945	0.972	1.061	1.035	0.625	0.651
1985	1.024	1.024	1.005	1.000	1.018	1.121	1.077	0.691	0.750
1986	0.992	0.994	0.975	0.968	0.986	1.104	1.052	0.669	0.720
1987	0.978	0.981	0.962	0.957	0.971	1.068	1.047	0.675	0.691
1988	0.976	0.993	0.974	0.937	0.976	1.064	1.030	0.647	0.687
1989	0.972	0.989	0.970	0.938	0.971	1.067	1.034	0.628	0.663
1990	0.988	1.003	0.984	0.952	0.982	1.077	1.043	0.609	0.644
1991	0.975	0.990	0.971	0.937	0.967	1.040	1.027	0.591	0.607
1992	0.957	0.974	0.955	0.919	0.950	1.018	1.007	0.572	0.570
1993	0.932	0.951	0.932	0.899	0.923	0.989	0.994	0.542	0.530

Outpatient visits per capita

	Yearly Average Values for US					Yearly Average Values for PA and CA			
Year	Actual outpatient visits per capita	At 85 HMO Levels	At 93 HMO Levels	At CA HMO Levels	At PA HMO Levels	Actual outpatient visits per capita in PA	Outpat_Visits in PA at CA HMO Levels	Actual outpatient visits per capita in CA	Outpatient visits in CA at PA HMO Levels
ALLYRS	1.249	1.255	1.246	1.221	1.247	1.704	1.679	1.265	1.291
1985	0.936	0.936	0.927	0.934	0.934	1.379	1.363	1.137	1.084
1986	1.000	1.002	0.993	0.997	0.997	1.413	1.438	1.108	1.128
1987	1.076	1.078	1.069	1.076	1.070	1.494	1.528	1.159	1.184
1988	1.171	1.180	1.171	1.115	1.171	1.528	1.571	1.225	1.259
1989	1.235	1.242	1.233	1.196	1.232	1.666	1.662	1.271	1.293
1990	1.312	1.319	1.310	1.282	1.308	1.837	1.746	1.262	1.314
1991	1.386	1.393	1.384	1.349	1.383	1.878	1.812	1.348	1.353
1992	1.523	1.532	1.523	1.477	1.523	2.067	1.944	1.438	1.462
1993	1.604	1.613	1.604	1.567	1.605	2.075	2.044	1.440	1.542

Admissions per capita

	Yearly Average Values for US					Yearly Average Values for PA and CA			
Year	Actual admissions per capita	At 85 HMO Levels	At 93 HMO Levels	At CA HMO Levels	At PA HMO Levels	Actual admissions per capita in PA	Admissions in PA at CA HMO Levels	Actual admissions per capita in CA	Admissions in CA at PA HMO Levels
ALLYRS	0.125	0.125	0.125	0.127	0.125	0.141	0.143	0.105	0.103
1985	0.142	0.142	0.142	0.143	0.142	0.157	0.158	0.120	0.119
1986	0.134	0.134	0.134	0.135	0.134	0.149	0.151	0.113	0.112
1987	0.128	0.128	0.128	0.129	0.128	0.143	0.145	0.108	0.107
1988	0.126	0.126	0.126	0.128	0.125	0.141	0.143	0.107	0.104
1989	0.123	0.123	0.124	0.125	0.123	0.139	0.141	0.105	0.103
1990	0.123	0.123	0.123	0.125	0.123	0.138	0.141	0.102	0.100
1991	0.120	0.120	0.120	0.122	0.120	0.135	0.137	0.100	0.097
1992	0.117	0.117	0.117	0.120	0.117	0.132	0.135	0.097	0.095
1993	0.115	0.114	0.115	0.117	0.114	0.130	0.133	0.095	0.092

Beds per capita

	Yearly Average Values for US					Yearly Average Values for PA and CA			
Year	Actual beds per capita	At 85 HMO Levels	At 93 HMO Levels	At CA HMO Levels	At PA HMO Levels	Actual beds per capita in PA	Beds in PA at CA HMO Levels	Actual Beds per capita in CA	Beds in CA at PA HMO Levels
ALLYRS	0.00445	0.00450	0.00443	0.00432	0.00444	0.00436	0.00425	0.00286	0.00294
1985	0.00480	0.00480	0.00473	0.00470	0.00479	0.00464	0.00456	0.00328	0.00335
1986	0.00468	0.00469	0.00462	0.00459	0.00467	0.00455	0.00448	0.00318	0.00324
1987	0.00457	0.00459	0.00452	0.00449	0.00456	0.00447	0.00441	0.00307	0.00311
1988	0.00449	0.00455	0.00448	0.00432	0.00450	0.00442	0.00425	0.00292	0.00304
1989	0.00442	0.00448	0.00441	0.00427	0.00442	0.00436	0.00422	0.00284	0.00294
1990	0.00439	0.00445	0.00438	0.00424	0.00438	0.00433	0.00419	0.00273	0.00282
1991	0.00433	0.00439	0.00432	0.00417	0.00431	0.00425	0.00412	0.00265	0.00273
1992	0.00424	0.00430	0.00423	0.00408	0.00422	0.00414	0.00402	0.00255	0.00264
1993	0.00417	0.00423	0.00417	0.00403	0.00414	0.00410	0.00400	0.00251	0.00258

Ratio of admissions to outpatient visits

	Yearly Average Values for US					Yearly Average Values for PA and CA			
Year	Actual admissions/ outpatient ratio	At 85 HMO Levels	At 93 HMO Levels	At CA HMO Levels	At PA HMO Levels	Actual admissions/outpatient ratio in PA	Ratio in PA at CA HMO Levels	Actual admissions/outpatient ratio in CA	Ratio in CA at PA HMO Levels
ALLYRS	0.126	0.122	0.129	0.147	0.127	0.089	0.109	0.091	0.071
1985	0.194	0.194	0.201	0.207	0.194	0.119	0.167	0.116	0.120
1986	0.166	0.165	0.173	0.180	0.167	0.112	0.139	0.110	0.099
1987	0.144	0.142	0.149	0.158	0.145	0.101	0.117	0.103	0.081
1988	0.129	0.123	0.130	0.153	0.128	0.095	0.113	0.094	0.069
1989	0.119	0.114	0.121	0.142	0.119	0.086	0.104	0.088	0.065
1990	0.110	0.105	0.112	0.134	0.112	0.078	0.097	0.086	0.062
1991	0.101	0.096	0.103	0.125	0.103	0.076	0.089	0.079	0.058
1992	0.090	0.084	0.091	0.115	0.092	0.072	0.079	0.072	0.049
1993	0.084	0.076	0.084	0.108	0.086	0.066	0.072	0.070	0.040

Ratio of Inpatient days to outpatient visits

	Yearly Average Values for US					Yearly Average Values for PA and CA			
Year	Actual inpatint days/outpatient ratio	At 85 HMO Levels	At 93 HMO Levels	At CA HMO Levels	At PA HMO Levels	Actual inpatient days/outpatient ratio in PA	Ratio in PA at CA HMO Levels	Actual inpatient days/outpatient ratio in CA	Ratio in CA at PA HMO Levels
ALLYRS	0.0026	0.0026	0.0027	0.0029	0.0026	0.0019	0.0021	0.0015	0.0013
1985	0.0037	0.0037	0.0038	0.0039	0.0037	0.0024	0.0032	0.0018	0.0022
1986	0.0033	0.0033	0.0034	0.0035	0.0033	0.0022	0.0027	0.0018	0.0018
1987	0.0030	0.0029	0.0030	0.0031	0.0030	0.0020	0.0023	0.0018	0.0015
1988	0.0027	0.0027	0.0027	0.0030	0.0027	0.0020	0.0022	0.0016	0.0013
1989	0.0026	0.0025	0.0026	0.0028	0.0026	0.0019	0.0020	0.0015	0.0012
1990	0.0024	0.0023	0.0024	0.0027	0.0024	0.0017	0.0019	0.0014	0.0011
1991	0.0022	0.0021	0.0022	0.0025	0.0022	0.0016	0.0017	0.0013	0.0010
1992	0.0020	0.0019	0.0020	0.0023	0.0020	0.0015	0.0015	0.0012	0.0008
1993	0.0018	0.0017	0.0018	0.0021	0.0018	0.0014	0.0012	0.0011	0.0006

Figure 1A

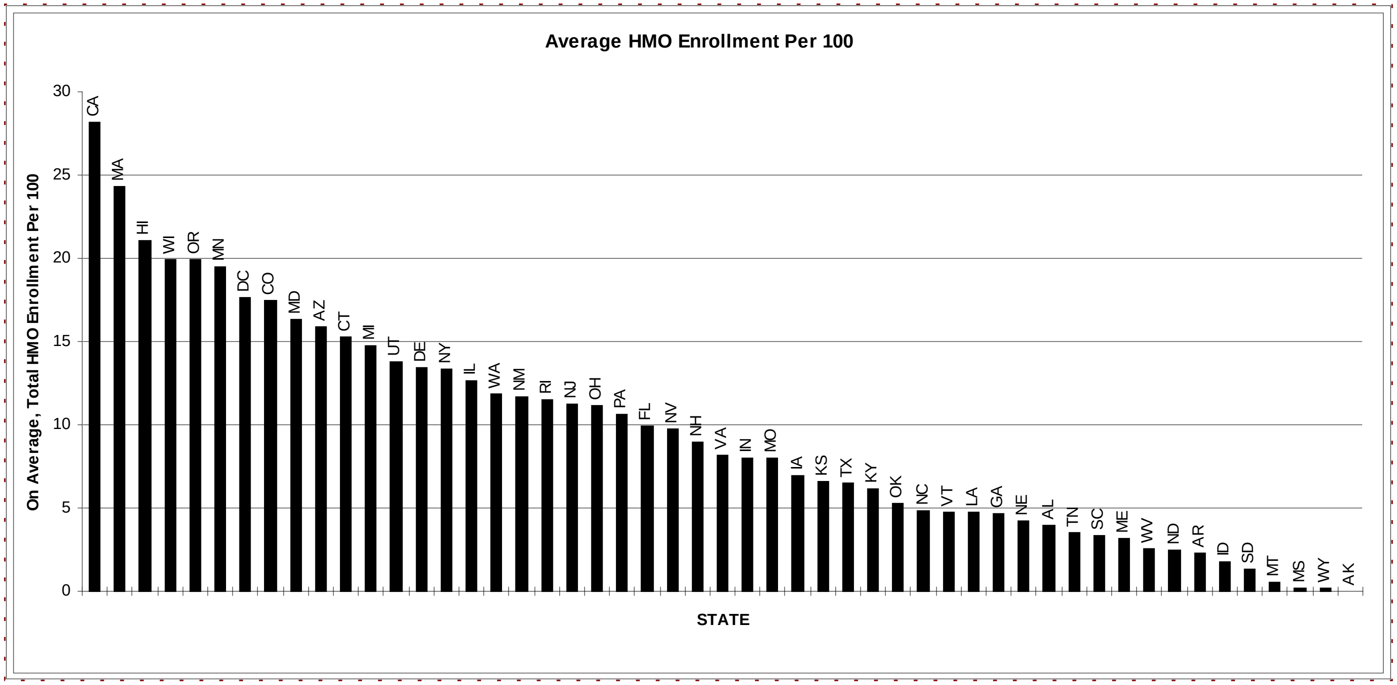
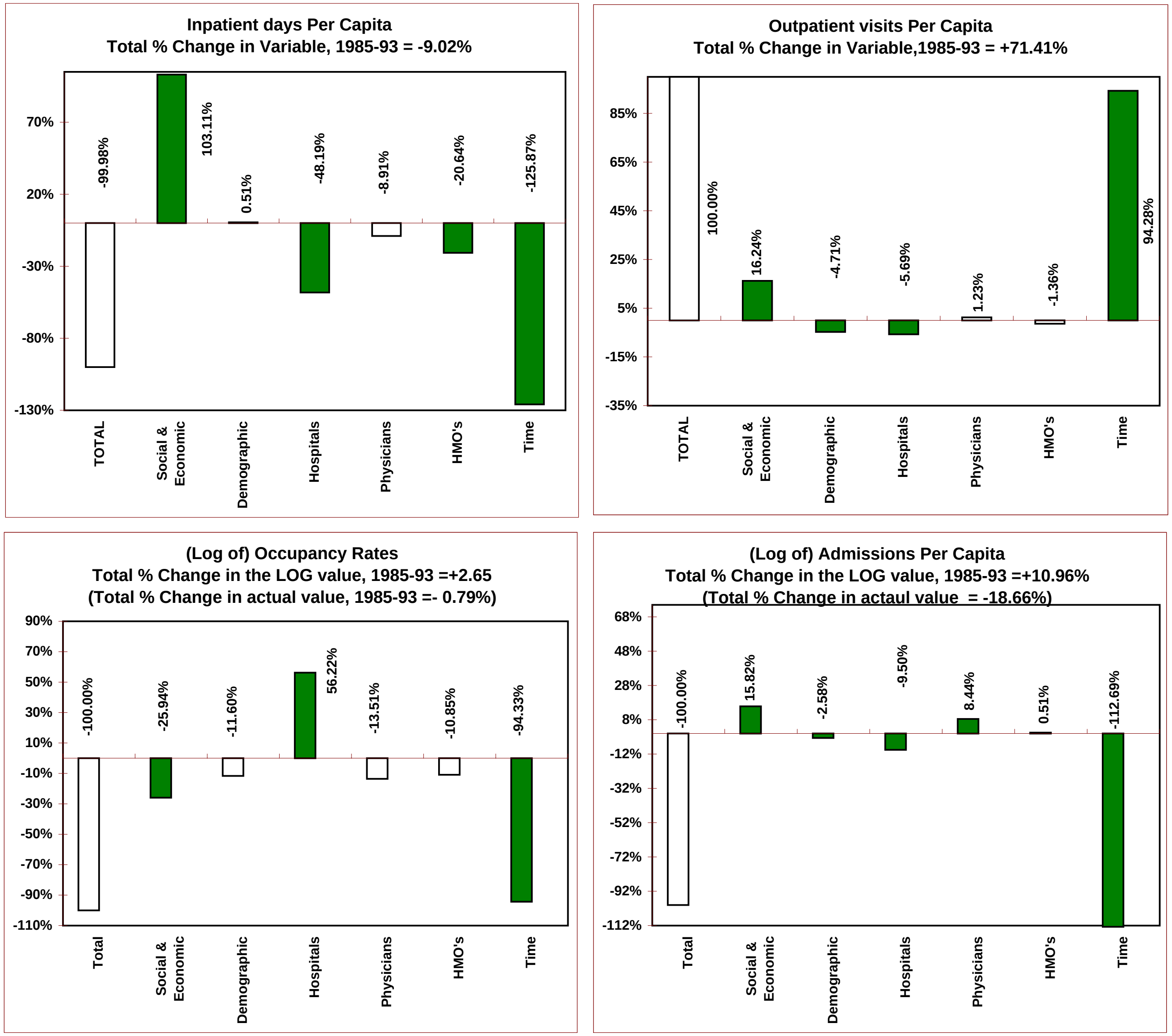

Average HMO Enrollment Per 100
On Average, Total HMO Enrollment Per 100
0
5
10
15
20
25
30
STATE
CA
MA
HI
WI
OR
MN
DC
CO
MD
AZ
CT
MI
UT
DE
NY
IL
WA
NM
RI
NJ
OH
PA
FL
NV
NH
VA
IN
MO
IA
KS
TX
KY
OK
NC
VT
LA
GA
NE
AL
TN
SC
ME
WV
ND
AR
ID
SD
MT
MS
WY
AK

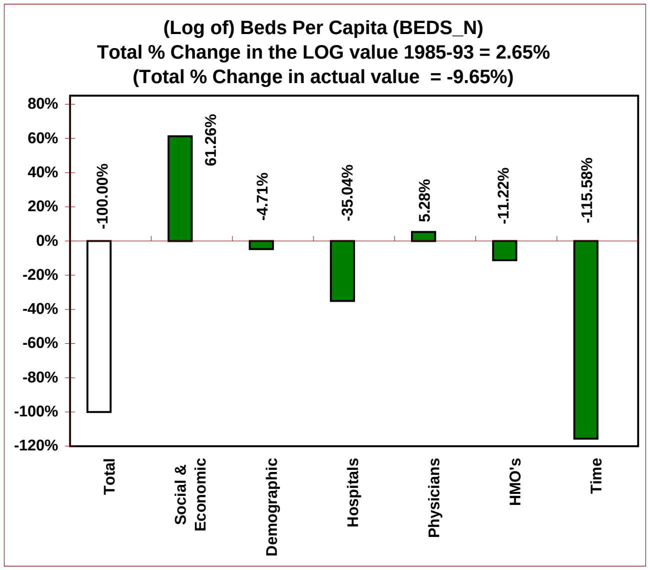
Figure 2A

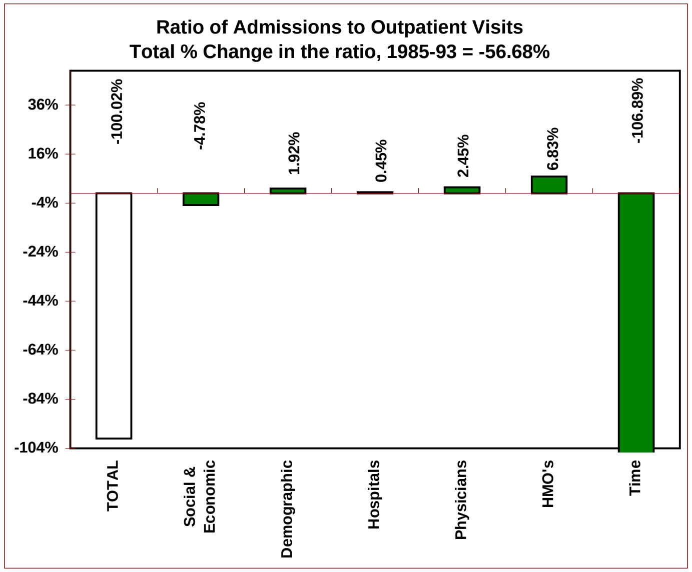
Factor Decomposition by Major Groups for:

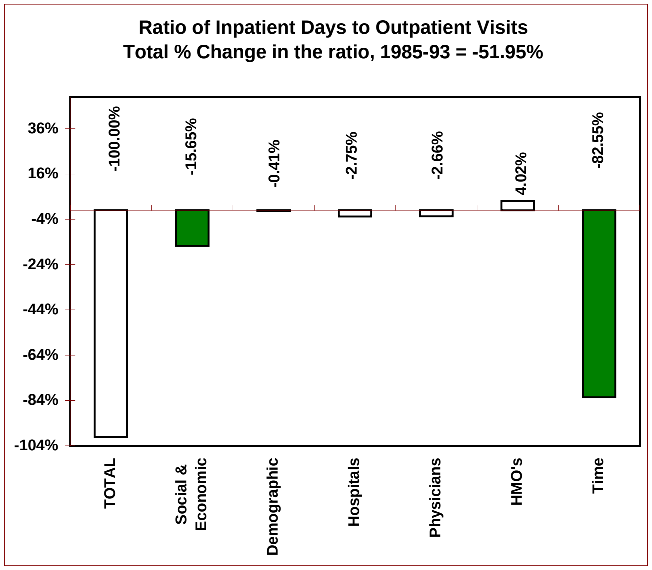


Shaded Bars had a p-value <0.05 in the Joint F-Test.

Figure 2A (Continued) **Factor Decomposition by Major Groups for:**







Shaded Bars had a p-value <0.05 in the Joint F-Test.