Does Managed Care Matter?
Hospital Utilization in the U.S. between 1985 and 1993

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Abstract

Objective: To Study the impact of HMOs on Hospital Utilization.

Data Sources: HMO data on InterStudy Censuses (1985 to 1995), InterStudy reports on MSAs served by HMOs, and GHAA Directories (1988 to 1991) as well as data from Area Resource Files, 1985 through 1993.

Study Design: Fixed effects regression models were estimated to compute elasticities and changes in the levels of seven different measures of hospital utilization with unit change in HMO penetration and number of HMOs. Hospital utilization measures were also forecast for the entire U.S., California and Pennsylvania at various hypothetical HMO levels: at 1985 levels, 1995 levels, California levels and Pennsylvania levels. Using the estimates from regression coefficients, factor decomposition was performed to measure changes in the dependent variables between 1985 and 1993 that can be attributed to changes in the explanatory variables.

Data Collection: Data from the sources mentioned above were organized as a nine year panel (1985-1993) aggregated up to the health services area (HSA)

Principal Findings: 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.

Conclusions: The findings do not support the traditional wisdom that an increase in HMO activity is *directly* associated with changes in hospital utilization levels. 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: HMOs; Hospital Utilization; Inpatient Days; Ambulatory Visits; Hospital Admissions

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1. 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 1000 in short term general hospitals decreased by 9.02% whereas outpatient visits per 1000 increased by 71.4%. Capacity and occupancy rates have also been decreasing. These and other changes in hospital services use have been accompanied by substantial institutional changes in the health care industry. Three such changes that have been emphasized and often studied in their relation to hospital usage are the Medicare Prospective Payment System (PPS), technological change, and the growth in enrollment of health maintenance organizations (HMOs).

Empirical research has focused on the effect and relationship of PPS to hospital usage and theoretical literature sheds light on the technological change in healthcare and its effect on hospital utilization. Empirical studies have also been conducted on the effect of HMOs on hospital usage, but have largely been limited to HMO enrollees. This paper provides measures of association between changes in the level of hospital utilization and changes in levels of HMO penetration in markets.

The evidence on the effect of PPS on hospital usage has been mixed. Early research showed that the immediate effect of PPS was a reduction in Medicare inpatient days, length of stay (LOS), and discharges, and an increase in outpatient visits (Sloan *et al.*, 1988; Hadley *et al.*, 1989). However, some researchers found that PPS did not have an effect on some of the hospital utilization variables. DesHarnais *et al.* (1988) found that PPS did not reduce LOS but decreased Medicare discharges. Hadley *et al.* (1989) concluded 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.

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 (Weisbrod, 1991; Neumann and Weinstein, 1991; Holmes, 1992; 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, 1995). 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.

Health care literature has placed significant emphasis on the contribution of managed care to changes in hospital utilization and expenditures. In particular, the emphasis has been on the rapid growth of health maintenance organizations (HMOs) (Christianson *et al.*, 1991). There is evidence suggesting that managed care reduces costs (Melnick and Zwanziger, 1995; Zwanziger *et al.*, 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. Similarly, studies that analyze differences in hospital utilization among HMO and FFS enrollees often report statistically significant differences in ambulatory visits and hospital usage (Lubeck *et al.*, 1985; Yelin *et al.*, 1986, 1996; Wolfe *et al.*, 1986; Dowd *et al.*, 1986; Stern *et al.*, 1989; Johnson *et al.*, 1989; Szilagyi *et al.*, 1990; Bradbury *et al.*, 1991; Udvarhelyi *et al.*, 1991; Rapoport *et al.*, 1992; Hadley and Mitchell, 9798). Caution must be observed so as not to generalize the results from such studies to be the same as the effect of HMOs on the overall ambulatory and hospital utilization. For instance, LOS is often reported as shorter among HMO enrollees than the FFS enrollees (see Tu *et al.* (2000) for a review of studies since Miller and Luft (1994)) and total ambulatory visits and physician visits are higher and significant among HMO enrollees than the FFS enrollees, whereas hospital days and inpatient and outpatient surgeries are fewer among HMO enrollees but not statistically significant (Tu *et al.*, 2000). However, the effect of HMOs on overall hospital use may differ, particularly if the observed HMO effects are due to favorable selection, as pointed out by Wilensky and Rossiter (1986). 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 literature. 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.

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 - and, that they are also responsible for substituting inpatient activity with more outpatient services. One study that stands out from the literature on managed care and hospital utilization is by Luft *et al.* (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 and conclude that in none of the three sites is the reduction in hospital use most plausibly attributed to HMO competition.

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 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% by 1993 (the actual decrease was 9.02% over the same period). The association between HMOs and the other six measures of hospital utilization was even smaller.

These results come as a surprise given the emphasis on 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. Although these time factors may also capture indirect effects of HMOs, even so, it is remarkable that the estimates of HMOs direct effects are so small.

2. Data

Data were obtained for 7 measures of hospital utilization and 5 major groups of explanatory variables: (1) Social and economic factors; (2) Demographic factors; (3) Hospitals; (4) Physicians and (5) HMOs. Hospital related variables are for short-term general hospitals in the entire U.S. from 1985 through 1993. The original data were at the county level, but were aggregated up to hospital service areas (HSAs) (Makuc *et al.*, 1991a,b) as a unit of observation.

Table 1 gives the descriptive statistics as well as the percentage change in the mean value between 1985 and 1993 of the variables used in the study. 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 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.

[INSERT TABLE 1 HERE]

For 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 (CA) and Pennsylvania (PA) averaged over 9 years, the enrollment per 100 in CA is about 28 persons, the highest in the nation and PA is the median state with an enrollment per 100 of about 10 persons. 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. Time trend and cross-sectional comparison graphs for the remaining utilization variables (not shown here) 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. [**INSERT FIGURE 1 AND 2 HERE**]

3. METHODOLOGY

Multivariate fixed effects regressions were run on the panel data set for seven 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. 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. An additional dummy 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 $i \in [1 \ldots 803]$ indexes HSAs, $t \in [1 \ldots 9]$ indexes years, and X_{kit} is the kth variable's observation for the ith HSA in year t. Similarly, HSA_{it}^{j} are 802 dummy variables such that $HSA_{it}^{j} = 1$ if $j = i$ and 0 otherwise and T_{it}^{l} are 8 dummy variables such that $T_{it}^{l} = 1$ if $l = t$ and 0 otherwise. Last, $Flag_{it}$ is a dummy variable which takes the value 1 if the number of HMOs in a given observation is 0. The error term U_{it} is assumed to be un-correlated with the RHS variables.

The fixed effects 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. The reader is cautioned that the regression models control for *time invariant HSA-specific effects* and the *time fixed effects* but not any *time varying HSA-specific effects*. If there are any *time varying HSA-specific effects*, they are in the error term (and may be correlated with the independent variables), and hence may be a source of endogeneity in the regression models. An example of this might be that HMOs selectively enter HSAs with low hospital utilization, which has been changing over time within HSAs.

We attempted to control for this possible source of endogenity using instruments for the number of HMOs and the HMO penetration measures. The instruments used were dummy variables showing if a "freedom of choice" (FOC) or "any willing provider" (AWP) law existed in that state-year. In particular, the dummy variables indicated if FOC or AWP law applies to HMOs for (i) pharmacies, (ii) physicians and (iii) hospitals. Thus there were six basic dummy variables plus their interaction terms. Justification of using these state laws as instruments for HMOs is provided elsewhere in literature (see for instance, Chernew (1995)).

However, this approach was abandoned based on joint F-tests results from OLS regressions when the left hand side variable was one of the endogeneous HMO variables, and the right hand side variables included these instruments and other exogeneous variables. The F-values were not very high, and were especially low (not significant) when the dependent variable was HMO penetration. The overall tests indicated that though these instruments may not be so bad for the number of HMOs, they performed poorly for HMO penetration measures. All in all, they fell in the class of the so called "weak" instruments (Staiger and Stock, 1997) leading to estimates that are biased in the direction of OLS results.

4. RESULTS

The "fits" from the regression analysis were reasonable for most of the dependent variables, for instance the models explain 75.3% of variation in log of beds per capita. Since the explanatory variables are often squared or logged, the interpretation of the sign of regression coefficients is not straightforward. To this end, instead of providing the regression coefficients, Table 2 provides the calculated changes in the level of dependent variables associated with a unit change in the explanatory variable, calculated at the sample mean. An asterisk (*) implies that the joint F-test for an explanatory variable and it's square (if it was there in the model) had a p-value less than 0.05. [**INSERT TABLE 2 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 change in a dependent variable associated with a percentage or unit change in the HMO variables is "small" when compared to changes associated with other explanatory variables. 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 and a unit increase in HMO enrollment per 1000 decreased the days per capita by -0.0002 days. Neither are statistically significant at the 0.05 level. Similarly, an increase in the number of HMOs and HMO enrollment per 1000, is associated with a decrease in beds per capita, inpatient days per capita, and outpatient visits per capita and an increase in admissions per capita. Of these, only the coefficient on beds per capita is statistically significant. 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. 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 ratio of admissions to outpatient visits. To the extent that the ratio can be interpreted as a (crude) measure of transferring patients from inpatient to outpatient services, the statistically significant positive coefficient does not have the "correct" sign.

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 typically order(s) of magnitude larger in comparison to the HMO-related variables. Further, this difference in order(s) of magnitude is also prevalent in the other independent variables. Thus, though HMOs do seem to have an effect on hospital utilization variables, they are far from being the most dominant factor in explaining variation in the dependent variables.

5. 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.

1. If for each HSA, the HMO variables were at their 1985 levels;
2. If for each HSA, the HMO variables were at their 1993 levels;
3. 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,
4. 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. 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 omitted. In Figure 3, the first column is for the U.S. and the second column for the two selected states. [**INSERT FIGURE 3 HERE**]

Observe that even though HMO penetration increased between 1985 and 1993 (see Table1), the actual hospital inpatient days per capita is not very different from the forecasted days per capita at 1985 and 1993 HMO levels (Figure 3.1a). 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, a state with higher HMO penetration. Although this difference would have been less if their HMO levels were switched, it would not have disappeared 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 forecasted 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%). The California occupancy rates fluctuate around 61% whereas Pennsylvania occupancy rates fluctuate around 68%. Again, observe that switching the HMO penetration levels between these two states has almost no effect on their occupancy rates. Comparing across the list of remaining dependent variables not shown in figure 3 (but available from authors upon request) 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.

6. 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 into 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.

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 given by

$$\beta_1 \times \frac{\Delta X_1}{||\Delta Y||} + \beta_2 \times \frac{\Delta X_2}{||\Delta Y||}$$

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). The bar graph in Figure 4 summarizes the factor decomposition results for inpatient days per capita.

The numerical results are consistent with the findings in the scenarios section, as well as the change in levels at the sample mean results in Table 2. However, the calculations in Table 3 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) explain the largest amount of variation in the dependent variables. Bar graphs similar to those in Figure 4 (for the remaining dependent variables but not shown here) show that the group labeled "social and economic factors" ranks second in explaining the amount of variation in all the dependent variables, except when the dependent variable is the log of occupancy rates and the ratio of inpatient days to outpatient visits. The group labeled "hospitals" 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: 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.

7. CONCLUSIONS

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. This paper does not control for these individual time varying factors and hence no conclusions about their role (or of the role of technology) can be drawn. One plausible explanation 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 *et al.*, 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 led 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.

The main results of this analysis, 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, policy makers may need to reevaluate the long term effects of time varying factors on hospital use rather than assume that it is necessarily the growth of managed care that is responsible for the decline in utilization.

Independent Variables			
Variable	Mean	Standard	% Change
		Deviation	1985-1993
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	1604	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%

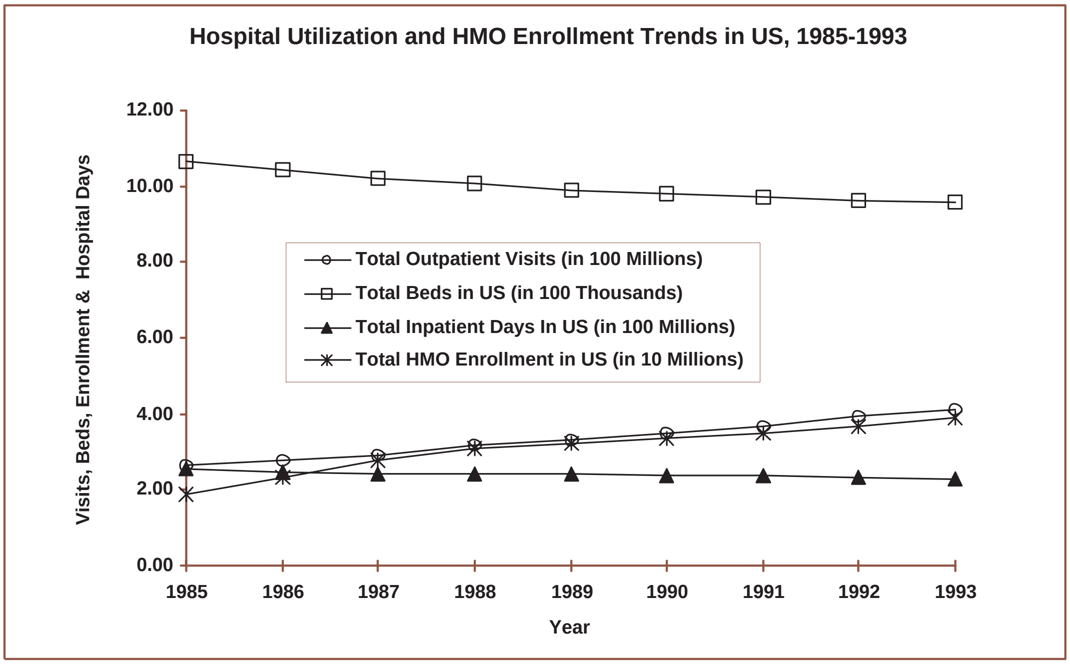
Table 1. Percentage Change between 1985-1993

Change in Levels at the Sample Mean							
	Occupancy	Visits per capita	Days Per capita	Ratio admissions to visits	Ratio days to visits	Admissions per capita	Beds per capita
AFDC per capita (in $1000)	-0.3704	1.172	0.5859*	-0.6400*	0.0018	-0.0058	0.0034*
Large Establishments per 1000	-0.0002	0.0011*	-0.0006*	0.0002*	0.0000*	0.0000	-0.0000*
Income per capita	0.0000*	0.0000	0.0000*	-0.0000*	-0.0000*	0.0000*	0.0000*
Medicare Enrollment per 1000	-0.0004	0.0028*	0.0043*	0.0001*	-0.0000*	0.0001*	0.0000*
Unemployment Rate	-0.0005	-0.0081	-0.0075*	0.0019*	0.0000	-0.0002	0.0000*
Births per 1000	-0.0016*	0.0106	-0.0212*	0.0037	0.0001	0.0021*	0.0000*
HSA Population in 1000s	0.0000	-0.0014*	-0.0003*	0.0001*	0.0000	-0.0000	-0.0000*
Hospitals	-0.0073*	0.0561*	0.0638*	-0.0008	0.0001	0.0038*	0.0003*
Non-Surgical PC MDs per 1000	-0.0134	0.0555	-0.0714*	0.0257*	-0.0005*	0.0189*	0.0003*
Surgeons per 1000	-0.012	-0.142	0.0011	0.0709*	0.0004	0.0204*	0.0001*
Teaching MDs per 1000	0.4125	-0.1977	0.5001	0.1474	0.0012	0.0007	0.0005
Dummy: 1 When No HMOs	0.0019	-0.0021	0.0186*	-0.0014	0.0000	0.0004	0.0000
Weighted Number of HMOs	-0.0007	-0.0254	-0.0145	0.0044*	0.0000	0.0007	-0.0001*
HMO Enrollment per 1000	-0.0000	-0.0001	-0.0002	0.0001*	0.0000	0.0000	-0.0000*
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*
* indicates that P-value $<$ 0.05							

TABLE 2. Change in Levels at the Sample Mean

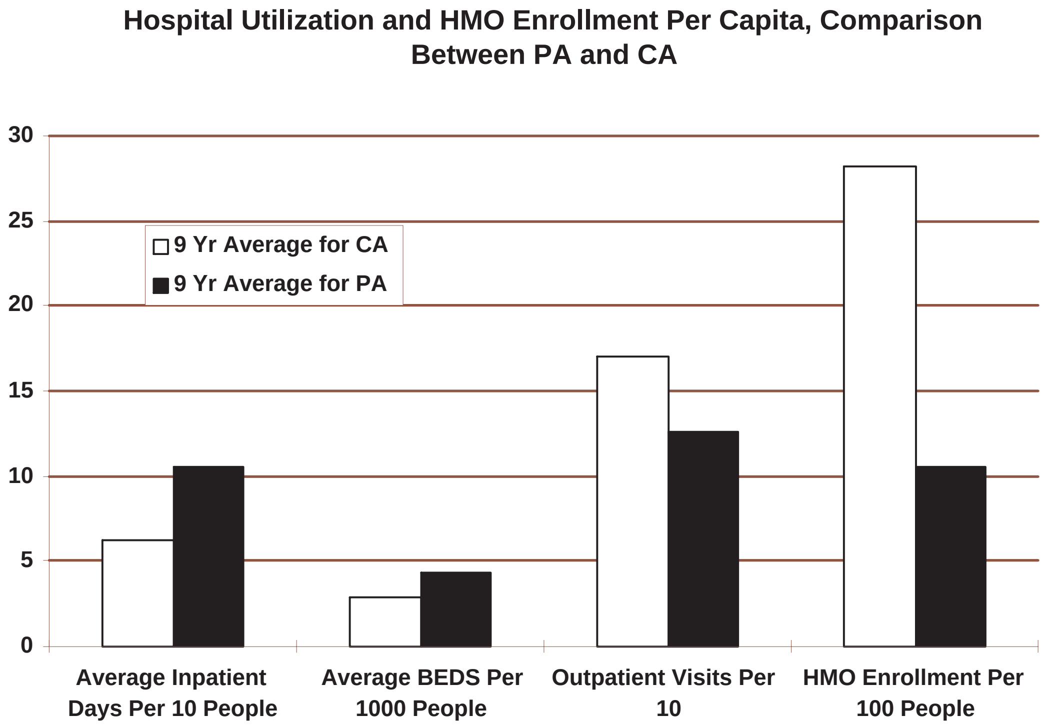
Factor Decomposition (Between 1985 and 1993)							
	Occupancy	Visits per capita	Days Per capita	Ratio admissions to visits	Ratio days to visits	Admissions per capita	Beds per capita
	Logged					Logged	Logged
% Δ in Dep Var. 85-93	2.65%	71.41%	-9.02%	-56.68%	-51.95%	10.96%	2.56%
% Δ in LEVEL of DepVar. 85-93	-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 PC MDs	-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							
Dummy: 1 When no HMOs	-9.30%	0.14%	-8.67%*	0.55%	-0.11%	-0.70%	-2.33%
Number of HMOs	9.86%	-0.50%	-4.13%	3.19%	1.65%	-0.52%	-3.46%*
Interaction term	-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%*

TABLE 3. Factor Decomposition (Between 1985-1993)



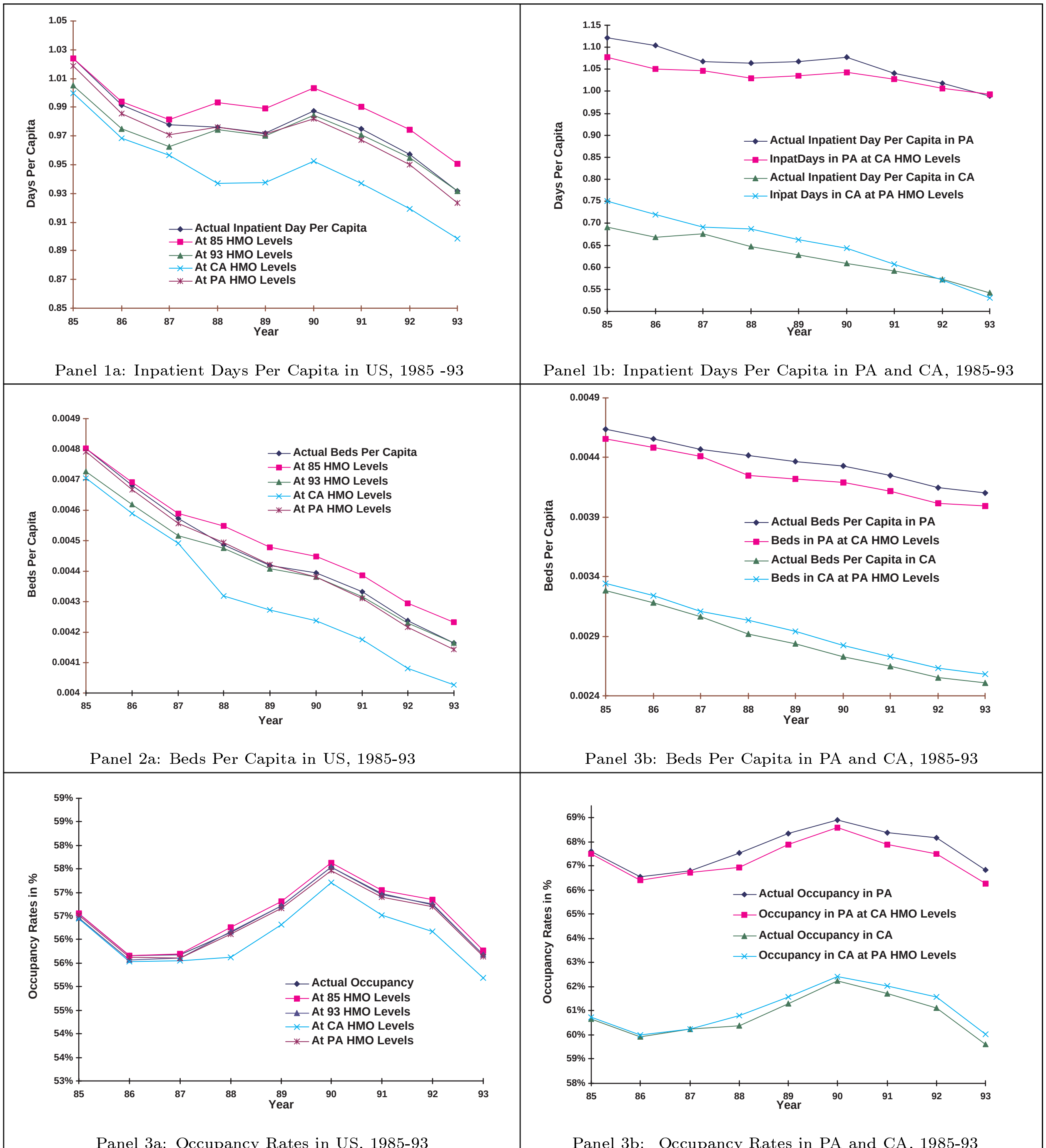
Hospital Utilization and HMO Enrollment Trends in US, 1985-1993
Visits, Beds, Enrollment & Hospital Days
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Total Outpatient Visits (in 100 Millions)
Total Beds in US (in 100 Thousands)
Total Inpatient Days In US (in 100 Millions)
Total HMO Enrollment in US (in 10 Millions)
1985
1986
1987
1988
1989
1990
1991
1992
1993
Year

Figure 1



Hospital Utilization and HMO Enrollment Per Capita, Comparison Between PA and CA
30
25
20
15
10
5
0
9 Yr Average for CA
9 Yr Average for PA
Average Inpatient Days Per 10 People
Average BEDS Per 1000 People
Outpatient Visits Per 10
HMO Enrollment Per 100 People

Figure 2



Panel 1a: Inpatient Days Per Capita in US, 1985 -93

Panel 1b: Inpatient Days Per Capita in PA and CA, 1985-93

Panel 2a: Beds Per Capita in US, 1985-93

Panel 3b: Beds Per Capita in PA and CA, 1985-93

Panel 3a: Occupancy Rates in US, 1985-93

Panel 3b: Occupancy Rates in PA and CA, 1985-93

Figure 3: Hospital Utilization Measures at Actual and Hypothetical HMO levels

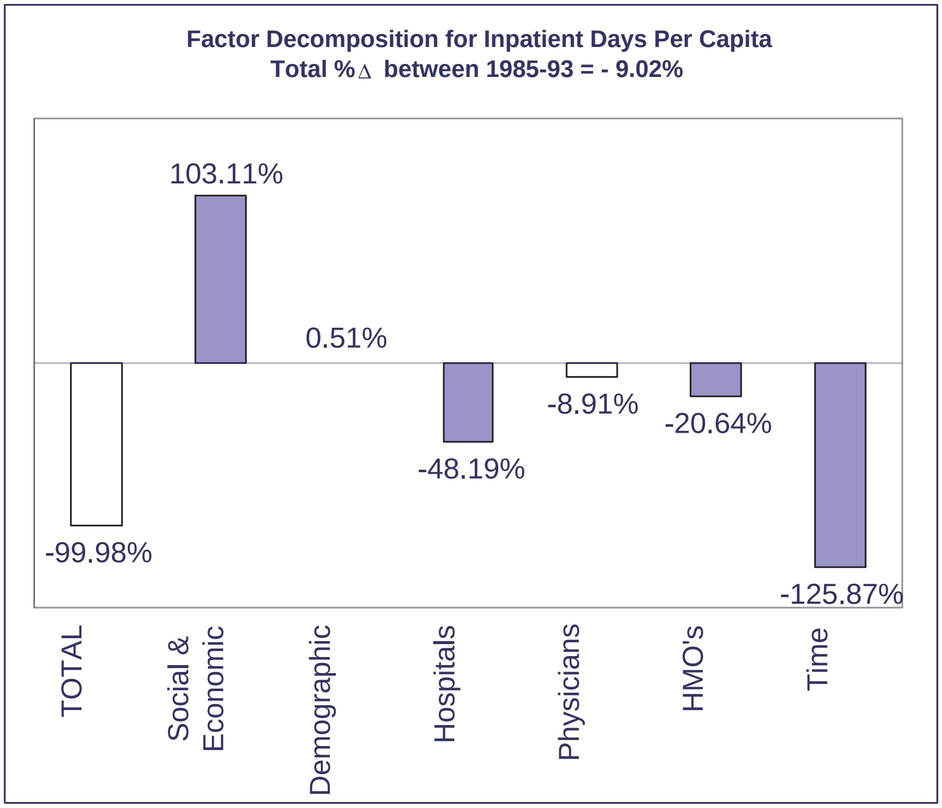


Figure 4. Shaded bars have a p value < 0.05 in the Joint F-Tests

References

Bradbury, R., Golec, J., and Stearns, F. (1991). Comparing hospital length of stay in independent practice association hmos and traditional insurance programs. *Inquiry*, **28**(1), 87–93.

Chernew, M. (1995). The impact of non-IPA HMOs on the number of hospitals and hospital capacity. *Inquiry*, **32**(2), 143–154.

Christianson, J. B., Sanchez, S., Wholey, D. R., and Shadle, M. (1991). The HMO industry: Evolution in population demographics and market structure. *Medical Care Review*, **48**(1), 3–46.

DesHarnais, S., Chesney, J., and Fleming, S. (1988). Trends and regional variations in hospital utilization and quality during the first two years of the prospective payment system. *Inquiry*, **25**(3), 374–82.

Dowd, B., Johnson, A., and Madson, R. (1986). Inpatient length of stay in twin cities health plans. *Medical Care*, **24**(8), 694–710.

Dowd, B., Feldman, R., Steven, and Finch, M. (1991). Health plan choice and the utilization of health care services. *The Review of Economics and Statistics*, **LXXIII**(1), 85–93.

Gelijns, A. C. and Rosenberg, N. (1994). The dynamics of medical change in medicine. *Health Affairs*, **13**(3), 28–46.

Gelijns, A. C. and Rosenberg, N. (1995). The changing nature of medical technology development. In N. Rosenberg, A. C. Gelijns, and H. Dawkins, editors, *Sources of Medical Technology: Universities and Industry*, volume V of *Medical Innovation at the Crossroads*, chapter 1, pages 13–14. National Academy Press, Washington, D.C.

Hadley, J. and Mitchell, J. (1997/98). Breast cancer treatment choice and mastectomy length of stay: A comparison of HMO and other privately insured women. *Inquiry*,

34(4), 288–301.

Hadley, J., Zuckerman, S., and Feder, J. (1989). Profits and fiscal pressure in the prospective payment system: Their impacts on hospitals. *Inquiry*, **26**(3), 354–365.

Holmes, B. L. (1992). Current strategies for the development of medical devices. In A. C. Gelijns, editor, *Technology and Health Care in An Era of Limits*, volume III of *Medical Innovation at the Crossroads*, pages 219–230. National Academy Press, Washington, D.C.

Johnson, A., Dowd, B., Morris, N., and Lurie, N. (1989). Differences in inpatient resource use by type of health plan. *Inquiry*, **26**(3), 388–98.

Laubach, G. D. (1995). Perspectives on industrial R& D management. In N. Rosenberg, A. C. Gelijns, and H. Dawkins, editors, *Sources of Medical Technology: Universities and Industry*, volume V of *Medical Innovation at the Crossroads*, chapter 9, pages 209–218. National Academy Press, Washington, D.C.

Lubeck, D., Brown, B., and Holman, H. (1985). Chronic disease and health system performance. care of osteoarthritis across three health services. *Medical Care*, **23**(3), 266–77.

Luft, H. S., Maerki, S. C., and Trauner, J. B. (1986). The competitive effects of health maintenance orgaizations: Another look at the evidence from Hawaii, Rochester, and Minneapolis/St. Paul. *Journal of Health Politics, Policy and Law*, **10**(4), 625–658.

Makuc, D., Haglund, B., Ingram, D. D., Kleinman, J. C., and Feldman, J. J. (1991a). Health services areas for the United States. In *Vital and Health Statistics; Data evaluation and methods research*, volume 2(112). U.S. Department of Health and Human Services, National Center for Health Statistics, Hyattsville, MD.

Makuc, D., Hagland, B., Ingram, D. D., Kleinmann, J. C., and Feldman, J. J. (1991b). The use of health service areas for measuring provider availability. *The Journal of Rural Health*, **7**(4), 347–356.

Melnick, G. and Zwanziger, J. (1995). State health care expenditures under competition and regulation, 1980 through 1991. *American Journal of Public Health*, **85**(10), 1391–6.

Miller, R. H. and Luft, H. S. (1994). Managed care plan performance since 1980: A literature analysis. *Journal of the American Medical Association*, **271**(9), 1512–18.

Moody, F. G. (1992). The changing health care economy: Impact on surgical techniques. In A. C. Gelijns, editor, *Technology and Health Care in An Era of Limits*, volume III of *Medical Innovation at the Crossroads*, chapter 14, pages 231–245. National Academy Press, Washington, D.C.

Muller, A. (1993). Medicare prospective payment reforms and hospital utilization. *Medical Care*, **31**(4), 296–308.

Neumann, P. J. and Weinstein, M. C. (1991). The diffusion of new technology: Costs and benefits to health care. In A. C. Gelijns and E. A. Halm, editors, *The Changing Economics of Medical Technology*, volume II of *Medical Innovation at the Crossroads*, chapter 2, pages 21–34. National Academy Press, Washington, D.C.

Parente, S. T., Gaynor, M. S., and Bass, E. (1996). Does managed care affect the decision to use a new technology? the case of laparoscopic cholecystectomy. (Unpublished) The Project HOPE Center for Health Affairs.

Rapoport, J., Gehlbach, S., Lemeshow, S., and Teres, D. (1992). Resource utilization among intensive care patients. managed care vs traditional insurance. *Archives of Internal Medicine*, **152**(11), 2207–12.

Robinson, J. C. (1996). Decline in hospital utilization and cost inflation under managed care in California. *Journal of the American Medical Association*, **276**(13), 1060–64.

Sloan, F. A., Morrisey, M. A., and Valvona, J. (1988). Effects of the medicare prospective payment system on hospital cost containment: An early appraisal. *The Milbank Quarterly*,

66(2), 191–220.

Staiger, D. and Stock, J. H. (1997). Instrumental variables regression with weak instruments. *Econometrica*, **65**(3), 557–586.

Stern, R., Juhn, P., Gertler, P., and Epstein, A. (1989). A comparison of length of stay and costs for health maintenance organization and fee-for-service patients. *Archives of Internal Medicine*, **149**(5), 1185–8.

Szilagyi, P., Roghmann, K., Foye, H., Parks, C., MacWhinney, J., Miller, R., Nazarian, L., Mclnerny, T., and Klein, S. (1990). The effect of independent practice association plans on use of pediatric ambulatory medical care in one group practice. *Journal of the American Medical Association*, **263**(16), 2198–203.

Tu, H. T., Kemper, P., and Wong, H. J. (1999/2000). Do HMOs make a difference? use of health services. *Inquiry*, **36**(4), 400–410.

Udvarhelyi, S., Jennison, K., Phillips, R., and Epstein, A. (1991). Comparison of the quality of ambulatory care for fee-for-service and prepaid patients. *Annals of Internal Medicine*, **115**(5), 394–400.

Weisbrod, B. A. (1991). The health care quadrilemma: An essay on technological change, insurance, quality of care, and cost containment. *Journal of Economic Literature*, **XXIX**, 523–552.

Wilensky, G. and Rossiter, L. (1986). Patient self-selection in hmos. *Health Affairs*, **5**(1), 66–80.

Wolfe, F., Kleinheksel, S., Spitz, P., Lubeck, D., Fries, J., Young, D., Mitchell, D., and Roth, S. (1986). A multicenter study of hospitalization in rheumatoid arthritis: effect of health care system, severity, and regional difference. *Journal of Rheumatology*, **13**(2), 277–84.

Yelin, E., Shearn, M., and Epstein, W. (1986). Health outcomes for a chronic disease in prepaid group practice and fee for service settings. the case of rheumatoid arthritis. *Medical Care*, **24**(3), 236–47.

Yelin, E., Criswell, L., and Feigenbaum, P. (1996). Health care utilization and outcomes among persons with rheumatoid arthritis in fee-for-service and prepaid group practice settings. *Journal of the American Medical Association*, **276**(13), 1048–53.

Zwanziger, J. and Melnick, G. (1996). Can managed care plans control health care costs? *Health Affairs*, **15**(2), 185–99.

Zwanziger, J., Melnick, G. A., and Bamezai, A. (1994). Costs and price competition in Caifornia hospitals, 1980-1990. *Health Affairs*, **13**, 118–128.

Appendix

	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	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
	Analysis of Variance						
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 Dum	5.293	194.2	48.88	322.2	67.05	213.9	119.6

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

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
	Independent		Dependent Variable						
			(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
		T For H0, B=0	-1.806	0.334	-4.975	2.403	2.552	7.602	0.781

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)
	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
per capita		T For H0, B=0	-0.589	-0.364	-1.568	2.494	1.217	-0.214	-1.995

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)
	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

Year	Actual beds per capita	At 85 HMO Levels	At 93 HMO Levels	At CA HMO Levels	At PA HMO Levels
ALLYRS	0.00445	0.00450	0.00443	0.00432	0.00444
1985	0.00480	0.00480	0.00473	0.00470	0.00479
1986	0.00468	0.00469	0.00462	0.00459	0.00467
1987	0.00457	0.00459	0.00452	0.00449	0.00456
1988	0.00449	0.00455	0.00448	0.00432	0.00450
1989	0.00442	0.00448	0.00441	0.00427	0.00442
1990	0.00439	0.00445	0.00438	0.00424	0.00438
1991	0.00433	0.00439	0.00432	0.00417	0.00431
1992	0.00424	0.00430	0.00423	0.00408	0.00422
1993	0.00417	0.00423	0.00417	0.00403	0.00414

Yearly Average Values for PA and CA

Year	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	0.00436	0.00425	0.00286	0.00294
1985	0.00464	0.00456	0.00328	0.00335
1986	0.00455	0.00448	0.00318	0.00324
1987	0.00447	0.00441	0.00307	0.00311
1988	0.00442	0.00425	0.00292	0.00304
1989	0.00436	0.00422	0.00284	0.00294
1990	0.00433	0.00419	0.00273	0.00282
1991	0.00425	0.00412	0.00265	0.00273
1992	0.00414	0.00402	0.00255	0.00264
1993	0.00410	0.00400	0.00251	0.00258

Ratio of admissions to outpatient visits

Yearly Average Values for US

Year	Actual admissions/ outpatient ratio	At 85 HMO Levels	At 93 HMO Levels	At CA HMO Levels	At PA HMO Levels
ALLYRS	0.126	0.122	0.129	0.147	0.127
1985	0.194	0.194	0.201	0.207	0.194
1986	0.166	0.165	0.173	0.180	0.167
1987	0.144	0.142	0.149	0.158	0.145
1988	0.129	0.123	0.130	0.153	0.128
1989	0.119	0.114	0.121	0.142	0.119
1990	0.110	0.105	0.112	0.134	0.112
1991	0.101	0.096	0.103	0.125	0.103
1992	0.090	0.084	0.091	0.115	0.092
1993	0.084	0.076	0.084	0.108	0.086

Yearly Average Values for PA and CA

Year	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	0.089	0.109	0.091	0.071
1985	0.119	0.167	0.116	0.120
1986	0.112	0.139	0.110	0.099
1987	0.101	0.117	0.103	0.081
1988	0.095	0.113	0.094	0.069
1989	0.086	0.104	0.088	0.065
1990	0.078	0.097	0.086	0.062
1991	0.076	0.089	0.079	0.058
1992	0.072	0.079	0.072	0.049
1993	0.066	0.072	0.070	0.040

Ratio of Inpatient days to outpatient visits

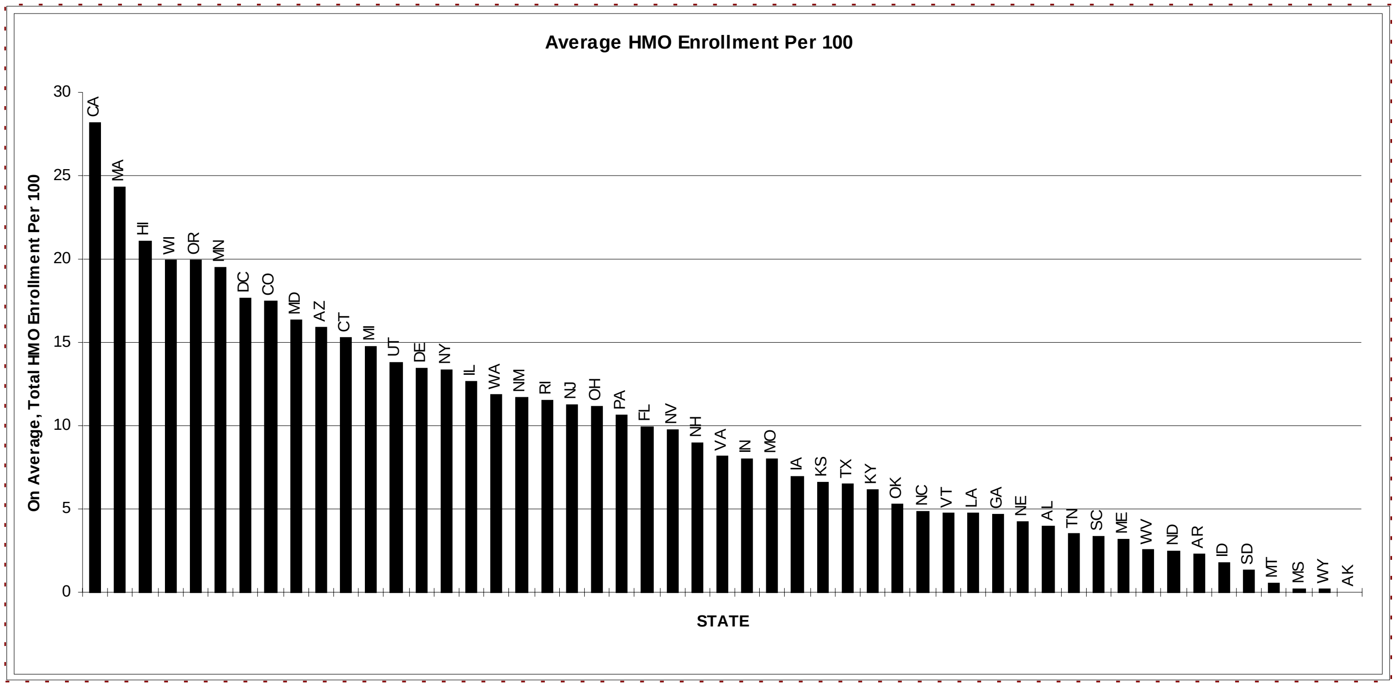
Yearly Average Values for US

Year	Actual inpatint days/outpatient ratio	At 85 HMO Levels	At 93 HMO Levels	At CA HMO Levels	At PA HMO Levels
ALLYRS	0.0026	0.0026	0.0027	0.0029	0.0026
1985	0.0037	0.0037	0.0038	0.0039	0.0037
1986	0.0033	0.0033	0.0034	0.0035	0.0033
1987	0.0030	0.0029	0.0030	0.0031	0.0030
1988	0.0027	0.0027	0.0027	0.0030	0.0027
1989	0.0026	0.0025	0.0026	0.0028	0.0026
1990	0.0024	0.0023	0.0024	0.0027	0.0024
1991	0.0022	0.0021	0.0022	0.0025	0.0022
1992	0.0020	0.0019	0.0020	0.0023	0.0020
1993	0.0018	0.0017	0.0018	0.0021	0.0018

Yearly Average Values for PA and CA

Year	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	0.0019	0.0021	0.0015	0.0013
1985	0.0024	0.0032	0.0018	0.0022
1986	0.0022	0.0027	0.0018	0.0018
1987	0.0020	0.0023	0.0018	0.0015
1988	0.0020	0.0022	0.0016	0.0013
1989	0.0019	0.0020	0.0015	0.0012
1990	0.0017	0.0019	0.0014	0.0011
1991	0.0016	0.0017	0.0013	0.0010
1992	0.0015	0.0015	0.0012	0.0008
1993	0.0014	0.0012	0.0011	0.0006

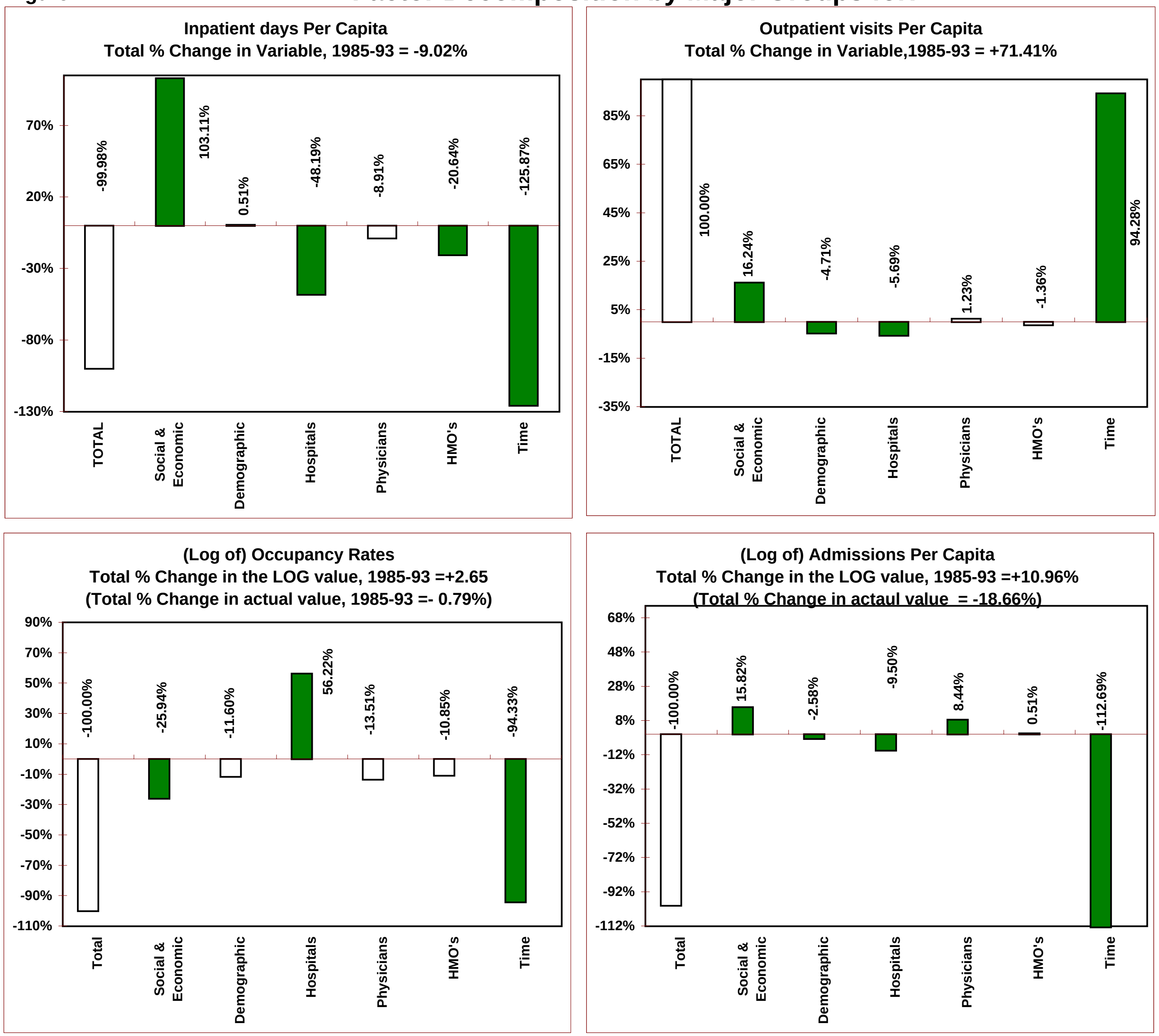
Figure 1A



Average HMO Enrollment Per 100
On Average, Total HMO Enrollment Per 100
30
25
20
15
10
5
0
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
STATE

Figure 2A

Factor Decomposition by Major Groups for:

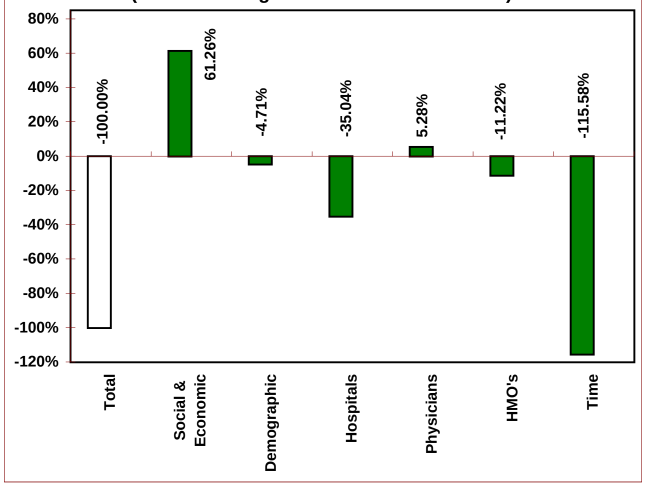


Shaded Bars had a p-value <0.05 in the Joint F-Test.

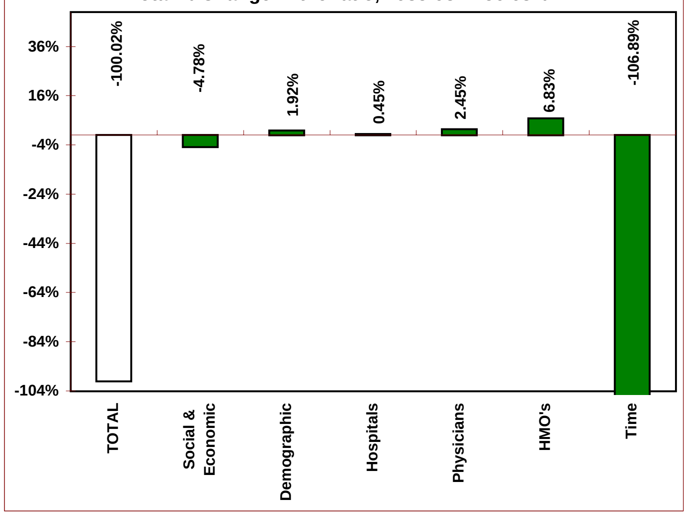
Figure 2A (Continued)

Factor Decomposition by Major Groups for:

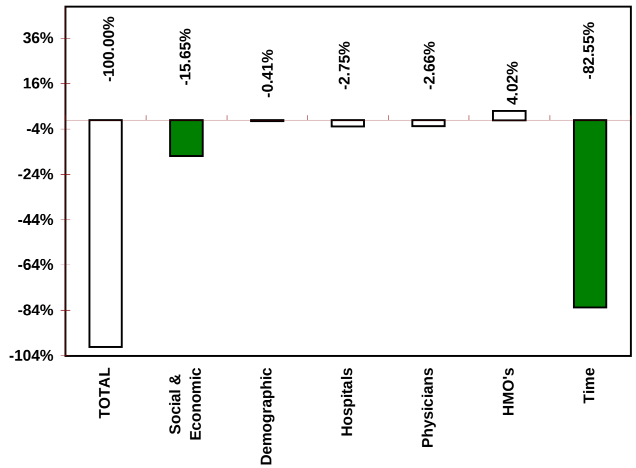
(Log of) Beds Per Capita (BEDS_N)
Total % Change in the LOG value 1985-93 = 2.65%
(Total % Change in actual value = -9.65%)



Ratio of Admissions to Outpatient Visits
Total % Change in the ratio, 1985-93 = -56.68%



Ratio of Inpatient Days to Outpatient Visits
Total % Change in the ratio, 1985-93 = -51.95%



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