Effect of Coinsurance: A Multivariate Analysis

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A study of the impact of coinsurance on physician visits, physician expense, ancillary services, and ancillary services expense. When a 25-percent coinsurance rate was introduced to the Palo Alto Group Health Plan, the members' demand for medical care was significantly reduced, other things remaining the same. This study differs from the preceding article in that it holds all other variables constant while changing one variable—that is, it considers the partial effect of each variable.

SELDOM IS IT POSSIBLE to conduct effectively controlled experiments to assess the impact of economic variables on real world phenomena. The Palo Alto Group Health Plan (GHP) data of Anne Scitovsky and Nelda Snyder represent such an experiment, although the GHP was not explicitly designed for experimental purposes. (For a more complete description of the data base and a discussion of the nature of the GHP, see the analysis in the preceding article.) This article examines the GHP data, using a slightly different conceptual framework and a different statistical methodology. Essentially both articles have reached the same conclusions, although there are some differences.

METHODOLOGY

This study considers the impact of coinsurance upon four variables only—physician visits, physician expense, ancillary services, and ancillary services expense. For each person in the study, the following data were also available: age, relation to the subscriber, sex, distance from the Palo Alto Medical Clinic, occupation group (at Stanford University), and family size.

Multiple regression methods were used to analyze these data. This technique permits the estimation of equations such as:

Physician visits = α_1 age of individual in years + α_2 distance from GHP clinic in miles + α_3 family size.

The α's in this equation are constants to be estimated from the data. They show the effect of changing one variable while holding the others constant. Thus, an individual who is 1 year older is hypothesized to make α_1 additional visits.

In this article the explanatory variables have not been entered in continuous form as in the above example. Rather, variables are broken into intervals or groups. Occupation is divided into faculty, other professional, and nonprofessional staff. Sex and subscriber variables are divided into five groups—male and female subscribers, male and female dependents, and children. Distance for dependents is divided into 5-mile segments, 0–5, 6–10, 11–15, 16–20, and greater than 20 miles; all subscribers are assumed to be in the 0–5 mile category. Age is divided into 0–4 years, 5–14, 15–18, 19–24, 25–44, 45–54, and 55 and over. When the individual being considered belonged to the category, the variable for that category took the value 1; otherwise it was zero. The advantage of this approach is that one does not have to assume, as in the above example, that each year or mile (or whatever) adds the same number of visits. The mean number of visits in each interval can be estimated by holding the other factors constant. (The family size variable is entered in continuous form.) For example, with other things equal, the mean number of visits among those aged 19–24 may be five, among those aged 25–44 it may be three, and among those aged 45–54 it may be four. No relationship among the age groups is assumed.

Initially, data for two years—1966 and 1968—were pooled, creating 5,134 effective observations. The explanatory variables listed above are virtually identical for each person in both years, except that age has increased by 2 years. These explanatory variables thus can only explain the level of visits by an individual, not any change between 1966 and 1968. In order to do that, a

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variable with the value 1 for all observations in the year 1968 and zero for all observations in 1966 was established. In 1968, of course, a coinsurance rate of 25 percent was in effect (that is, in 1968 patients paid 25 percent of the Clinic's normal fees but paid no money fees in 1966). The coefficient of this variable may be interpreted as the effect of a 25-percent coinsurance rate on the demand for medical care. Since virtually all other variables have been held constant, it is reasonable to expect that the only changes observed in demand were due to the introduction of coinsurance. By specifying the impact of coinsurance in such a way it is assumed that coinsurance led to an equal decline in visits or expense in each class. Evidence is presented below that this hypothesis cannot be rejected.

The technique of regression analysis leads to an estimate of the demand for physician visits and ancillary services and the changes in expenses for these services for a reference group. The reference group used for the following analyses was composed of persons in a family of four where the employed member was classified as nonprofessional staff and was a male subscriber aged 25–44. The estimated differences in levels of usage and expenses for groups of persons with different characteristics can also be calculated.

A word of caution is added here regarding these results. The decision to participate in the GHP could be made (or changed) by the family at any time. As a result, there may be some self-selection of persons in the plan in 1968 that would bias the results. About 300 of the original 2,870 members (10.6 percent) cancelled during the first year coinsurance was in effect; their overall use in 1966 was virtually identical to those who stayed in GHP. Therefore, it can be assumed that self-selection presents only a limited problem.

DEMAND FOR PHYSICIAN SERVICES

The basic finding of this article is the same as that of the Scitovsky-Snyder study: Coinsurance significantly reduces demand for medical care in this population, other things remaining the same. Table A in the Technical Note at the end of this article shows the coefficients of one regression on each of the four dependent variables (physician visits, physician expense, ancillary services, and ancillary services expense).

After the introduction of coinsurance all groups experienced declines of 1.37 in the average number of visits and $18.66 in average expense. The probability is .00005 that decreases this large would have been observed if coinsurance in fact had no effect.

The results of the analysis for predicting usage among groups are shown in table 1 for physician visits and expense. Persons in the reference group averaged 4.27 visits in 1966. On the average, the number of visits in 1968 for each person in this group declined to 2.90 visits, or 32 percent; physician expense decreased from $66.81 in 1966 to $48.15 in 1968, or 28 percent.

Other demographic groups had somewhat different levels of usage. Table 1 also shows visits and expenses for groups of persons with different characteristics than the reference group. For example, if a person was a female dependent of a faculty member, aged 25–44, living 0–5 miles from the Clinic, and in a family of four, the mean difference from the reference group in the number of visits would be 2.53 (the difference for female dependents) plus 0.36 (the difference

TABLE 1.—Physician visits and expense and change from reference group, by selected characteristics, 1966

Characteristic	Physician visits			Physician expense		
	Number	Change from reference group		Amount	Change from reference group	
		Number	Percent		Amount	Percent
Nonprofessional male subscriber, age 25–44, family of 4 (reference group)	[1,2] 4 27	--------	--------	[1] $66 81	--------	--------
Not male subscriber, but—						
Female subscriber	5 14	[3] 0 87	20 4	73 79	$6 98	10 4
Male dependent, adult	5 46	1 19	27 9	78 15	11 34	17 0
Female dependent, adult	6 80	[1] 2 53	59 3	108 83	[1] 41 02	61 4
Child	1 86	−2 41	−56 4	38 67	−28 14	−42 1
Not aged 25–44, but age—						
0– 4	9 04	[1] 4 77	111 7	95 18	28 37	42 5
5–14	7 13	[2] 2 86	67 0	83 13	16 32	24 4
15–18	7 25	[2] 2 98	69 8	90 88	24 07	36 0
19–24	5 66	1 39	32 6	68 17	1 36	2 0
45–54	5 07	[1] 80	18 7	80 58	[1] 13 77	20 6
55 and over	6 27	[1] 2 00	46 8	89 97	[1] 23 16	34 7
Not 0–5 miles, but—						
6–10	3 91	− 36	−8 4	56 29	[3] −10 52	−15 7
11–15	4 26	01	−0 2	66 04	−0 77	−1 2
16–20	3 48	− 79	−18 5	57 34	−9 47	−14 2
21 and over	2 76	[3] −1 51	−35 4	48 09	[3] −18 72	−28 0
Employee in family not nonprofessional, but—						
Faculty	4 63	.36	−8 4	69 79	2 98	−4 5
Other professional	4 43	.16	−3 7	68 75	1 94	−2 9

[1] Significantly different from zero at 1 percent.
[2] Significantly different from zero at 5 percent.
[3] Significantly different from zero at 10 percent.
[4] Dependents only.

associated with faculty families), or a total difference of 2.89. The percentage change differs slightly across groups. The absolute decline is the same in each group, but each group had a different number of visits in 1966. The percentage reduction is slightly lower for faculty and other professional staff, higher for subscribers than for their dependents, and higher for dependents living further from the Clinic.

These results essentially corroborate the previous article's tables from the same data—that is, faculty members have higher utilization rates than other professional staff, who have higher rates than nonprofessional staff. Usage declines with distance from the source of care and follows a U-shaped pattern with respect to age. The U-shaped appearance is somewhat deceptive. Since all those under age 18 are considered children, the difference attributable to children should be added to those under age 18. Taking this into account produces a considerably less regular U shape. Even when all of these systematic patterns of demand for physician services are noted, the introduction of coinsurance is shown to have had a highly significant effect in reducing demand for physician services. Our analysis differs from that of the Scitovsky-Snyder study in that it holds all other variables constant while changing one variable—that is, it looks at the partial effect of each variable.

It has been suggested that the effects of coinsurance may be asymmetric. Behavior of persons when coinsurance goes from 0 to 0.25 may be different than behavior when coinsurance goes from 0.25 to 0. This result is not suggested by standard economic theory, but numerous institutional constraints may cause such a result. The question is clearly empirical and could be tested if a similar set of data could be found where a coinsurance provision had been removed, rather than instituted.

EXPENDITURES FOR PHYSICIAN SERVICES

The physician expense column of table 1 shows that spending for these services also decreased with the introduction of coinsurance but to a lesser degree than the number of physician visits (28 percent, compared with 32 percent for the reference group). A "visit" can imply a simple examination by a general practitioner or a complex specialized workup by a board-certified specialist. Thus, a simple-visit variable may be a somewhat ambiguous measure of the quantity of physician services demanded. Since expenses were not reduced by as large a percentage as visits with the introduction of coinsurance, one might infer that relatively inexpensive procedures had been reduced proportionately more than expensive procedures. The differences between "use" and "expense" do not, however, appear to be statistically significant at normal levels of hypothesis testing.[1]

TIME COSTS IN THE DEMAND FOR SERVICES

In the demand equations, it is striking how much the usage by female dependents differs from that by the reference group. Female subscribers (who are in the labor force) used slightly more services than male subscribers (0.87 more visits per year, significant at 0.03 probability), but female *dependents* (many of whom, presumably, are not in the labor force) used, on the average, 2.53 more visits per year than male subscribers and 1.66 more visits per year than female *subscribers* ($1.66 = 2.53 - 0.87$). The null hypothesis of no difference between the utilization rates of female dependents and female subscribers can be rejected at a 0.001 level of probability. On the assumption that time cost is higher on the average for female subscribers than for female dependents, these data give striking evidence on how much time costs influence the demand for medical services. It has been suggested that the differences between the utilization rates of men and women may have been pregnancy-related. That hypothesis was tested in another regression by including a dummy variable for female dependents aged 45 and over (who should be past childbearing age). If the female dependents' dummy showed pregnancy effects, then the subgroup aged 45 and

[1] The mean decrease in visits was estimated to be 24.07 percent of the demand in 1966 (calculated as the decline in average visits for the entire population), with a standard error around that estimate of 2.98 percent. The mean decrease in expense was estimated to be 23.78 percent, with a standard error around that estimate of 4 25 percent. To rigorously test the hypothesis of no difference between these means would require knowing the covariance between them. Computing this figure does not seem worth the computational costs.

over should show lower use. The actual coefficient was —0.38 visits ($t = .78$), an insignificant difference. Another inference from this result is that the major differences between the use of physician services by men and women are probably not due to biological differences—a common justification—but to differences in the cost of time.

With this interpretation, a question can be raised concerning the relationship between sick-leave provisions and time costs for subscribers. Faculty and other professional subscribers hold jobs that require a certain amount of output rather than a certain amount of time, and, in fact, subscribers in these groups are generally not covered by sick-leave provisions. Thus, their visits would tend to come from time not devoted to market work, and time costs could be expected to be higher than they are for nonprofessional staff, where sick-leave provisions are more frequent. Moreover, sick-leave provisions only apply to employees paid hourly. Only 16 percent of the total number of employees work at an hourly rate (virtually all of whom are nonprofessional staff), and of these an undetermined number work less than half time and so would not be eligible for the health plan. Thus sick-leave provisions do not appear to be an important factor.

The average price per unit of service can be obtained by dividing annual expense by annual use. An overall average price per unit of $13.83 was obtained using the GHP data for both years ($69.14/5.00). With a 25-percent coinsurance rate, this means that in 1968 members paid an average of $3.46 more per visit than they did in 1966 when there was no coinsurance. From the GHP data an arc elasticity of demand for physician services—showing the percentage change in demand that results from a given change in monetary price—can be computed using the formula on page 27 in the Technical Note. The arc elasticity of demand for a $3.46 increase in cost with a 25-percent coinsurance rate is —0.137;[2] a 10-percent increase in price would result in a 1.37-percent decline in visits.

This analysis is somewhat misleading regarding the sensitivity of medical care demand to total price, however. If a value of $10 were placed on time and transportation costs—so that the price of medical services jumped from $10 (with no monetary payment) to $13.46 (with the 25-percent coinsurance)—the arc elasticity would be: (—1.37/$3.46) × ($23.46/10.00) = —0.927. Thus, a 10-percent increase in total price would result in a 9.3-percent reduction in the quantity of medical care purchased.

The elasticity figure is obviously quite dependent upon the value of other costs, including time costs. If a value of $5.00 were used for time costs, a 10-percent increase in total price would result in a 5.3-percent reduction in the use of services. If a value of $15.00 were used for time costs, a 10-percent increase in total price would result in a 13.2-percent reduction in the use of services. This line of reasoning suggests that very time-intensive services, such as hospitalization, would show quite small elasticities with respect to money price but possibly large elasticities with respect to total price.

Even though the elasticity coefficient is quite dependent on the value of other costs used in the equation, it does reveal why normal estimates of demand for medical services show price elasticities that are relatively low compared with other commodities—the base prices used are not really the total prices consumers consider when deciding how much of the service to purchase. Which price to use depends upon what one is trying to predict. If one wants to estimate the effects of a change in the monetary price on demand for medical care, the monetary price is sufficient. If one wishes to estimate demand for the services of a different medical care delivery system that will alter time or travel expenses, it may be necessary to consider the value of the consumer's time, travel distances, and the time required to obtain the services.

DEMAND FOR ANCILLARY SERVICES

The regressions on use and expense data for ancillary services (equations 3 and 4 of table A of the Technical Note) show similar but less

[2] The estimated own-price elasticity of demand for physician services of —0.14 is almost identical to an elasticity estimate of total medical expenditures from an entirely different data source. Using insurance premium data, that elasticity was computed to be —0.13 as the coinsurance rate changed from 20 percent to 25 percent. See Charles E. Phelps and Joseph P. Newhouse, *Coinsurance and the Demand for Medical Services*, Rand Report No. R–974.

strong effects of coinsurance on demand. The number of ancillary services used by the reference groups decreased 13 percent when coinsurance was introduced; expenditures on ancillary services decreased by an identical amount. These decreases are significantly different from zero at a 5-percent confidence limit (one-tailed test), but they are neither as large nor as statistically significant as the decreases in physician utilization and expense data. As the preceding article points out, these results suggest that patients may have less personal control over what is done by a physician than over the initial decision to visit a physician.

DIFFERENTIAL IMPACT OF COINSURANCE

The proposition that various groups are affected differentially by the change in insurance coverage was tested by ascertaining whether the change in quantities demanded between 1966 and 1968 was systematically related to any demographic variable. This procedure permitted testing the assumption that the absolute decline in visits was equal in all demographic groups. If the change was systematically related to a demographic variable, the 1.37 decline in visits and the $18.66 decline in physician expense for all groups should be corrected to show a different absolute decline for the particular demographic group in question. Results from this test are reported in table B in the Technical Note. The null hypothesis here is that the effect of coinsurance does not change with age, income, travel distance, or relationship to subscriber.

Because total price for medical services includes not only monetary price but a time cost, it can be assumed *a priori* that those persons with higher time costs (members living farther away from the Clinic, for example) would face a lower proportional increase in total price with the introduction of coinsurance. Hence, assuming that, on the average, all groups would respond similarly to price changes, their reduction in utilization should be less. Put another way, those with very high time costs should be relatively undeterred by changes in the monetary price. This hypothesis was borne out only partially by the data. In general, male plan members, who probably face higher time costs, were less affected by the coinsurance than female members.[3] Persons facing less travel time, however, were not more strongly influenced by the coinsurance, as would be predicted. (An F-statistic testing the joint hypothesis that all of the distance variables were zero was 0.34.) One explanation for this result is that when coinsurance was introduced those living further away had a greater tendency to switch to nonplan services than did those who were living close by.

Even more noteworthy is the fact that the change in demand did not differ significantly between different occupation (income) groups in this population, although it might be expected that the demand of those with lower time costs (the nonprofessional group) would be reduced significantly more than the highest income groups (professional staff). However, an F-statistic testing the hypothesis that there was no difference among the occupational groups in the amount of decline—that is, that the coefficients of the two occupational variables both were zero—equals 0.07, clearly insignificantly different from zero. (If there were in fact no difference among occupational groups, at least this much difference among the groups would be observed more than 90 percent of the time.) Whether this conclusion would be maintained over a wider income range cannot be answered from this study, but these results suggest that the response of outpatient medical care demand to price does not change with the income of the consumer unit—that is, there is not an interaction between income and price responsiveness.

The Scitovsky-Snyder study finds some evidence that the decline in visits after the introduction of coinsurance was greater among the nonprofessional group. That finding can be reconciled with the finding of this article in three ways:

1. Nonprofessional staff had lower mean utilization rates, so that the same absolute change (described in this article) is a larger relative change (described in the preceding article).

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[3] An F-statistic testing the joint hypothesis that the coefficients for female dependents, female subscribers, and male subscribers equal zero is 2.56 A similar test on the dependency status jointly tested whether the coefficients on male and female dependents were zero; the F-statistic was 2.87. The critical level for rejection at the 5-percent level is 2.99.

2. Their finding is based partly on other data, especially their finding regarding the change in the percentage of the various occupational groups having no physician visits during the year and the change in the volume of physical examinations.

3. The analysis in the preceding article does not hold factors other than age and sex constant between the occupational groups Given the results of table B—that the other factors were unrelated to the change in visits—this difference between the studies does not appear to be important.

Interaction between income and dependency status was also tested to see if subscribers of different income levels behaved differently than nonsubscribers. The results were generally negative, and they have not been included in this article.

F-statistics can be used to test the null hypothesis that none of the explanatory variables in the regression equation systematically affect the change in demand for medical services when a copayment of 25 percent is introduced (that is, that the entire coefficient vector is equal to zero). The following tabulation shows the F-statistics for four variables and the approximate probability of occurrence if in fact there were no difference among groups:

Change in—	F-value	Percentage probability [1]
Physician visits	0 8219	65
Physician expense	7686	74
Ancillary services	1 0552	40
Ancillary services expense	1 0563	40

[1] Calculated by interpolation from tabled values of F the probability of F being greater than 0 76 is 75 percent, the probability of F being greater than 0 96 is 50 percent; and the probability of F being greater than 1.20 is 35 percent.

The F-statistics shown above are all sufficiently low so that the null hypothesis for these equations cannot be rejected at conventional levels of significance. The tabulation also shows the probability of occurrence if the null hypothesis were true: if there were, in fact, no differences between any of the groups in their response to insurance. For example, a 65-percent probability of occurrence means if there were no differences between the groups, an F-statistic this large or larger would be obtained 65 percent of the time. One cannot infer from this that there is a 35-percent (100—65) chance that there is a difference among the groups. If there were, in fact, an infinitesimal difference among groups in their response to coinsurance, an F-statistic this large would have been observed approximately 35 percent of the time. The larger any true difference, the smaller is the chance of observing an F-statistic as large as this. The assumption that monetary coinsurance reduces demand equally for all the persons in the sample is thus supported.

The F-statistics test the null hypothesis that the effect of coinsurance is the same for all groups. The hypothesis that the effect of coinsurance is different for any individual demographic group (considered singly) can be tested by investigation of individual t-statistics in table B. (The t-statistics are calculated on the assumption that the other estimated coefficients equal their true values.) These t-statistics show that only one demographic variable—female dependents—is significant at conventional levels of probability,[4] and this variable is significant for all four measures of utilization under investigation. The introduction of coinsurance reduced demand by female dependents significantly more than for other members of this population. Again, on the assumption that female dependents face on the average lower time costs, this result is in accord with previous hypotheses that those facing the lowest total price in 1966 (time and travel costs) would be most significantly affected by coinsurance. This result further strengthens the belief that the major reason for the higher demand by female dependents in 1966 (and in 1968) was the implicitly lower time costs for that group than for any of the other members of the study population.[5]

Moreover, this result implies that the introduction of better insurance will raise the share of visits made by female dependents. If the total number of visits does not expand, this increase will be at the expense of other groups. At the

[4] One must be careful in attaching much confidence to this result, since the chance of finding one variable significant at the 1-percent level among 17 variables is not 1 percent but nearly 17 percent.

[5] For technical reasons, it was necessary to include some variables in the regressions in table B that contained similar information, such as "dependent child" and "age under 5." The appropriate statistical tests of significance are on the sum of those two variables For the change in physician visits, the difference for dependent children under age 5 is 1.41 ($t = 1.90$); the sum of the coefficients is not statistically significant for dependent children aged 5–14 and for children aged 15–18.

moment there is little evidence on what might be expected to happen to total visits.

Another piece of evidence that strongly supports the hypothesis that the introduction of coinsurance results in a large change in utilization among groups with low time costs is the Scitovsky-Snyder finding that all visits decreased by 24.1 percent but home visits decreased by 51.6 percent. Since there is essentially no travel time or waiting time for home visits, the time price for home visits is negligible.[6]

POSSIBLE SHORTCOMINGS OF STUDY

Several factors could possibly limit the application of these findings. First, if some exogenous factor such as a local epidemic artificially increased demand in 1966, or some factor (such as a miracle) systematically reduced demand for the entire community in 1968, then the observed differences in these data could be attributed to factors other than or as well as the introduction of coinsurance. The GHP plan data in the Scitovsky-Snyder study, however, show essentially no change in visits to the Palo Alto Medical Clinic between the two years. Furthermore, the Kaiser Foundation Health Plan-Northern California reports a similar number of outpatient visits in the two years (see their table 12, page 14).

In addition, it would be preferable, as mentioned earlier, to conduct an investigation of those who remained in the GHP in 1968 and those who chose some other source of insurance/medical care.[7] Unfortunately, no data are available on the demand of those persons in 1968 who left GHP, since they could presumably obtain their medical care from any provider in the community, rather than being restricted to the Palo Alto Clinic.

A final potential problem with this study is that, with the introduction of coinsurance in 1968, some persons enrolled in GHP may have continued their enrollment but purchased some of their medical care from other providers, presumably at full market prices. Doing this would be rational behavior if the total cost of some private services (including travel time) were lower than the costs of GHP. If such behavior occurred, then some of the observed reduction in care may actually be only a shift to other suppliers, rather than an actual decrease in the market quantities demanded. Such behavior would be more likely among those who lived far from the Clinic. As noted above, this could account for the greater reduction in demand for GHP services among those who live farther away. To the extent that this is true, the decrease in demand for an entire community would be less than estimated here for this particular prepayment group. As the preceding article pointed out, however, an individual who intended to make much use of outside providers would probably have opted for alternative insurance coverage; thus, this factor does not appear to be significant.

SUMMARY

Multiple regression analysis of the GHP data shows that the introduction of 25-percent coinsurance in a prepayment setting reduced physician visits among the subscribers and their dependents by 1.37 visits on the average. Furthermore, the only group that was likely to have been more sensitive to the change in price was female dependents of subscribers. For other groups in the GHP population, responses to the change in price were not significantly different from each other. The data also show that the use of ancillary services did not decrease as much as the use of physician services.

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[6] Assuming a zero time cost for home visits, the implied value of time for an office visit is approximately $2.50 This is computed as the value of time that would make the arc elasticity for office visits equal 0.347, the elasticity for home visits as computed from table 10 (page 00) of the Scitovsky-Snyder study.

[7] The decision of GHP members to participate in the plan and to use its services should be analyzed in the context of a simultaneous equation model. On the basis of their use of services in 1966, persons dropping GHP appeared to be little different from those keeping plan membership, so the simultaneous equation bias is probably small.

Technical Note

REGRESSION RESULTS

In this article the dependent variables are in absolute form rather than in relative form as they are in the Scitovsky and Snyder study. This causes some minor differences in results as noted.[8] Except for family size, all of the explanatory variables have been entered in dummy variable form, since all the information is categorical. In these regressions, the constant term refers to the usage by male-subscriber, nonprofessional staff with travel distance less than 5 miles, whose age in 1966 was 25–44. The coefficients of the other variables, such as aged 45–54, refer to the decrease (or increase) in use associated with that category in relation to the constant term. The distance variables apply only to dependents; subscribers are assumed to travel from work to the Clinic and so fall in the 0–5 mile category.[9]

TABLE A.—Regression estimates of the demand for medical care under the Palo Alto Group Health Plan, 1966–68 [1]

Explanatory variables	Dependent variables: Physician visits (Equation 1)	Physician expense (in dollars) (Equation 2)	Ancillary services (Equation 3)	Ancillary services expense (in dollars) (Equation 4)
Coinsurance (1968)	−1 3677 (−8 0848)	−18 660 (−5 5932)	−0 6774 (−2 3413)	−3 5395 (−1 7398)
Faculty	0 3568 (1 3917)	2 9767 (0 5888)	1 4216 (3 2422)	6 4606 (2 0956)
Other professional	0 1630 (0 6422)	1 9435 (0 3882)	0 2045 (0 4710)	1 2528 (0 4103)
Female subscriber	0 8682 (2 1650)	6 9835 (0 8831)	0 6518 (0 9504)	−0 2339 (−0 0485)
Male dependent	1 1868 (1 3354)	11 335 (0 6467)	1 4821 (0 9750)	7 8766 (0 7369)
Female dependent	2 5348 (10 099)	41 018 (8 2867)	2 6798 (6 2425)	14 436 (4 7826)
Child	−2 4100 (−1 4389)	−28 136 (−0 8518)	−0 7243 (−0 2528)	−12 858 (−0 6384)
Distance (in miles).[2] 6–10	−0 3588 (−1 1082)	−10 520 (−1 6478)	−0 3811 (−0 6882)	−2 3941 (−0 6149)
11–15	0 0125 (0 0374)	−0 7698 (−0 1171)	−0 7187 (−1 2604)	−4 1933 (−1 0459)
16–20	−0 7862 (−0 8962)	−9 4664 (−0 5472)	−1 8077 (−1 2048)	−11 941 (−1 1318)
21 and over	−1 5119 (−2 7317)	−18 720 (−1 7151)	−1 3906 (−1 4690)	−5 0130 (−0 7532)
Age 0–4	4 7737 (2 7870)	28 371 (0 8399)	−1 0708 (−0 3655)	−0 7660 (−0 0372)
5–14	2 8626 (1 7063)	16 324 (0 4934)	−0 8756 (−0 3051)	1 1288 (0 0560)
15–18	2 9828 (1 7608)	24 070 (0 7205)	0 4638 (0 1601)	8 2698 (0 4060)
19–24	1 3914 (0 8497)	1 3603 (0 0421)	−0 9314 (−0 3325)	2 4193 (0 1228)
45–54	0 7991 (3 0643)	13 774 (2 6784)	2 5395 (5 6938)	19 535 (6 2293)
55 and over	2 0017 (6 2908)	23 158 (3 6906)	2 8350 (5 2093)	22 734 (5 9413)
Family size	−0 0934 (−1 2583)	−0 8365 (−0 5716)	0 0084 (0 0663)	−0 2621 (−0 2937)
Constant term	4 6339 (11 535)	70 158 (8 8556)	4 5411 (6 6090)	24 096 (4 9875)
R^2	0 0619	0 0493	0 0559	0 0520
"F"	18 751	14 744	16 819	15 582

[1] Figures in parentheses are t-statistics In a sample of this size, t=1 65 has 0 10 probability, t=1 96 has 0 05 probability, and t=2.58 has 0 01 probability.
[2] The distance variable is set at 0–5 miles for subscribers

In table B, the dependent variable is the change in demand, so that a negative coefficient implies that the coinsurance had a stronger effect in reducing demand for the group represented by that particular independent variable. For example, since the coefficient of female dependent in the table B equations is negative, the coinsurance reduced demand more for female dependents than for male subscribers (whose change in usage is measured by the constant term).

From the data in this article one may compute an arc elasticity of demand showing the percentage change in demand for a given percentage change in monetary price over the range of zero coinsurance to 25-percent coinsurance. The formula for arc elasticity ($\bar{\eta}$) is:

$$\bar{\eta}=\frac{\Delta y}{\Delta x}\cdot\frac{(\bar{x})}{(\bar{y})}=\frac{(y_2-y_1)}{(x_2-x_1)}\cdot\frac{(x_1+x_2)/2}{(y_1+y_2)/2}=\frac{(y_2-y_1)}{(x_2-x_1)}\cdot\frac{(x_1+x_2)}{(y_1+y_2)}$$

where x is the monetary price (x_1 = \$0 and x_2 = \$3.46) and y is the number of visits (y_1 = 5.683 and y_2 = 4.314).

POSSIBLE BIASES

Is it possible that the standard errors of the coefficients on the 1968 coinsurance dummy variables in the regressions of table A are biased,

[8] Since some individuals had zero use in the base year, relative changes could not be used as a dependent variable. Dividing the coefficient estimates by the appropriate average value of variables in 1966 (as in table 1) will provide estimates of relative changes comparable to those found by using group averages.

[9] Less than 5 percent of subscribers' visits took place at night (after 8 p.m.) or on weekends (other than Saturday from 9 a.m. to 1 p.m.).

Table B.—Regression estimates of the change in demand for medical care under the Palo Alto Group Health Plan, 1966–68 [1]

Explanatory variables	Physician visits *Equation 1*	Physician expense (in dollars) *Equation 2*	Ancillary services *Equation 3*	Ancillary services expense (in dollars) *Equation 4*
Faculty	0 0329	−12 137	−0 2686	−4 5182
	(0 0751)	(−1 2724)	(−0 3400)	(−0 7880)
Other professional	0 0524	−4 4812	0 2434	−0 7855
	(0 1209)	(−0 4745)	(0 3112)	(−0 1384)
Female subscriber	−0 7449	−12 308	−0 2343	0 5785
	(−1 0874)	(−0 8249)	(−0 1896)	(0 0645)
Male dependent	1 1850	30 582	−2 4355	−15 661
	(0 7805)	(0 9248)	(−0 8893)	(−0 7878)
Female dependent	−0 9335	−22 154	−1 5295	−12 784
	(−2 1773)	(−2 3724)	(−1 9777)	(−2 2773)
Child	2 7558	15 136	2 5909	17 050
	(0 9632)	(0 2429)	(0 5020)	(0 4551)
Distance (in miles): [2]				
6–10	−0 5532	3 6752	0 3165	1 0470
	(−1 0003)	(0 3051)	(0 3173)	(0 1446)
11–15	−0 2862	−1 5885	0 4768	5 2941
	(−0 5024)	(−0 1281)	(0 4641)	(0 7100)
16–20	−0 7446	3 1003	0 3557	9 2158
	(−0 4969)	(0 0949)	(0 1316)	(0 4697)
21 and over	0 0953	−21 960	1 2279	6 0446
	(0 1008)	(−1 0665)	(0 7200)	(0 4883)
Age:				
0–4	−4 1802	−21 243	−4 0155	−23 209
	(−1 4287)	(−0 3333)	(−0 7608)	(−0 6058)
5–14	−3 1280	−19 200	−3 2612	−20 847
	(−1 0915)	(−0 3076)	(−0 6309)	(−0 5556)
15–18	−2 9714	−17 180	−3 4513	−22 363
	(−1 0269)	(−0 2726)	(−0 6612)	(−0 5902)
19–24	−3 6643	−28 463	−5 2748	−29 498
	(−1 3099)	(−0 4671)	(−1 0453)	(−0 8053)
45–54	−0 3539	−0 3252	−2 0463	−14 792
	(−0 7945)	(−0 0335)	(−2 5467)	(−2 5362)
55 and over	−0 2018	4 5403	−1 5717	−7 2991
	(−0 3713)	(0 3835)	(−1 6031)	(−1 0257)
Family size	0 0323	0 6772	−0 3634	−1 2829
	(0 2550)	(0 2453)	(−1 5892)	(−0 7730)
Constant term	−0 6235	−7 0471	2 1127	12 055
	(−0 9294)	(−0 4823)	(1 7459)	(1 3725)
R^2	0 0055	0 0051	0 0070	0 0070
"F"	0 8219	0 7686	1 0552	1 0563

[1] Figures in parentheses are *t*-statistics. In a sample of this size, *t*=1 65 has 0 10 probability, *t*=1 96 has 0 05 probability, and *t*=2 58 has 0 01 probability; an *F* value of 1 20 for the entire equation has 0 25 probability on the null hypothesis, an *F* value of 0 96 has 0 50 probability, and an *F* value o 0 76 has 0 75 probability

[2] The distance variable is set at 0–5 miles for subscribers

Table C.—Comparison of *t*-statistics of coinsurance coefficient found in table A with *t*-statistics for 2-year difference regressions

Dependent variable	1968 coinsurance coefficient, *t*-statistics	2-year difference coefficient (b_0) *t*-statistics
Physician use	8 08	9 47
Physician expense	5 59	5 93
Ancillary services	2 34	2 60
Ancillary services expense	1 74	1 87

because of (presumed) positive correlation of the error terms between the i^{th} person's physician visits in 1966 and 1968. Suppose the error term is of the form $\epsilon_{it} = \mu_i + v_{it}$, where μ_i is a random variable specific to each individual and time invariant, and v_{it} varies with each individual in each time period. Then, if μ_i and v_{it} are independent, the covariance of ϵ_{i1966} and ϵ_{i1968} equals the variance of μ_i. This correlation is not a standard first-order autocorrelation, and any established direction of bias that such a correlation might produce is unknown. To guard against the possibility of such biases, y_i was defined to be the difference between the i^{th} person's use in 1966 and in 1968, and regressions of the form $y_i = b_o + u_i$ where b_o is simply a constant term and u is a random error term were run. The error term in these regressions equals Δv_{it} and by assumption has a variance-covariance matrix proportional to the identity matrix. The constant term that re-

(Continued on page 44)

Table D.—Summary statistics on population characteristics, utilization, and expense for members of the Palo Alto Group Health Plan, 1966 and 1968

Variable	Mean	Standard deviation
	Explanatory variables	
Faculty	0 404	0 491
Other professional	385	487
Female subscriber	069	253
Male dependent	010	.098
Female dependent	234	.423
Child	421	.494
Distance (in miles)		
6–10	082	275
11–15	076	265
16–20	010	098
21 and over	020	.159
Age		
0–4	049	217
5–14	237	425
15–18	.088	283
19–24	049	216
45–54	.182	386
55 and over	127	333
Family size	4 020	1 500
	Dependent variables	
Physician visits.		
1966	5 68	6 58
1968	4 31	5 81
Average	5 00	6 25
Physician expense		
1966	$78 47	$129 17
1968	59 81	114 40
Average	69 14	122 37
Ancillary services		
1966	6 03	12 92
1968	5 35	7 73
Average	5 69	10 65
Ancillary services expense		
1966	$30 91	$96 16
1968	27 37	43 76
Average	29 14	74 73

TABLE M-5.—Old-age and survivors insurance trust fund: Status, 1939-72

[In thousands]

Period	Receipts			Expenditures				Assets at end of period		
	Net contribution income [1]	Transfers from general revenues [2]	Net interest [3]	Cash benefit payments [4]	Rehabilitation services for disabled	Transfers to railroad retirement account [5]	Net administrative expenses [6]	Invested in U.S. Government securities [7]	Cash balances	Total assets
Fiscal year:										
1939-40	$550,000	...	$42,489	$15,805	...	...	$12,288	$1,738,100	$6,598	[8] $1,744,698
1944-45	1,309,919	...	123,854	239,834	...	...	26,950	6,546,281	67,100	6,613,381
1949-50	2,106,388	$3,604	256,778	727,266	...	...	56,841	12,644,823	247,789	12,892,612
1954-55	5,087,154	...	438,029	4,333,147	...	−$9,551	103,202	20,580,491	560,511	21,141,001
1959-60	9,842,685	...	517,130	10,269,709	...	600,437	202,369	19,748,848	1,079,877	20,828,725
1960-61	11,292,676	...	531,103	11,184,531	...	331,734	235,889	19,523,517	1,376,833	20,900,350
1961-62	11,454,643	...	541,254	12,657,835	...	360,788	251,490	18,434,665	1,191,468	19,626,133
1962-63	13,327,762	...	514,822	13,844,584	...	422,523	262,527	17,613,190	1,325,894	18,939,083
1963-64	15,502,726	...	541,552	14,579,166	...	402,636	302,709	18,304,869	1,393,982	19,698,851
1964-65	15,857,212	...	586,237	15,225,894	...	435,638	300,283	18,765,724	1,414,761	20,180,485
1965-66	17,865,947	...	594,758	18,071,453	...	443,820	253,680	17,908,655	1,963,580	19,872,236
1966-67	22,567,002	78,000	725,901	18,885,714	$88	508,046	333,901	21,764,099	1,751,290	23,515,389
1967-68	22,662,430	78,000	899,397	20,737,093	277	437,634	447,309	23,234,480	2,298,423	25,532,904
1968-69	25,952,737	381,545	1,014,080	23,732,010	1,806	491,482	465,028	26,220,292	1,970,647	28,190,939
1969-70	29,954,673	442,151	1,349,613	26,266,928	1,239	578,818	474,035	30,106,913	2,509,443	32,616,355
1970-71	31,915,231	448,916	1,618,138	31,101,018	1,859	613,026	551,889	31,361,082	2,969,766	34,330,848
1971										
February	3,839,937	...	38,656	2,511,420	...	...	36,339	29,665,187	3,419,809	33,084,995
March	2,736,821	...	10,171	2,540,985	213	...	34,875	30,743,085	2,512,829	33,255,914
April	3,483,561	...	24,544	2,540,586	455	...	42,837	31,204,357	2,975,784	34,180,141
May	3,889,510	...	45,663	2,536,527	155	...	53,824	32,239,536	3,285,272	35,524,808
June	2,598,030	...	684,009	3,792,043	271	613,026	70,660	31,361,082	2,969,766	34,330,848
July	2,363,751	...	10,528	2,806,087	152	...	16,325	30,718,718	3,163,845	33,882,563
August	3,911,251	...	43,176	2,813,500	136	...	42,092	31,908,292	3,072,971	34,981,263
September	2,604,985	...	11,11[illegible]	2,8[illegible],154	1,319	...	19,045	31,569,087	3,178,754	34,747,841
October	2,052,626	...	34,209	2,856,650	−1,066	...	62,808	30,702,773	3,213,512	33,916,285
November	2,622,130	...	32,635	2,867,091	246	...	27,993	30,655,701	3,020,019	33,675,720
December	1,796,307	487,546	718,507	2,848,610	−240	...	40,656	30,686,119	3,102,936	33,789,055
1972										
January	2,505,025	...	10,252	2,885,206	304	...	116,576	30,226,870	3,075,377	33,302,247
February	3,879,734	...	39,630	2,905,853	143	...	58,892	31,259,465	2,997,258	34,256,723

[1] Equals amounts appropriated (estimated tax collections, subsequently adjusted) Includes deposits by States under voluntary coverage agreements and deductions for refund of estimated employee-tax overpayment Early years reflect former appropriation bases.

[2] From 1947 to 1951, for benefits with respect to certain World War II veterans Beginning 1966, for military wage credits, and, beginning Dec. 1968, Federal payment for special age-72 benefits, see footnote 4.

[3] Includes interfund transfer of interest on administrative expenses reimbursed to the OASI trust fund from the other 3 social security trust funds, 1958 to date (see footnote 6)

[4] Before deductions for (1) SMI premium payments and, when applicable, (2) recoupment of overpayments of hospital and medical service benefits provided to OASI beneficiaries Includes special benefits for persons aged 72 and over not insured under the regular or transitional provisions of the Social Security Act.

[5] The purpose of the financial interchange provisions of the Railroad Retirement Act, as amended, is to place the trust funds in the same position in which they would have been had railroad employment always been covered under OASDHI. Negative figures represent transfers to OASI trust fund. Excludes transfers to HI trust fund for hospital insurance coverage of railroad workers, accounted for elsewhere (see table M-7).

[6] Beginning Nov. 1951, adjusted for reimbursements to trust fund of small amounts for sales of services Beginning Oct 1953, includes expenses for central and regional office building construction. Except for reimbursements from the appropriate trust fund to Treasury Department for its expenses as incurred, beginning 1957 administrative expenses for OASI and DI were paid initially from OASI trust fund with subsequent reimbursement, plus interest (see footnote 3), from DI trust fund for allocated cost of DI operations Beginning 1966, subject to subsequent adjustment among all 4 social security trust funds for allocated cost of each operation

[7] Book value includes net unamortized premium and discount, accrued interest purchased, and repayment of interest accrued on bonds at time of purchase.

[8] Reflects assets of predecessor fund, the old-age reserve, January 1937–December 1939

Source Unpublished Treasury report keyed to *Final Statement of Receipts and Expenditures of the U.S. Government*

MULTIVARIATE ANALYSIS

(*Continued from page 28*)

sults from this equation is identical to the coefficient on the 1968 coinsurance dummy in the regressions reported in table A.

The standard errors of the coefficients in these sample regressions should be higher than the corresponding coefficients in table A if the autocorrelation in the data biases the standard errors of table A coefficients downward, and the reverse should be true if the autocorrelation biases the standard errors in table A upward. The results uniformly suggest that the *t*-statistics on the 1968 coinsurance variables in table A are biased downward (that is, that standard errors are biased upward) compared with the simple regression suggested here. (The actual coefficients were identical—to the five decimal places reported—in all pairs of regressions.) The *t*-statistics for these regressions are given in table C. The means and their standard deviations for the explanatory and dependent variables are shown in table D.