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Yael Benjamini; Yoav Benjamini

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The Choice Among Medical Insurance Plans

By Yael Benjamini and Yoav Benjamini*

Theoretical studies dealing with the efficiency of medical insurance have appeared in the economic literature since Kenneth Arrow's seminal article (1963), yet few deal with the choice among plans. This is because until recently most people in the United States were offered only one plan as a job-related fringe benefit, which meant that choosing another plan implied substantial financial loss. Empirical study concerning the effect of socioeconomic factors on the choice of plan was thus almost impossible.

Following the Health Maintenance Organizations (HMO) Act of 1973, many employers now offer their workers group policies for several plans, with no tax advantage to one method or another. The numerous different plans can be divided into two major categories: conventional insurance (*CI*) schemes and HMO plans. The *CI* schemes are characterized by fee-per-service, third-party reimbursement of most medical expenses made on behalf of the insured (for example, the Blue Cross/Blue Shield/Major Medical plans).¹ Under a HMO plan, the insured has access to a comprehensive range of health services in time of need in return for per capita periodic payments.

This paper analyzes the choice between the two types of insurance. An interpretation of Richard Zeckhauser (1970) implies that for a homogeneous group, an optimal HMO plan is Pareto superior to the optimal con-

ventional one. It is shown here that the opposite may be true for a nonhomogeneous group, depending on how heterogeneous the group is. Although for members of a homogeneous group a HMO plan is welfare superior, members of a heterogeneous group may be better off with a *CI* scheme.² This discrepancy between the results for homogeneous and heterogeneous groups has theoretical importance. Our study suggests that where people can choose between the two types of plans, the group that is formed in a specific HMO plan is more homogeneous than its counterpart in a *CI* scheme. We conclude by discussing the practical consequences of these findings for the design of medical insurance plans.

1. *CI* vs. HMO for Homogeneous Groups

Here we compare the two types of medical insurance for a large group of identical individuals.³ Following Zeckhauser's case I and Arrow (1976), we assume that a representative individual purchases a policy for an actuarially fair premium, and in time of need decides how much medical services to consume. These services are purchased on a fee-per-service basis, but the price the insured actually pays per unit (the coinsurance rate) is lower than the real market price. Increasing the co-insurance rate will result, simultaneously, in a welfare gain, as the medical care subsidy that causes moral hazard (see Arrow, 1976) is reduced, and a welfare loss because of increasing risks.

*Department of Economics and Department of Statistics, respectively, Tel Aviv University, Ramat-Aviv 69 978, Tel Aviv, Israel. This research was partially supported by funds granted to the Foerder Institute for Economic Research by Bank Leumi Le-Israel. The work includes part of the first author's Ph.D. thesis done at Princeton University under the guidance of Edwin Mills to whom thanks are due. We also thank Gary Truhlar of the University of Pennsylvania for valuable help in organizing the data for the analysis.

¹All the *CI* systems are variations on this theme with different premiums, coverage limit, deductibles, or co-insurance schemes.

²The analysis for a homogeneous group is equivalent to using a representative individual, a widespread practice in theoretical studies (see, for example, Zeckhauser and Arrow, 1976). In view of the results of this work, using a representative individual might have misleading implications.

³Large in the sense that the law of large numbers is applicable; identical in the sense that they have the same income, distribution on states of health, and utility function.

This second-best type of plan can be compared to an optimal plan where the expected utility of any individual is maximized under a collective budget constraint (which is also the expected budget constraint for each member). Such a plan is described in Zeckhauser's case II, where optimality is achieved in a perfect contingent claims market. The individual gets a lump sum state-dependent insurance payment and purchases the medical service at the market price. Thus overuse (moral hazard) due to reduced price is prevented, while risk spreading is optimal. As Zeckhauser puts it, this plan is "the best that can be done with any actuarially fair plan" (p. 20). However, it is not materialized because it "requires the insurance plan to be able to distinguish unambiguously among all medical conditions... encourage its insureds to evade through misclassification, lead to errors in classification that would create injustices as well as inefficiencies" (p. 20).

While recognizing the problematic nature of such a contingent-claim market insurance plan, we suggest here that it is still possible to achieve optimality by employing a different organizational structure; in case of illness, the insured gets the needed medical treatment in-kind, instead of getting the money to purchase it. This is the essence of HMO plans where a contract is made between a group of insureds and a team of medical practitioners; for a periodic per capita actuarially fair payment, the patient receives treatment free of charge in time of need. The services given are the members' optimal choice *ex ante*, but dictated to them *ex post*, so there is no way the patient can consume more and create moral hazard. Thus, consumption of medical care and all other goods as well as risk distribution is optimal, implying that the HMO plan represents a Pareto optimal resource allocation.

Comparing the *CI* and the HMO plans, it is clear that the latter affords a higher level of welfare; in the *CI* plan the disposable income for medical and all other goods and services is the same for all states of health, while for the HMO plan's insureds, it can vary. This means that the levels of consumption of medical services and all other goods

in the best *CI* plan are feasible but not optimal for the HMO plans' insureds.

II. *CI* vs. HMO for Heterogeneous Groups

Medical insurance is purchased primarily through job-connected group policies, and the results derived in Section I assume that such groups are homogeneous. However, we show below that the optimality of the HMO schemes for a group policy relies crucially on this assumption, thus questioning the validity of its usage in our problem. A HMO plan is very rigid: all members pay the same premium and receive the same services when sickness occurs. If income, tastes, or any other factor that affects the demand differs, this is inefficient because consumption may be above or below the preferred level. The *CI* plan is more flexible. Although the terms of insurance are identical for all, patterns of consumption may differ, giving the *CI* system an efficiency advantage.

This is demonstrated graphically in Figure 1, where the *DD* curve represents the demand for medical services in a specific state of health. If the market price is 1 and *SM* is a perfectly elastic supply curve, the optimal quantity is v_s^* . This is also the quantity supplied by the HMO plan; the HMO policy holders observe the totally inelastic supply curve S_p .

Figure 1 also describes the parallel situation for *CI* policy holders. These patients, with the same demand curve *DD*, encounter a perfectly elastic supply curve at price q , which is the co-insurance rate adopted by this *CI* plan. The quantity demanded is $\hat{v}_s$, where $\hat{v}_s > v_s^*$. The darkened triangle is the welfare loss introduced by the wedge between the producers' price and the consumers' price. The magnitude of the welfare loss depends on the size of $1 - q$ and the elasticity of demand for medical services at this state of health. The total welfare loss for a *CI* patient is the expected sum of these losses for all states of health. As there is no deadweight loss associated with the HMO plan, it is clear that for one individual, or for a homogeneous group of such individuals, the HMO plan is welfare superior to the *CI* plan.

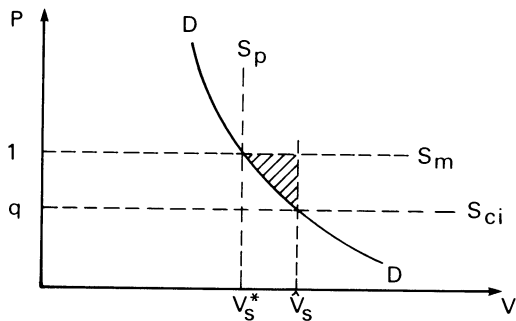


FIGURE 1. WELFARE LOSS WITH THE CI PLAN

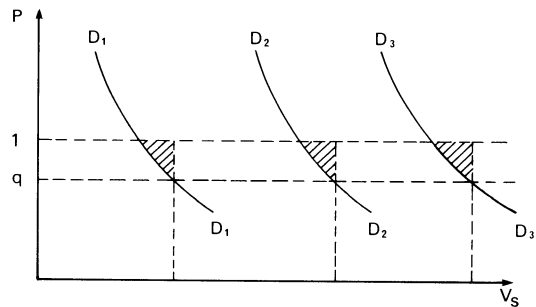


FIGURE 2. WELFARE LOSS FOR HETEROGENEOUS GROUPS IN THE CI PLAN

Now, consider a heterogeneous group consisting of three equal-sized subgroups, with DD_i representing the demand curve of the i th group for medical services at the same state of health. In Figures 2 and 3a,b, DD_1 represents the subgroup with the lowest income and DD_3 the subgroup with the highest income.⁴ As DD_2 represents the demand curve for the median insured, this is the relevant curve for the insurance plan.⁵

Figure 2 shows the welfare loss for these groups in a CI plan with a co-insurance rate (and premium) that fits the median insured. It is apparent that the size of the deadweight loss does not depend on the distance between the groups; the sum of losses is not significantly different if the demand curves are DD'_1 and DD'_3 (as shown in Figure 3b), instead of DD_1 and DD_3 . (In cases where the demand functions of the different groups are just shifts, the losses are unaffected by the actual distance.) In the HMO scheme, the situation is very different. With the same three subgroups, there is a welfare loss associated with consumption above or below the

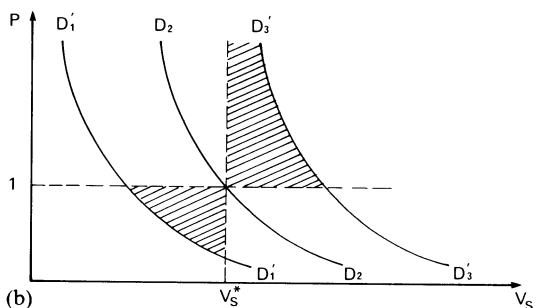
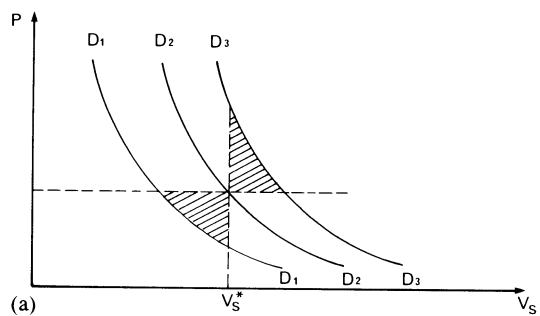


FIGURE 3. WELFARE LOSS FOR HETEROGENEOUS GROUPS IN THE HMO PLAN

⁴Equivalently, DD_1 may represent the group with low preference to medical care, and DD_3 the group with high preference, either due to tastes or to subtle physical differences.

⁵In job-connected group policies, the terms of the policy are usually affected only by marital status or family size. Using the median insured can be justified on the grounds that when an insurance firm tries to attract groups and compete with other plans to gain the favor of the majority of workers, it must appeal to the median worker.

most desired level of medical services, shown in Figures 3a and 3b by the darkened areas. It is obvious that the further the demand curves are from each other (i.e., the more heterogeneous the group), the larger is the corresponding aggregate welfare loss, with no such loss to the median insured.

We can summarize the graphic comparison between the two plans as follows. Al-

though a homogeneous group is definitely better off in an HMO plan, a heterogeneous group may be worse off. The advantage of the HMO plan declines as differences in tastes, income, or risk prospects within the group increase. When heterogeneity is sufficiently strong, a *CI* plan may be better. Any specific individual, however, may determine whether an HMO scheme is better for him than a *CI* scheme by ascertaining whether any of the available HMO plans is close enough to his preferred plan.

III. The Empirical Evidence

Data on the 6168 employees of the University of Pennsylvania are used to explore empirically the differences in homogeneity among groups of insureds. The university's employees are offered a choice of six health insurance schemes, of which we compare here the members of two: a *CI* scheme—Blue Cross/Blue Shield/Major Medical, and a HMO scheme—The Philadelphia Health Plan. The employer's contribution to the medical insurance premium is independent of the chosen plan. The health scheme enrollment can be changed every six months without any reduction in coverage. Finally, each person associates daily with people who choose other plans and has access to knowledge about the pros and cons through open houses and written material. Thus we may assume that most of the employees prefer the plan they are enrolled in.⁶

We compare the homogeneity of the two groups by comparing the distributions of income, age, and the level of education. This is done by comparison of measures of the absolute and relative variation (spread) of the two groups. Along more traditional mea-

sures such as the variance, the variance of the logarithm of the variables, and the coefficient of variation, we use the interquartile range of the variables and of the logarithm of the variables. The latter are more robust against extreme values, which might be of doubtful relevance but nevertheless exist in the data at hand. The distributions of income and age for the two groups are visually compared in Figure 4 using boxplots.⁷ Data about education are given in terms of eight partially ordered categories that were ordered and ranked. We thus supplement the analysis of education using the ranks by comparing the entropy of the two groups. Entropy is a measure of homogeneity defined on the distribution of the population in the n categories:

$$\mathbf{P} = (P_1, \dots, P_n)$$

$$\text{by } H(\mathbf{P}_n) = - \sum_{i=1}^n P_i \log P_i.$$

If all the population is concentrated in one category, all p_i 's are 0 except for one which is 1, and $H(\mathbf{P}_n) = 0$. If the population is heterogeneous and uniformly divided in the categories $H(\mathbf{P}_n) = \log n$. Thus higher entropy indicates more heterogeneity. See Henri Theil (1971, p. 71) for details and interpretation.

The values of the various measures of homogeneity as computed for the two groups are given and compared in Table 1. The absolute measures indicate that the heterogeneity of the *CI* group is 30–50 percent larger than that of the HMO group. The difference indicated by the relative measures—those eliminating differences associated with the different levels of the variables—is 15–30 percent. (The latter comparison is especially important for age because the two groups have different age averages.) En-

⁶There is a possible bias because of spatial considerations when benefits are given in-kind. Since members of HMO plans have to travel to specific locations to receive the medical services, those living farther away might prefer a *CI* plan merely of the above consideration, which is not captured in the theoretical model. We thus limit the group of *CI* plan members used in the comparison to those living in neighborhoods (identified by Postal Zip Code information) from which the HMO plan attracts its members.

⁷A boxplot is a schematic display of the distribution. The top and the bottom of the box are the quartiles and the cut is the median. The lines connect the furthest points which are less than 1.5 times the interquartile range away from the quartiles. Outside points are displayed individually. For detailed description, see J. W. Tukey (1977).

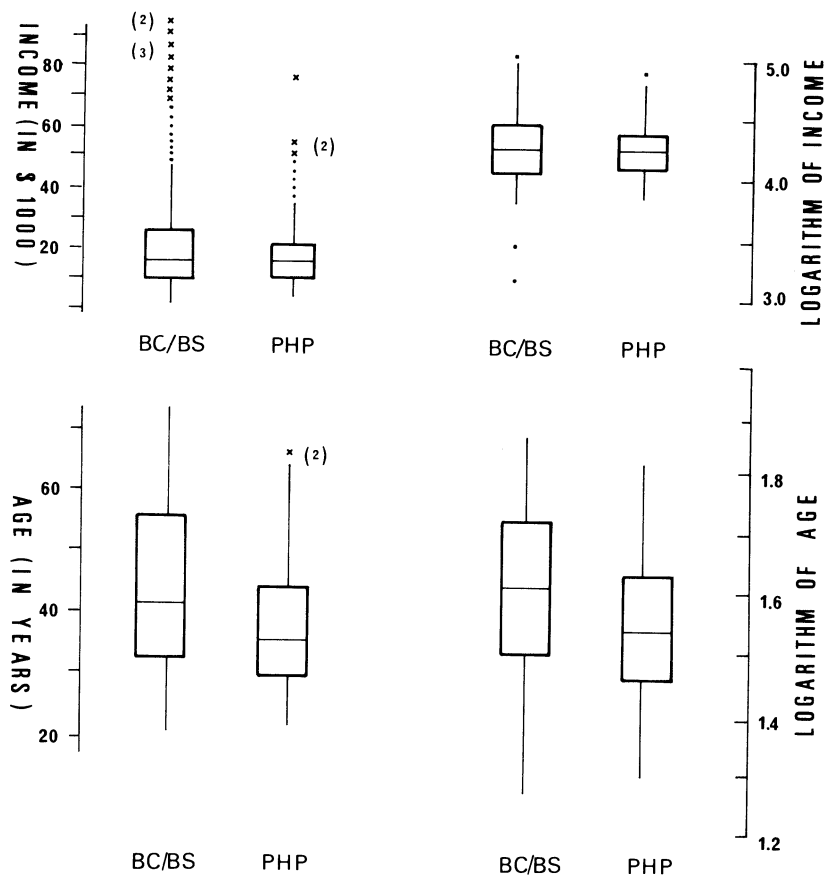


FIGURE 4. BOXPLOTS OF INCOME AND AGE (AND LOGARITHMS)

TABLE 1—COMPARISONS OF CONVENTIONAL INSURANCE (CI) PLANS
AND HEALTH MAINTENANCE ORGANIZATION (HMO) PLANS

Variable	Type	Number in Group	Mean	Median	Standard Deviation	Ratio of Standard Deviations ^a	Inter- quartile Range	Ratio of Interquartile Ranges ^b	Coefficient of Variation
Income	CI	3279	20,874	17,400	12,628				
(in Dollars)	HMO	491	19,141	17,400	9,134	1.38 ^c	15,144	1.34	.366
Log of	CI	3279	4.25	4.24	.233				
Income	HMO	491	4.24	4.24	.190	1.23	.288	1.24	.003
Age	CI	3279	41.5	40	12.5				
(in years)	HMO	491	37.1	35	10.4	1.2	21	1.15	.091
Log of Age	CI	3279	1.60	1.60	.133				
	HMO	491	1.55	1.54	.115	1.16	.171	1.3	.007
Education	CI	2754	4.87	5	2.47				
(in ranks)	HMO	398	5.47	5	2.35	1.04 ^c	6	1.5	.244
							4		.221

^aSignificance of Ratio $\neq 1$ judged through *F*-test for equality of variances done under the assumption of normal populations.

^bSignificance of Ratio $\neq 1$ judged using the variances of the asymptotic distributions of the Interquartile Ranges (see David). For education binominal confidence limits were used.

^cInappropriate to judge significance because assumptions are clearly not met.

trophy for education is 1.97 (.01) for the *CI* group, and 1.71 (.04) for the HMO group (with asymptotic standard errors in parentheses).

The statistical significance of the above results is judged by various methods. Variances of the normal asymptotic distributions of the interquartile ranges (H. A. David, 1970) and of the entropy measures (Theil) are estimated. These variances are used to test whether the differences in these heterogeneity measures between the two groups are significant. For the variance measures, the *F*-test (based on the assumption that the distribution of the variables are normal) is used. For the analysis of education expressed in ranks, where the asymptotic distribution of the interquartile range is nonnormal, confidence bounds are computed for the interquartile ranges of each group, and the two were checked for overlap. The conclusions of these tests were the same. The differences described previously were all significant at least at the .0001 level.

We therefore conclude that for the two groups at hand, all the comparisons of the measures of homogeneity of income, age, and education, show that the *CI* group is more heterogeneous than the HMO group.

V. Concluding Remarks

The theoretical framework presented in this work suggests that an HMO plan is a more efficient way of providing medical insurance for a relatively homogeneous group. Different groups may have different plans that best fit their members. People who do not find an HMO plan close enough to their ideal (or live far from the HMO medical center) would be better off using the *CI* plan. In the set of data under research it has been shown that where employees can choose among several plans they cluster in relatively homogeneous groups in a specific HMO plan. This finding can be explained by the theory above that the members perceive the importance of homogeneity in HMO plans. A competing explanation argues that newcomers to the university are more likely to choose the less conservative HMO scheme, forming a

group that is more homogeneous. The full explanation is probably a combination of those two (and possibly others), but in view of the additional work on this data (see our 1984 paper), we value the latter as less important.⁸

Using this theory to characterize the desired market for medical insurance, it is apparent that a uniform HMO plan of insurance cannot be optimal, as it is impossible for one plan to approximate the choice of most of the people when the group is as big as diversified as the whole nation. It implies that any governmental system that imposes a unique HMO-like structure on the entire society (such as the British National Health Services) is inefficient. Thus, the optimal system would consist of various HMO plans, coexisting with fee-for-service providers whose patients are covered by conventional policies. We recommend that, wherever spatially feasible, people should be encouraged to make an intelligent choice between as many available plans as feasible to enable more people to take advantage of their preferred HMO plan.

⁸In our earlier paper, we used a logit model to explain the choice of the plan. Using that model, a decrease of five years in the age (the difference of the two groups) is estimated to increase the probability of choosing an HMO plan by .007. Though the change was found to be significantly different than zero, it is too small to entirely explain the empirical findings.

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