Second, Mishan's use of taxes and subsidies as *incentives* to internalize externality is not clear. In section II, he employs variable taxes or subsidies to transform the opportunity locus of X and Y onto the appropriate marginal evaluation curve. However, this will not, contrary to Mishan's expectation, induce either to select the intersection of the curves over other (equally desirable) points along the appropriate marginal evaluation curve. Since neither is being made better off, neither has an incentive to maximize. The intersection could be induced through lump sum transfers combined with a per-unit tax (or subsidy) on X.

Finally, Mishan considers whether it will be simple to regulate externality with a tax system. I agree that it is a practical matter. He suggests the problem is likely to be small because the welfare effects of the internalizing technique will be small. However, in some real world cases that come to mind (e.g., Pauly's example of water pollution), compensation at marginal damage rates leads to considerable deviation from exact compensation.

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The Economics of Moral Hazard: Comment

When uncertainty is present in economic activity, insurance is commonly found. Indeed, Kenneth Arrow [1] has identified a kind of market failure with the absence of markets to provide insurance against some uncertain events. Arrow stated that "the welfare case for insurance of all sorts is overwhelming. It follows that the government should undertake insurance where the market, for whatever reason, has failed to emerge" [1, pp. 945, 961]. This paper will show, however, that even if all individuals are risk-averters, insurance against some types of uncertain events may be nonoptimal. Hence, the fact that certain kinds of insurance have failed to emerge in the private market may be no indication of nonoptimality, and compulsory government insurance against some uncertain events may lead to inefficiency. It will also be shown that the problem of "moral hazard" in insurance has, in fact, little to do with morality, but can be analyzed with orthodox economic tools.

The particular type of insurance for which the argument will be presented is that of insurance against medical care expenses, for it was in a discussion of medical expense insurance that Arrow framed the propositions cited above. However, the analysis is applicable as well to other types of insurance, such as automobile collision insurance.

I. *The Welfare Implications of Insurance*

It is assumed that all individuals are expected utility maximizers and are risk-averters, and that the incidence of illness is a random event. This excludes preventive medicine from consideration, and it also ignores the effect that medical insurance might have on the purchase of preventive care. Bernoulli's theorem, as cited by Arrow [1, pp. 959-61], states that such individ-

uals will prefer insurance with a premium m which indemnifies against all costs of medical care to facing without insurance a probability distribution of such expenditures with mean m.

There is a social gain obtained by purchase of this insurance (as long as the insurer suffers no social loss) since pooling of risks reduces the total risk, and therefore the risk per insured, because of the Law of Large Numbers. Of course, the existence of transactions costs means that the policy is not really offered at the actuarially fair premium m. However, since the individual preferred actuarially fair insurance to self-insurance, he will prefer some insurance with an actuarially unfair premium to self-insurance, so long as the premium is not too "unfair." His preference in this regard will depend on the intensity of his risk aversion and the strength of the Law of Large Numbers in reducing risk.

As indicated above, Arrow concluded from this analysis that the absence of commercial insurance against some uncertain medical-care expenses provides a case for government intervention to provide such insurance. Dennis Lees and R. D. Rice [6] answered that this insurance was not offered because of selling and transactions costs. Arrow [2] replied, in effect, that such costs were dead-weight losses anyway, and indeed would be eliminated by compulsory social insurance. It seems clear, however, that there is another and better way to explain why some insurances are not offered commercially. It is to show that some, perhaps many, medical care expenses are not "insurable" in the standard sense.

In order for the welfare proposition given above to be valid, the costs of medical care must be random variables. But if such expenses are not completely random, the proposition no longer holds. The quantity of medical care an individual will demand depends on his income and tastes, how ill he is, and the price charged for it. The effect of an insurance which indemnifies against all medical care expenses is to reduce the price charged to the individual at the point of service from the market price to zero. Even if the incidence of illness is a random event, whether the presence of insurance will alter the randomness of medical *expenses* depends on the elasticity of demand for medical care. Only if this demand is perfectly inelastic with respect to price in the range from the market price to zero is an expense "insurable" in the strict sense envisioned by Arrow's welfare proposition.

Suppose, for example, that an individual faces the probability $p_1 = \frac{1}{2}$ that he will not be sick at all during a given time period (event I_1) and so will demand no medical care, probability $p_2 = \frac{1}{4}$ that he will contract sickness I_2, and probability $p_3 = \frac{1}{4}$ that he will contract "more serious" sickness I_3. The position of his demand curve for medical care depends on which illness, if any, he contracts. In Figure 1, it is assumed that his demand curves D_2 and D_3 are perfectly inelastic, and that his demand curve for the "no illness" case is identical with the y-axis. Without insurance, the individual faces the probability p_1 that he will incur no medical expenses, the probability p_2 that he will need 50 units of medical care (which is assumed to be priced at marginal cost), and the probability p_3 that he will need 200 units of medical care at a cost of 200 MC. The mean of this probability distribution (or the expected values of the

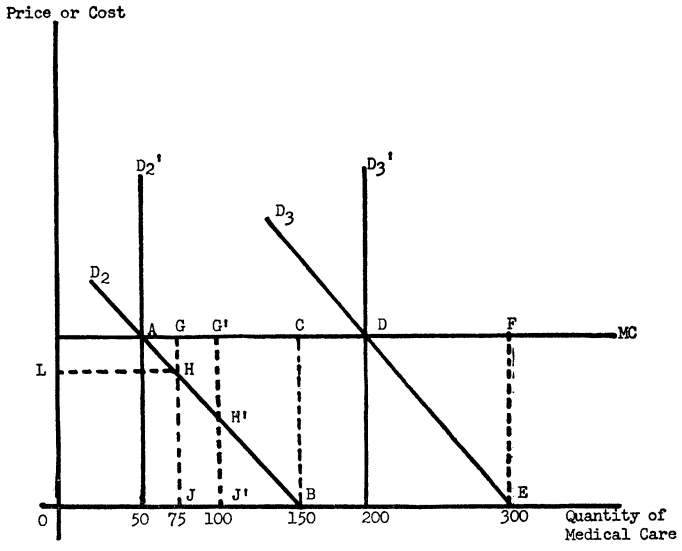

FIGURE 1

individual's medical care expenses) equals ($\frac{1}{2} \times 0 + \frac{1}{4} \times 50\ MC + \frac{1}{4} \times 200\ MC$) or 62.5 MC. Hence, an actuarially fair insurance which indemnifies the individual against all costs of medical care could be offered at a premium P of 62.5 MC. Arrow's welfare proposition indicates that the individual would prefer paying a premium of 62.5 MC to risking the probability distribution with the mean $m = 62.5\ MC$.

Suppose, however, that the individual's demand curves are not all perfectly inelastic, but are as D_2' and D_3'. Then the individual has to choose between facing, without insurance, the probability distribution ($\frac{1}{2} \times 0 + \frac{1}{4} \times 50\ MC + \frac{1}{4} \times 200\ MC$) with a mean m of 62.5 MC, and paying a premium of $P = (\frac{1}{2} \times 0 + \frac{1}{4} \times 150\ MC + \frac{1}{4} \times 300\ MC) = 112.5\ MC$ in order to obtain insurance. In such a case, he may well prefer the risk to the insurance.

The presence of elasticity in the demand curves implies therefore that the individual will alter his desired expenditures for medical care because of the fact of insurance. The individual who has insurance which covers all costs demands medical care as though it had a *zero* price, but when he purchases insurance, he must take account of the *positive* cost of that care, as "translated" to him through the actuarially necessary premium. Hence, he may well not wish to purchase such insurance at the premium his behavior as a purchaser of insurance and as a demander of medical care under insurance makes necessary.[1]

[1] This is exactly the same sort of "inconsistency" that Buchanan has noted in connection with the British National Health Service. Individuals demand medical care as though it were free but in voting decisions consider the positive cost of such care. Hence, they vote, through their representatives in the political process, to provide facilities for less medical care than they demand in the market. See [4].

The presence of a "prisoners' dilemma" motivation makes this inconsistency inevitable.[2] Each individual may well recognize that "excess" use of medical care makes the premium he must pay rise. No individual will be motivated to restrain his own use, however, since the incremental benefit to him for excess use is great, while the additional cost of his use is largely spread over other insurance holders, and so he bears only a tiny fraction of the cost of his use. It would be better for all insurance beneficiaries to restrain their use, but such a result is not forthcoming because the strategy of "restrain use" is dominated by that of "use excess care."

If the demand for medical care is of greater than zero elasticity, the existence of this "inconsistency" implies that inefficiency may well be created if individuals are forced, by taxation, to "purchase" insurance which indemnifies against some kinds of medical care expense. For an efficient solution, at least some price-rationing at the point of service may be necessary.

Suppose there are no significant income effects on the individual's demand for medical care resulting from his payment of a lump-sum premium for insurance. In Figure 1, the inefficiency loss due to behavior under insurance, if that insurance were compulsory, would then be roughly measured by triangles *ABC* and *DEF*. These areas represent the excess that individuals do pay over what they would be willing to pay for the quantity of medical care demanded under insurance. Against this loss must be offset the utility gain from having these uncertain expenses insured, but the net change in utility from a compulsory purchase of this "insurance" could well be negative.

Moreover, if individual demands for medical care differ, it is possible that the loss due to "excess" use under insurance may exceed the welfare gain from insurance for one individual but fall short of it for another individual. It follows that it may not be optimal policy to provide compulsory insurance against particular events for all individuals. Some events may be "insurable" for some persons but not for others. It also follows that some events, though uncertain, may not be insurable for anyone. If persons differ (a) in the strength of their risk aversion or (b) in the extent to which insurances of various types alter the quantity of medical care they demand, an optimal state will be one in which various types of policies are purchased by various groups of people. There may be some persons who will purchase no insurance against some uncertain events.

Insurance is more likely to be provided against those events (a) for which the quantity demanded at a zero price does not greatly exceed that demanded at a positive price, (b) for which the extent of randomness is greater, so that risk-spreading reduces the risk significantly, and (c) against which individuals have a greater risk-aversion. There is uncertainty attached to "catastrophic" illness, but it appears that the elasticity of demand for treatment against such illness is not very great (in the sense that there is one and only one appropriate treatment). Furthermore, the "randomness" attached to such illnesses is relatively great, in the sense that they are unpredictable for any individual, and people's aversion to such risk is relatively great. Hence, one would expect to

[2] For a discussion of the prisoners' dilemma problem, see [7].

find, and does find, insurance offered against such events. Similar statement might be made with respect to ordinary hospitalization insurance.

There is also some uncertainty attached to visits to a physician's office, but the extent of randomness and risk-aversion is probably relatively low for most persons. The increase in use in response to a zero price would be relatively great. One would not expect to find, and does not in general find, "insurance" against such events. Similar analysis applies to insurance against the cost of dental care, eyeglasses, or drugs.

II. *Moral Hazard*

It has been recognized in the insurance literature that medical insurance, by lowering the marginal cost of care to the individual, may increase usage; this characteristic has been termed "moral hazard." Moral hazard is defined as "the intangible loss-producing propensities of the individual assured" [4, p. 463] or as that which "comprehends all of the nonphysical hazards of risk" [5, p. 42]. Insurance writers have tended very strongly to look upon this phenomenon (of demanding more at a zero price than at a positive one) as a moral or ethical problem, using emotive words such as "malingering" and "hypochondria," lumping it together with outright fraud in the collection of benefits, and providing value-tinged definitions as "moral hazard reflects the hazard that arises from the failure of individuals who are or have been affected by insurance to uphold the accepted moral qualities" [5, p. 327], or "moral hazard is every deviation from correct human behavior that may pose a problem for an insurer" [3, p. 22]. It is surprising that very little economic analysis seems to have been applied here.[3]

The above analysis shows, however, that the response of seeking more medical care with insurance than in its absence is a result not of moral perfidy, but of rational economic behavior. Since the cost of the individual's excess usage is spread over all other purchasers of that insurance, the individual is not prompted to restrain his usage of care.

III. *Deductibles and Coinsurance*

The only type of insurance so far considered has been an insurance which provides full coverage of the cost of medical care. However, various devices are written into insurance, in part to reduce the moral hazard, of which the most important are deductibles and coinsurance.[4] The individual may well

[3] In his original article, Arrow mentions moral hazard as a "practical limitation" on the use of insurance which does not "alter the case for creation of a much wider class of insurance policies than now exist." [1, p. 961]. However, Arrow appears to consider moral hazard as an imperfection, a defect in physician control, rather than as a simple response to price reduction. He does not consider the direct relationship which exists between the existence of moral hazard and the validity of the welfare proposition. More importantly, in the controversy that followed [2] [6], moral hazard seems to have been completely overlooked as an explanation of why certain types of expenses are not insured commercially.

[4] A deductible is the exclusion of a certain amount of expense from coverage; coinsurance requires the individual to pay some fraction of each dollar of cost.

prefer no insurance to full coverage of all expenses, but may at the same time prefer an insurance with these devices to no insurance.[5]

A. *Deductibles*

Suppose the insurance contains a deductible. The individual will compare the position he would attain if he covered the deductible and received additional care free with the position he would attain if he paid the market price for all the medical care he consumed but did not cover the deductible. If income effects are absent in Figure 1, the individual will cover a deductible and consume 150 units of medical care when event I_2 occurs as long as the "excess" amount he pays as a deductible (e.g., area AGH for a deductible of 75 MC) is less than the consumer's surplus he gets from the "free" units of care this coverage allows him to consume (e.g., area HJB). If the deductible exceeds 100 MC (at which point area $AG'H'$ equals area $H'J'B$), the individual will not cover the deductible and will purchase 50 units. Hence, the deductible either (a) has no effect on an individual's usage or (b) induces him to consume that amount of care he would have purchased if he had no insurance. If there are income effects on individual demands, because the deductible makes the individual poorer his usage will be restrained somewhat even if he covers the deductible.

B. *Coinsurance*

Coinsurance is a scheme in which the individual is, in effect, charged a positive price for medical care, but a price less than the market price. The higher the fraction paid by the individual, the more his usage will be curtailed. In Figure 1, if he had to pay OL of each unit's cost, he would reduce his usage if event I_5 occurred from 150 units to 75 units. The smaller the price elasticity of demand for medical care, the less will be the effect of coinsurance on usage.

It is possible for the restraining effect of coinsurance to reduce moral hazard enough to make insurance attractive to an individual who would have preferred no insurance to full-coverage insurance. Indeed, there is an optimal extent of coinsurance for each individual. The optimal extent of coinsurance is the coverage of that percentage of the cost of each unit of medical care at which the utility gain to the individual from having an additional small fraction of the cost of each unit of care covered by insurance equals the utility loss to him upon having to pay for the "excess" units of care whose consumption the additional coverage encourages. If the marginal gain from the coverage of additional fractions of cost always exceeds the marginal inefficiency loss, he will purchase full coverage insurance; if the marginal loss exceeds the marginal gain for all extents of coinsurance, the individual will purchase no insurance. If individual demands differ, the optimal extent of coinsurance will differ for different individuals.

[5] Arrow [1, pp. 969-73] gives some other arguments to explain why the individual will prefer insurance with deductibles or coinsurance to insurance without such devices.

IV. *Conclusion*

It is possible to conclude that even if all individuals are risk-averters, some uncertain medical care expenses will not and should not be insured in an optimal situation. No single insurance policy is "best" or "most efficient" for a whole population of diverse tastes. Which expenses are insurable is not an objective fact, but depends on the tastes and behavior of the persons involved.

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The Economics of Moral Hazard: Further Comment

Mr. Pauly's paper [3] has enriched our understanding of the phenomenon of so called "moral hazard" and has convincingly shown that the optimality of complete insurance is no longer valid when the method of insurance influences the demand for the services provided by the insurance policy. This point is worth making strongly. In the theory of optimal allocation of resources under risk bearing it can be shown that competitive insurance markets will yield optimal allocation when the events insured are not controllable by individual behavior. If the amount of insurance payment is in any way dependent on a decision of the insured as well as on a state of nature, then the effect is very much the same as that of any excise tax and optimality will not be achieved either by the competitive system or by an attempt by the government to simulate a perfectly competitive system. For some earlier, less detailed, discussions of this point see [1, pp. 55-56], [2, pp. 961-62].

In this note, I would like to stress a point which Mr. Pauly overlooks in his exclusive emphasis on market incentives. Mr. Pauly has a very interesting sentence: "The above analysis shows, however, that the response of seeking more medical care with insurance than in its absence is a result not of moral per-