FURTHER REMARKS
ON
ADVERSE SELECTION AND STATISTICAL DISCRIMINATION*

by

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Discussion Paper Number 255
July 1982

*This paper was originally presented to the Cambridge Quakers in March 1982. Support by the National Science Foundation and the U.K. Social Science Research Council is gratefully acknowledge.

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While much has been written about adverse selection since the enunciation of the "Lemons Principle" by Akerlof [1970], this literature has been largely theoretical in nature. Thus the recent paper by Dahlby [1982], which provides evidence supporting the hypothesis that adverse selection plays an important role in insurance markets, is welcome. Unfortunately the evidence presented sheds little light on the relevance of three competing models of equilibrium in markets with informational asymmetry. Dahlby suggests that his analysis supports the equilibrium concept developed by Miyazaki [1979]. However I shall argue below that all the evidence is consistent with the alternative equilibria proposed by Wilson [1977] and Riley [1979 a,b].

A central feature of the equilibrium proposed by Miyazaki is that insurance companies offer some loss making policies (to high risk individuals) and break even overall by offering only profit making policies to low risk individuals. Both Wilson and Riley reject systematic cross-subsidization because of the difficulty each insurance company has in monitoring the extent of cross-subsidization by other insurance companies. Clearly each company has an incentive to discourage its agents from promoting loss making policies or, better still, to drop the policies entirely.

To illustrate the role of adverse selection when each insurance policy offered at least breaks even, consider the following simple model. An insurance contract is a pair $\langle x, y \rangle$ where x is that part of the loss not covered by the contract (the "deductible") and y is the premium, paid whether or not the loss occurs. An individual in the i th risk class faces a variety of possible loss levels L(s) with associated probabilities $\pi_i(s)$. Given an initial wealth of w and Neumann-Morgenstern preference scaling function $V(\cdot)$ his expected utility, if he accepts the contract $\langle x, y \rangle$ is

$$(1) \quad u_i(x,y) = \sum_s \pi_i(s)V(w-x-y) + \left[1 - \sum_s \pi_i(s)\right]V(w-y) \ .$$

Risks are assumed to be uncorrelated and hence, appealing to the law of large numbers, insurance companies are assumed to be risk neutral. For simplicity we ignore any costs of insurance provision which are independent of whether or not a claim is made.[1] However we assume that there is a non-negligible cost K of processing and verifying any claim. Then an insurance policy $\langle x, y \rangle$ breaks even if

$$(2) \quad \sum_s \pi_i(s)\left[L(s)+K-x\right] = y \ .$$

To simplify matters further we assume that, while individuals differ in their overall probability of loss, the fraction of claims of each type is the same. Then we may write

$$(3) \quad \pi_i(s) = \pi_i p(s), \text{ where } \sum_s p(s) = 1 \ .$$

Making use of this assumption we shall henceforth characterise each risk class according to its overall loss probability π. Combining (1) and (3), each member of risk class π_i has an indirect expected utility function

$$(1') \quad u_i(x,y) = \pi_i V(w-x-y) + (1-\pi_i)V(w-y) \ .$$

Furthermore, for an insurance company to break even on this risk class we require, using (2) and (3),

$$(2') \quad \pi_i(\bar{L}+K-x) = y$$

where $\overline{L}$ is defined to be the average loss, that is

$$(4)\quad \overline{L} = \sum_s \pi_i(s)L(s) \;/\; \sum_s \pi_i(s) = \sum_s p(s)L(s) \ .$$

Since individuals prefer lower premiums and lower deductibles, a separating equilibrium is then a schedule of premiums and deductibles,

$$(5)\quad y = \phi(x) \ ,$$

such that, for each risk class π_i, the expected utility maximising insurance contract, $<x_i, y_i> = <x_i, \phi(x_i)>$, satisfies the break even condition (2').

This is illustrated in Fig. 1. The y axis has been inverted so that the description of the equilibrium parallels as closely as possible the original discussion of labour market signalling by Spence [1973]. The dotted lines represents the break even conditions for the highest risk class π_h and another lower risk class π_c. Several indifference curves are also depicted. Note that the dashed indifference curve of the highest risk group is drawn more steeply. This reflects the fact that the higher the probability of loss, the bigger is the premium reduction necessary to induce an individual to accept a larger deductible. To confirm that this must be the case we note that along an indifference curve

$$du = (\partial u/\partial x).dx + (\partial u/\partial y)dy = 0$$

Then, from (1') the marginal willingness of risk class π to accept a higher deductible in return for a lower premium is

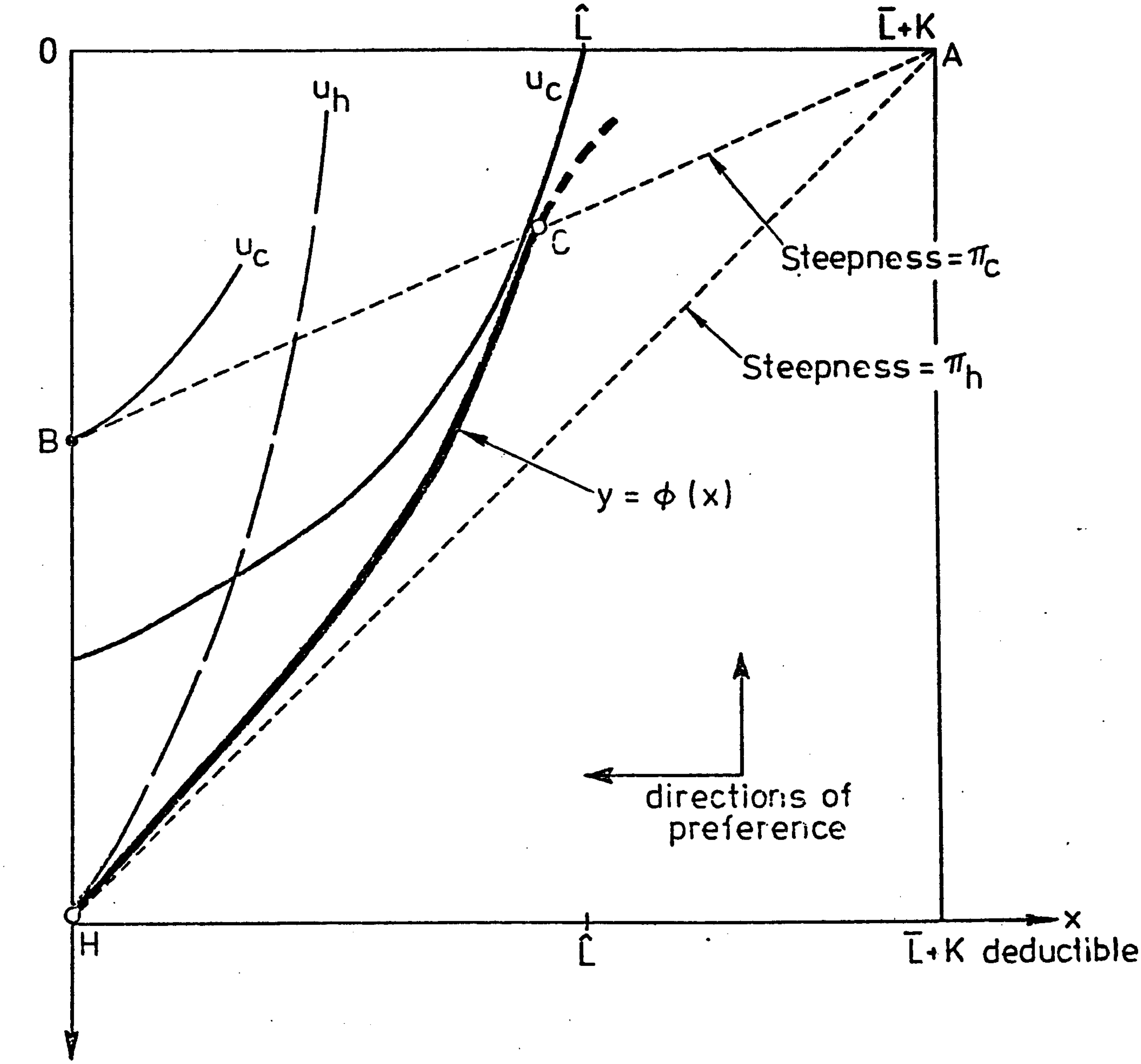

Fig. 1. A separating equilibrium

$$-\frac{dy}{dx}\bigg|_{du=0} = \frac{\partial u/\partial x}{\partial u/\partial y} = \frac{\pi V'(w-x-y) + (1-\pi)V'(w-y)}{\pi V'(w-x-y)} .$$

Since the right hand side is strictly decreasing in π, the overall loss probability, it follows that the lower risk classes do require a smaller incentive to accept a larger deductible.

In Spence's original analysis there was no constraint on the amount of signalling by the highest risk class. However this early work did not take into account the incentive for firms to offer new insurance policies or the possibility of a deterrent effect via profitable reactions by other firms to insurance policy offerings. In the "reactive equilibrium" (Riley [1979 a,b]) only those with an incentive to signal do so. Then the highest risk class does no signalling. This is illustrated in Fig. 1. Members of risk class π_h observe the schedule $y = \phi(x)$ and pick the point H (no deductible).

Risk class π_c would also choose full coverage (the point B in the figure) if insurers could identify them and offer contracts along the dotted breakeven line AB, that is, along

$$\pi_c(\overline{L}+K-x) = y$$

However, in the absence of any direct means of identification, their best alternative is the contract $<x_c, y_c>$ (the point C in the figure). Note that for both risk classes the break even condition, (2'), is satisfied.

Since risk classes with loss probabilities between π_c and π_h have indifference curves of intermediate steepness they choose points on the schedule $y = \phi(x)$ between C and H. Furthermore the best insurance contract for those with loss probabilities less than π_c lies on $y = \phi(x)$

to the right of C.

However, as depicted, the indifference curve for risk class π_c through C, the best available contract for this risk class also passes through the point $<\hat{L},0>$ that is

$$u_c(x_c,y_c) = \pi_c V(W-\hat{L}) + (1-\pi_c)V(w) \ .$$

Then suppose that $\hat{L}$ is the certainty equivalent loss for an uninsured individual, that is

$$\sum_s \pi_c(s)V(W-L(s)) = \pi_c \sum_s p(s)V(W-L(s)) = \pi_c V(W-\hat{L}) \ .$$

This being the case, risk class π_c is just indifferent between accepting the best available insurance policy and dropping out of the market. Moreover, all those with loss probabilities lower than π_c will be strictly better off choosing not to purchase insurance.

To summarize, signalling by accepting higher deductibles only partially offsets the problem of adverse selection. In general those with loss probabilities which are sufficiently small relative to the highest loss probability will remain out of the market for insurance.[2]

From this crucial observation we can easily contrast the reactive equilibrium for each of two observably different sub-populations, say, males and females. Suppose that the two sub-populations differ only in the way that the overall loss probability, π, is distributed. First suppose that lowest loss probability π_ℓ is the same for the two sub-populations but the highest is larger for males than for females. This is depicted in Fig. 2a. The corresponding equilibrium schedules of insurance policies are depicted in Fig. 2b. With $\pi_h^f < \pi_h^m$ it is a straightforward matter to confirm that the critical loss probability

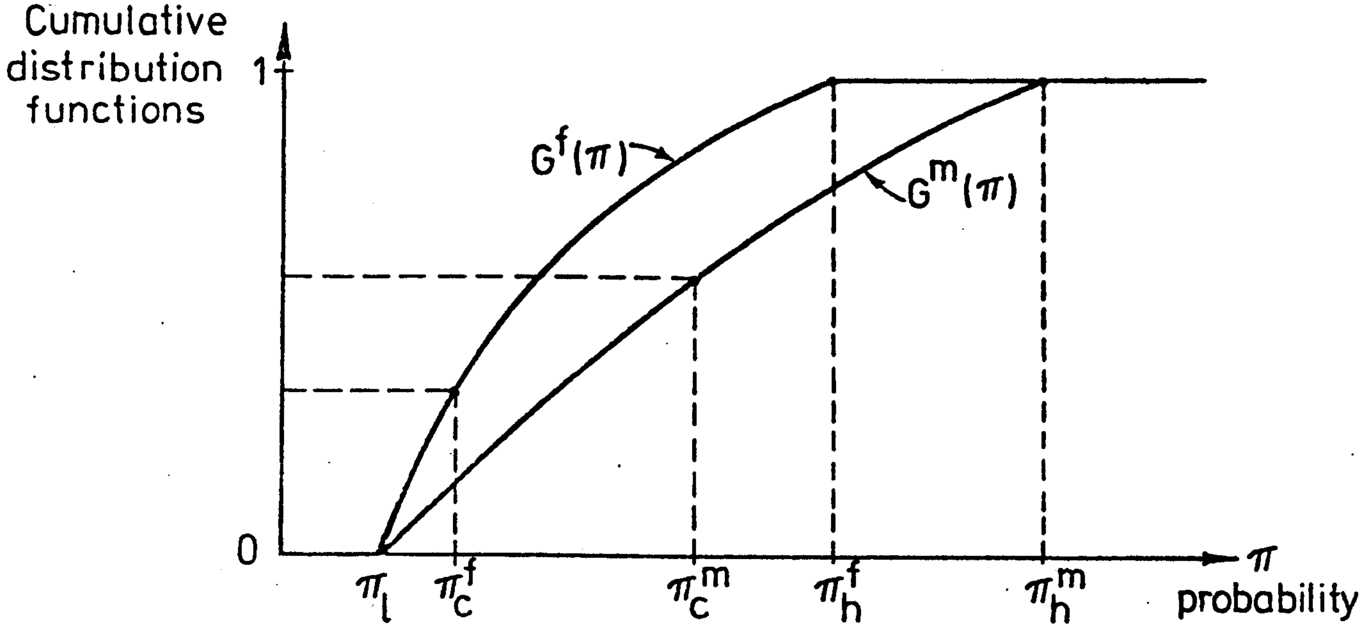

Fig. 2a. Distributions of Loss Probability for Males and Females

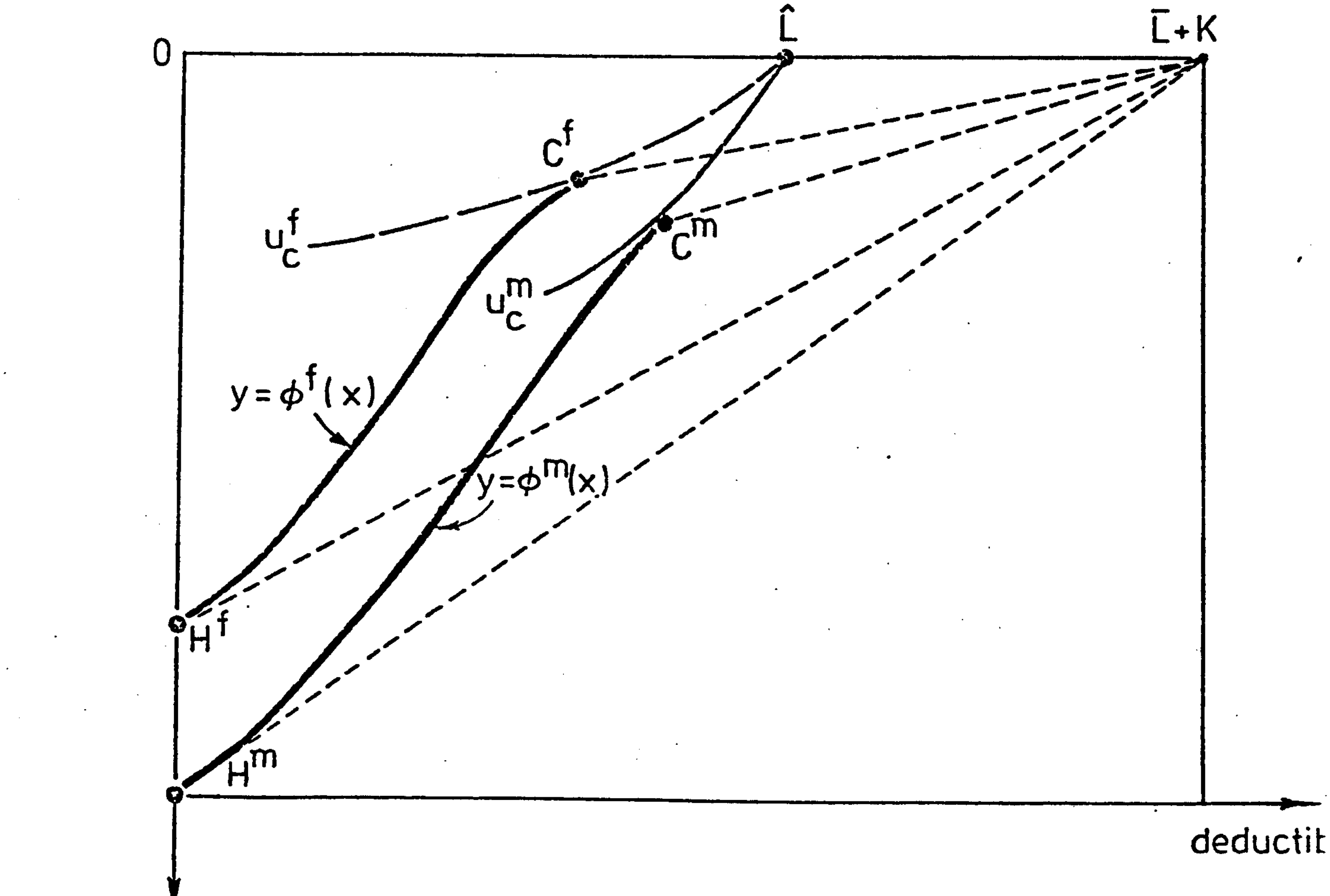

Fig. 2b Equilibria for the two sub-populations.

for females, π_c^f, is less than that for males. Then, given the distributions of π for males and females depicted in Fig. 2a, not only are the premiums for women lower, but the proportion of women purchasing insurance is higher. This is precisely what Dahlby finds in his Table 1.

From Fig. 2b one can easily see the effect of a regulation prohibiting statistical discrimination. With the two sub-populations pooled the highest risk class has loss probability π_h^m. Then the reactive equilibrium schedule is $y = \phi^m(x)$, the schedule for the male sub-population. It follows immediately that all those females with loss probabilities between π_c^f and π_c^m are better off without insurance. The regulation thus increases the adverse selection problem <u>without</u> any offsetting benefit to the male sub-population.

It is important to recognize that this last conclusion is strongly dependent upon the way we have modelled differences between males and females. An alternative formulation might have the same maximum loss probabilities for males and females but a lower average size of loss for females, that is

$$\bar{L}^f < \bar{L}^m$$

Once again premiums would be lower for females than males, at any given level of the deductible. However now prohibition of statistical discrimination does result in a pooling of the smaller losses by females with the larger losses by males. The prohibition therefore raises premiums for females and lowers premiums for males. As a result all males purchasing insurance are better off and there is some entry by males into the insurance market. All females purchasing insurance are worse off and there is some exit by females from the insurance market.

To summarise I have attempted to show that the phenomena examined by Dahlby are entirely consistent with a model of equilibrium in insurance markets which does not exhibit any cross-subsidization of high risk classes by low risk classes. Hopefully this clarification will encourage empiricists to seek the more detailed insurance data that will help resolve the issue of whether systematic cross-subsidisation is in fact common in unregulated insurance markets.

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Footnotes

1. Including such costs simply reinforces the arguments below.

2. This conclusion is based on the assumption, implicit in Figure 1, that $\hat{L}$ is less than $\bar{L} + K$. Since the certainty equivalent loss, $\hat{L}$, exceeds the expected size of the loss $\bar{L}$, the introduction of insurance provision costs is critical.