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# Discrimination and Risk-Rated Insurance

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by

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Preliminary comments invited

## I. Introduction

The problems associated with the provision of insurance to a population which is composed of different risk types have recently received an increasing amount of attention from economists, lawyers, actuaries and other interested groups. Adverse selection is perhaps the most important consequence which may arise when insurance is provided to a population composed of varying risk types.[1] This problem occurs when the class of risks (or set of risk classes) who purchase insurance differs "adversely" from that expected by the firm.

For example, suppose consumers are identical except for the probability they have of sustaining some loss against which firms offer insurance. Suppose further that firms are unable to distinguish between risk types but consumers know their own probability of loss (i.e., asymmetric information persists). If a firm offers a contract at an actuarially fair price to low risk types then high risk types will also purchase it with the result that firms will earn negative expected profits. Hence the problem of adverse selection restricts the ability of firms to offer "efficient" contracts to low risk types.

One way in which firms may react to the problem of adverse selection is by using imperfect information to form different risk categories which are assigned various premium levels. That is, although firms cannot determine precisely the risk class to which each individual belongs, they may be able to observe characteristics which are correlated, albeit imperfectly, with risk classes. In other words, they are able to categorize risks imperfectly. The economic implications of this behavior have been analyzed in Dahlby [1980] and Hoy [1981 a,b].

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The use of personal characteristics in differentiating among risk classes recently has been the source of a great deal of controversy. This controversy has in most cases concentrated on the discriminatory effects of categorizing risks. The purpose of the first part of this paper is to present some of the welfare implications of categorization and to compare these results with the effects that categorization has with respect to price discrimination among consumers. This task is initiated in Section Two with an examination of the definition of price discrimination as it is applied to insurance and also a brief discussion of the recent controversy. In Section Three some economic models which allow the analysis of the implications of providing insurance to populations composed of different risk types are presented. These models are used in Section Four to determine the economic implications of imperfectly categorizing risks as well as the effects with respect to price discrimination.

The principal contribution of the first part of this paper is the comparison between the welfare implications and the discriminatory aspects of categorization. Some of the results of this comparison are:

    i)   from a situation of no price discrimination, categorization may lead to a situation with price discrimination;

   ii)   Although there is a class of situations in which categorization generally reduces the "average" level of unfavorable price discrimination experienced by low risk types, some low risk types will experience an increase in the extent of price discrimination as a result of categorization.

iii) It is possible that even low risk types will prefer, ex ante

to knowing the category to which they will be assigned, that

the process of categorization be suppressed.

These results cast doubt on the relevance of price discrimination as

a standard in determining the desirability of allowing (or encouraging)

firms to categorize risks. Furthermore, it is argued that a welfare analysis

provides a more comprehensive criterion by which to judge the merits of

allowing or prohibiting firms to imperfectly categorize risks.

The welfare implications of categorization which are summarized in

Part I of this paper suggest that in some cases categorization should be en-

couraged and in others prohibited. However, it is not guaranteed in any

case that firms will implement the preferred action. If information is

costless then firms will implement a corresponding scheme even if it is not

desirable and, contrariwise, will (probably) not expend resources to attain

information about categorization schemes which are desirable. Therefore,

government intervention may be desirable.

There are several problems which are likely to arise if the government

attempts to control the extent of categorization. This is especially the case

if the government attempts to suppress this activity. These difficulties

represent (in most part) the topics of Part II of this paper. Some of these

problems are associated with conflicts among regulations which are designed

to satisfy various objectives of the government concerning various aspects

of the insurance industry (e.g., income inequality and solvency of the firms).

A few of these possible conflicts are discussed in Section Five. In Section

Six some of the more direct problems associated with attempts to suppress

specific types of categorization schemes are considered (e.g., the possibility

that firms will try to thwart the efforts of government intervention).

There are several important economic aspects of categorization which are not considered in this paper because of the simplicity of the economic models which are used. The effects of relaxing some of the assumptions made in this paper are considered tentatively in Section Seven. Special emphasis is placed on the impact that these changes have on policies concerning categorization. The results of the paper are summarized in the final section.

It should be noted that although the discussion in Section Seven suggests that the economic models used in this paper are too simplistic to derive comprehensive results by which to judge the merits of specific categorization schemes, they are nevertheless appropriate for the purpose of criticizing the use of price discrimination as a general criterion by which to assess the desirability of categorizing risks in the insurance industry. In fact, the models used in this paper are likely to be more supportive than more realistic and complex ones to the proponents of the criterion of price discrimination. For example, one problem which is generally associated with trying to determine the discriminatory effects of various pricing schemes is the choice between marginal and average cost. In these models marginal and average costs are identical and so this issue is avoided. Since it is argued in the first part of this paper that the analysis of the effects of categorization on price discrimination is not a useful criterion by which to judge the merits of categorization even for these models, at least this part of the paper represents a concrete contribution to the issue of allowing firms to use risk classes when determining price schedules for insurance. Although it may be argued that the choice of criterion (i.e., price discrimination or welfare analysis) is a problem of choosing between different

value judgements, this is only partly true. The inputs to the arguments concerning this choice are at least in part "real world considerations" (i.e., positivistic). For example, if information is perfect, then the use of price discrimination as a criterion at least becomes unambiguous (see Section Four) even if not any more ethically desirable. In this sense, therefore, the discussion in Part I of this paper is one concerning nonbasic value judgements.[3]

In Part II of this paper it is argued that the models discussed in Part I are not sufficiently complex to incorporate all of the important economic aspects relevant to the issue of categorization. The purpose of Part II, therefore, is to point out some of the more important problems associated with attempts to regulate categorization in insurance markets. Some directions for future research which would provide important results for use in deriving appropriate regulatory measures are suggested in Part II.


PART I

II. The Present Controversy Concerning
Categorization and Discrimination

The issue of whether or not insurers should try to differentiate among individuals who belong to different risk classes has been the source of much controversy in recent years. What is usually at issue is the use of such characteristics as sex, race, and age which firms often employ in an attempt to differentiate among the various risk classes of their customers. Even if statistical evidence strongly supports the hypothesis that one group of individuals (e.g., males) faces a distribution of losses with a higher expected value than some other group (e.g., females), it is often argued whether or not characteristics such as sex should be used as the basis

for determining premium structures in which different groups are charged different premium levels. These arguments which appear in newspapers, the insurance literature, and even in the courts, are usually concerned with the impact that this activity has on the extent of "unfair price discrimination".

An example of the arguments presented by both sides of the debate concerning the use of the characteristic sex as an underwriting factor is given by Cummins [1980]. He investigates the controversy over using sex as a factor for constructing mortality tables or for determining the relationship between payments and benefits in pension plans. Since it has been discovered that, at least in the United States, females have a longer life expectancy than do males, females have been charged lower rates for life insurance and have received lower annuity and pension payments per dollar contributed.

Cummins [1980] cites the court case of the <u>City of Los Angeles, Department of Water and Power vs. Manhart</u> in which

> "the U.S. Supreme Court ruled that an employer
> cannot require unequal pension plan contributions
> for similarly situated male and female employees."

This outcome is suggested by Cummins to be one event in a list of occurrences defining a trend towards the suppression of specific characteristics used to categorize risks in insurance. He notes further that

> "bills have been introduced in both houses
> of the U.S. Congress that would bar the
> use of sex (as well as race, color, religion,
> and national origin) as a classification factor
> in any type of insurance."

The proponents of the view that certain characteristics should not be used as underwriting factors generally put forward the argument that using such characteristics as sex or race to categorize risks introduces "unfair discrimination" against certain groups in society. However, those who support the use of these characteristics in classifying risks argue that not to do so introduces "unfair price discrimination in the usual economic sense". These individuals do, of course, require that the resulting categories have an appropriate actuarial base.

The construction of a definition of "unfair price discrimination" which is both operationally meaningful and intuitively pleasing when applied to insurance rates is not a straightforward task. One principal reason for the difficulty is that the costs of providing insurance are not certain. Furthermore, marginal and average costs generally differ. Nevertheless, with respect to the debate concerning the categorization of risks the following definition will suffice.

> "An insurance rate structure will be considered to
> be unfairly discriminatory...if, allowing for
> practical limitations, there are premium differences
> that do not correspond to expected losses and
> average expenses or if there are expected average
> cost differences that are not reflected in
> premium differences."
>
> ...Williams [1969, pp. 211-2]

According to this definition the use of characteristics which determine groups of individuals with different expected values of losses will lead to a reduction in "unfair price discrimination". However, as Williams [1969, p. 212] notes, the determination of risk classes is not a straightforward process. There are both

technical and economic limitations to the construction of a classifi-
cation scheme which includes all factors which are relevant to individuals'
loss distributions. It is not surprising, therefore, that a consensus
concerning this debate does not exist. This being the case, even if
individuals do agree that the reduction of "unfair price discrimination"
ought to be the goal of rate regulation in insurance, it is not clear
how this concept should be defined or how the limitations on information
about different risk classes should be incorporated into the debate.
This problem is addressed in a very illuminating manner in a paper by
Schmalensee [1981]. His results will be considered in Section Four of
this paper.

In this paper the welfare implications of risk categorization are
reviewed for various types of economic equilibria. These results supple-
ment the above-mentioned debate concerning the effects of categorization
with respect to price discrimination.[4] Furthermore, as mentioned in the
introduction, it is demonstrated that individuals who sustain a reduced
level of "unfavourable" price discrimination (i.e., low risk types) as a
result of categorization may prefer that the process of categorizing risks
be suppressed. This possible outcome casts doubt on the relevance of
price discrimination as a criterion for determining the desirability of
allowing (or encouraging) firms to categorize risks. These results (dis-
cussed in Section Four) are then used to consider: (i) the desirability
of regulatory measures which attempt to prohibit or encourage categorization;
(ii) difficulties that such measures may incur; and (iii) possible by-products
of such measures which may affect other aspects and objectives of insurance.

III. <u>Types of Insurance Market Equilibria Under Conditions</u>
     <u>of Asymmetric Information</u>

The types of equilibria for insurance markets, with heterogeneous
risks (i.e., consumers) and asymmetric information, which will be con-
sidered in this paper differ according to the assumptions made about firm
behavior. The specific models of interest will be referred to as the
Nash Equilibrium, presented by Rothschild and Stiglitz [1976] and
the Wilson E2 equilibrium, introduced by Wilson [1976]. Rigorous
formulations of these models are not presented in this paper. The reader
may refer to the original presentations mentioned above or, for a more
brief treatment, see Hoy [1981a]. Only very crude intuitive explanations
of these models, supported by equally crude numerical examples, are provided
in this paper.

The above-mentioned studies have investigated the possibility that
insurance firms offer a menu of policies such that high risk individuals
will choose to purchase the expensive high coverage policy while low risk
types choose the cheaper low coverage policy. This is an example of a self-
selection mechanism (i.e., each consumer chooses freely the policy which
is designed for his risk type). The reason that such a strategy may be
successful arises from the fact that high risk types are willing to pay a
higher price for increased coverage because of their greater probability
of loss. Therefore, when offered policies which vary according to both
price and quantity, it is sometimes possible that individuals will choose
among them in such a way that firms may avoid the problem of adverse selection.
If this is the case, then the equilibrium will be called a "separating"
one.

Rothschild and Stiglitz show that under certain conditions (in particular, when the proportion of high risk types in the population is "large") a separating policies outcome may also be a Nash equilibrium. If this is the case, then the outcome will be referred to as a "no-subsidy separating equilibrium". Reasons for this terminology will become clear later.

The Nash equilibrium concept which is employed by Rothschild and Stiglitz [1976] is characterized by the following assumptions:

N1. Firms offer no contract which makes negative expected profits;

N2. There is no contract (other than those offered) which will make positive expected profits;

N3. Firms are myopic in the sense that each firm does not take into account the consequences that its own actions will have on the behavior of other firms.

The third assumption complies with the intuitive notion of the "smallness" of firms which is often associated with the assumption of perfect competition. That is, since each firm is "small" it does not anticipate that its own actions will have an effect on the actions of other firms. Although there are other assumptions which are made by Rothschild and Stiglitz [1976] they do not vary among the models considered in this paper and are generally incidental to the principal results derived from these models. They are discussed as the following example is derived.

Suppose consumers' preferences over risky alternatives can be represented by identical risk averse von Neumann-Morgenstern utility indexes. Therefore, consumers will purchase full coverage insurance if the price is an actuarially fair one.[5] Consumers are also assumed to possess identical initial (certain) wealth and face a possible loss of size L. They differ

only according to the probability of sustaining this loss. Let $p_H$ represent the high risk types' probability of experiencing the loss and $p_L$ represent the low risk types' probability of receiving loss L ($p_H > p_L$).

Firms are risk neutral, competitive, and face zero administrative costs. Therefore, they will offer insurance at actuarially fair rates and earn zero expected profits by doing so. Suppose, for example, that clients' probabilities of sustaining loss L = \$100 are $p_H$ = 0.4 for high risk types and $p_L$ = 0.2 for low risk types. If firms could differentiate between high and low risk types, the former would receive full coverage insurance at the actuarially fair price of \$40 (i.e., $p_H L$) while low risk types would receive full coverage insurance at the actuarially fair price of \$20 (i.e., $p_L L$). However, the assumption of asymmetric information precludes this possibility since it is naturally in the interest of high risk types to misrepresent themselves as low risk types in order to qualify for the "low risk" policy. This is an example of adverse selection. Under these conditions firms would earn negative expected profits.

An alternative to the above predicament is for firms to offer a single contract which if purchased by individuals of both risk types will earn zero expected profits. For example, suppose the (heterogeneous) population of risks is made up of 50% high risk types and 50% low risk types. This being the case, $\bar{p}$ = 0.5 $p_H$ + 0.5 $p_L$ = 0.3 represents the pooled probability of loss (i.e., the expected value of the loss probability for an individual randomly selected from the population). Therefore, the pooled actuarially fair price for full coverage insurance is \$30 (i.e., $\bar{p} L$). Since low risk types prefer partial coverage at this price, firms will offer only partial coverage. For example, they may offer 80% coverage which gives rise to an actuarially fair cost of \$24 (i.e., 0.8 $\bar{p} L$).

Unfortunately, pooled-type contracts do not represent a Nash equilibrium, although they may represent a Wilson E2 equilibrium discussed later in this section. The former result is demonstrated by the following example. If firms did offer a pooled contract (e.g., the 80% coverage contract at price $24 mentioned above) then, since high risk types prefer "more expensive, higher coverage policies" than do low risk types, it is possible for an innovating firm to offer a lower coverage policy at a somewhat cheaper price with this policy being preferred by low risk types to the pooled contract but not by high risk types. For example, suppose the contract with only 70% coverage at a price of $17.50 (0.7 X $25) is preferred to the pooled contract by low risk types but not by the high risk types. Such a contract, by attracting only low risk types, would earn positive expected profits since the actuarially fair cost of coverage to low risk types is only $14 (i.e., $0.7\ p_L L = 0.7 \times \$20 = 14$), less than the price of $17.50. The result of this action is that firms offering the "pooled contract" of 80% coverage at $24 will eventually begin to earn negative expected profits since their low risk customers will be attracted by the innovating firm and the actuarially fair cost of providing 80% coverage insurance to high risk types is $32 ($0.8\ p_H L$). Therefore, these firms will be driven out of the market and high risk types will be forced to purchase the innovating firm's contract. Since the innovating firm will eventually hold contracts for both high and low risk types it also will earn negative expected profits. This occurs because the expected cost of offering this contract to both risk types is $21 ($0.7 \times \bar{p}L$) which is greater than the price of $17.50. It is, therefore, a result of the assumption that firms are myopic (see assumption N3) which leads to the nonexistence of a Nash equilibrium. That is, no contract or set of contracts will earn zero expected

profits if firms behave myopically.[6]

However, a Nash equilibrium may nevertheless exist provided that the proportion of high risk types in the population being insured is sufficiently large that pooling contracts are ruled out completely. This outcome occurs if as a result of the "large" proportion of high risk types, the "pooling " price (i.e., $\bar{p}L$) is sufficiently high that low risk types prefer to choose from the "no-subsidy separating pair of contracts". As previously indicated, the "no-subsidy separating equilibrium" makes use of a self-selection mechanism by which high and low risk types purchase the policies which are specifically designed for individuals in their respective risk categories. In this equilibrium high risk types receive full coverage insurance at their actuarially fair price (i.e., $p_H L = \$40$). Low risk types choose a policy which offers only a fraction of coverage at their actuarially fair rate (e.g., 20% coverage at the price $0.2\ p_L L = \$4$). The contract which low risk types purchase must be designed so that high risk types prefer the contract which is designed for them. This is the reason that low risk types are offered only a fraction of coverage. The self-selection mechanism is successful because high risk types prefer the high-priced full coverage policy to the low-priced partial coverage policy.

The separating policies outcome described above will persist as a Nash equilibrium provided the proportion of high risk types in the population is large enough for the resultant pooling price to be sufficiently high that low risk types prefer their contract of the separating pair to any "pooling" contract. This possibility depends, among other things, on the degree of risk aversion of consumers. Alternatively, if the proportion of high risk types is smaller than some critical level then the myopic behavior of firms leads to the result that a Nash equilibrium does not exist.

Wilson [1976], on the other hand, considered the implications of firms behaving with foresight. Specifically, in a Wilson-type equilibrium it is assumed that no firm will offer one or more contracts which, although initially earning non-negative expected profits, will cause other firms to withdraw their policies with the result that the initial firm earns negative expected profits. This assumption will be referred to as the Wilson foresight assumption.[7]

In contrast to the Nash equilibrium, the Wilson E2 equilibrium is characterized by the following assumptions.

W1. Firms offer no contract which, after other firms have reacted, makes negative expected profits.

W2. There is no contract (other than those offered) which, after firms have reacted to it being offered, will make positive expected profits.

W3. Firms are not myopic but, instead, possess foresight in that each firm <u>does</u> take into account the effects of its actions on other firms' behavior. Therefore, if a firm's contract offer earns negative expected profits <u>after</u> other firms have reacted to its policy offer then such a contract will not be made available.

As a result of assumption W3 the Wilson E2 equilibrium does allow for pooling contracts such as the previously-mentioned one of 80% coverage at the actuarially fair (pooled) price of $24. The reason for this result is that innovating firms will not try to entice low risk types away from such a pooling contract since, if they did, the firms offering the pooling contract would earn negative expected profits and, upon their exit, so would the

innovating firms. This series of events violates the assumption of Wilson foresight and enables a pooling contract to exist as a Wilson E2 equilibrium. In this way the introduction of the Wilson foresight assumption circumvents the non-existence possibility which occurs under the Nash equilibrium concept.

If the proportion of high risk types is sufficiently large that the Nash equilibrium (i.e., the no subsidy separating one) exists then it will also be the Wilson E2 equilibrium. However, if the proportion of high risk types in the population being insured is sufficiently small that the Nash equilibrium does not exist, then the Wilson E2 equilibrium does exist and is a pooling one. This being the case, firms could offer the no-subsidy separating pair of contracts and earn zero expected profits. However, both high and low risk types prefer the pooling contract (i.e., when the proportion of high risk types is small) so that the no-subsidy separating pair of contracts is not, in these instances, offered.

The last point made in the above paragraph leads to the first result concerning discrimination that will be made in this paper.

Proposition 1: It is possible that even if a no-subsidy separating pair of contracts can be offered by firms (earning zero expected profits) to their clients it may be the case that both high and low risk types can be made better off by a subsidy type equilibrium. That is, low risk types as well as high risk types may prefer to face some positive price discrimination rather than none.

Although the above proposition is not concerned with the activity of categorization, it provides an analogous result to some of those derived in the following section.

IV.  The Welfare Implications of Imperfectly
     Categorizing Risks

In this section the welfare implications of categorization are con-
sidered for the Wilson E2 equilibrium concept. Since the Nash equili-
brium concept is subject to the non-existence possibility it represents a
rather special case. Dahlby [1981] considers the use of compulsory insurance
regulation to deal with the non-existence problem. However, he does not
examine the implications that imperfect categorization may have with respect
to the non-existence problem. This latter aspect of the Nash equilibrium
concept is considered in this section. The results of this section are then
considered in light of the issue of the effects of categorization on price
discrimination.

Recall that a no-subsidy separating equilibrium is one in which high
risk types receive full coverage at their actuarially fair price while low
risk types receive less than full coverage at their actuarially fair price.
For the example of the previous section ($p_H = 0.4$, $p_L = 0.2$, L = 100) high
risk types pay \$40 for 100% coverage ($p_H L$) while low risk types pay \$4
for 20% coverage (0.2 $p_L L$). Such a separating policies outcome will occur
and persist as a Nash equilibrium provided the proportion of high risk types
is greater than some critical level; in which case it will also represent the
Wilson E2 equilibrium.

If perfect information is made available to firms so that they can
differentiate, without error, between high and low risk types, then low risk
types can be offered full coverage insurance at their actuarially fair rate
(i.e., at a price of \$20 = $p_L L$) and be made better off with firms not having

to worry about the problem of adverse selection. The introduction of per-
fect information, therefore, leads to a Pareto-type welfare improvement
since high risk types continue to receive the same policy at the same price.
This result, however, has no effect on the issue of price discrimination
since individuals face their risk-specific actuarially fair price both
before and after categorization so that no cross-subsidization occurs either
before or after categorization.

Since information which relates individuals to their risk type is in
general not perfect, it is important to investigate the issue of whether
or not information which correlates, albeit imperfectly, some personal char-
acteristic (e.g., sex) to risk type leads to a Pareto-type welfare improve-
ment. The general welfare implications of imperfectly categorizing risks
is the main topic of this section.[8]

Consider first the above-mentioned case where the initial equilibrium
is the no-subsidy separating pair of contracts. Suppose information leads
to the creation of a high and a low risk category. Since the information is
assumed to be imperfect, it follows that there will be some misclassification.
For example, let the initial (aggregate) population be composed of 50% high
risk types and 50% low risk types. An imperfect categorization scheme
leads to the creation of two identifiable groups of individuals with, say,
75% high risk types and 25% low risk types in the high risk category and with
25% high risk types and 75% low risk types in the low risk category. Since
the proportion of high risk types in the aggregate population is assumed
to be sufficiently large that the no-subsidy separating policies outcome
represents either the Nash or Wilson E2 equilibrium (which one depends on
how firms behave) then, a _fortiori_, so will members of the high risk category

face this separating policies outcome.

However, it is possible that the proportion of high risk types in the low risk category will be sufficiently small that low risk types will prefer a pooling equilibrium to the separating policies one. This being the case, a pooling contract, which makes high and low risk types better off,[9] will be offered to members of the low risk category if firms behave according to the Wilson foresight assumption (i.e., for the Wilson E2 equilibrium). However, if firms behave according to the Nash assumption of myopia (see assumption N3 for the Nash equilibrium concept), then no competitive equilibrium will exist for members of the low risk category. If, as it is sometimes assumed, no insurance is sold when a competitive equilibrium doesn't exist then it follows that members of the low risk category are worse off as a result of categorization (i.e., since they do not receive any insurance). The results which have been stated thus far are summarized in the following proposition.

Proposition 2: Suppose the equilibrium before categorization is the no-subsidy separating pair of contracts. In this case, perfect categorization leads to a Pareto-type welfare improvement as low risk types are made better off and high risk types are not affected. If the information is imperfect then either there is no effect (i.e., if the proportion of high risk types is "large" even in the low risk category) or one of two alternative outcomes will occur: (i) if firms behave according to the Nash equilibrium model (i.e., myopically) then no competitive equilibrium will exist for members of the low risk category (i.e., they are worse off); or (ii) if firms behave with Wilson foresight (i.e., according to the Wilson E2 equilibrium model) then members of the low risk category will receive a "preferred" pooling contract and hence be made better off. In the former case, therefore,

imperfect categorization leads to a Pareto-type worsening in welfare while in the latter case it leads to a Pareto-type improvement in welfare.

Since in a pooling-type equilibrium low risk types are charged a price which is greater than their actuarially fair one while high risk types are charged a price lower than their actuarially fair one it follows that cross-subsidization (i.e., price discrimination) occurs. Such is not the case for a no-subsidy separating policies outcome. These observations, when applied to the results of Proposition 2, lead to the following remark concerning price discrimination.

Remark 1. It may be the case that improvements in information (i.e., concerning firms ability to identify the risk type of consumers) will lead to an increase in price discrimination rather than a reduction. This result occurs if the initial equilibrium is the no-subsidy separating pair of contracts and firms behave with Wilson foresight. Furthermore, as is the case in Proposition 1, an increase in price discrimination may be preferred even by low risk types for whom price discrimination is "unfavorable".

It is possible that the proportion of high risk types in the aggregate population is sufficiently small that the no-subsidy separating policies outcome does not occur before categorization. Under the Nash assumptions no competitive equilibrium exists while for the Wilson E2 equilibrium a pooling contract is offered. Since the proportion of high risk types is even smaller after categorization for members of the low risk category then, a fortiori, the same type of equilibrium holds for the low risk category as before categorization. The equilibrium for members of the high risk category may or may not be the no-subsidy separating one (i.e., the result depends on the size of the increase in the proportion of high risk types). Since the case in

which high risk types receive a no-subsidy separating policies outcome adds no new insights to the set of possible results of categorization, it is not considered further.

Therefore, suppose the proportion of high risk types is sufficiently small both before categorization (i.e., for the aggregate population) and after categorization for both categories that a Nash equilibrium does not exist in any of these situations. Equivalently, the Wilson E2 equilibrium in each situation will be a pooling one. Since the Nash equilibrium never exists in this case, only the effects of categorization for the Wilson E2 equilibrium will be considered. The following numerical example which was used previously is a helpful descriptive tool for illustrating the results which follow.

Recall, $p_H = 0.4$ and $p_L = 0.2$ represent the loss probabilities for high and low risk types while L = \$100 is the size of the loss. The aggregate population is assumed to be made up of 50% high risk types and 50% low risk types. Therefore, the actuarially fair price for full coverage insurance for this "pooled" population is \$30 (i.e., $0.5\ p_L L + 0.5\ p_H L$). If 80% coverage is provided (i.e., before categorization) in the pooling contract then the price of insurance will be \$24. This price will lead to zero expected profits for firms who sell insurance to equal numbers of (or with equal probability of selecting) high and low risk types.

After categorization, it is assumed, the percentages of high and low risk types are (respectively) 75% and 25% in the high risk category and 25% and 75% in the low risk category. Therefore, the actuarially fair (pooled) price of full coverage insurance is \$35 for members of the high risk category (i.e., $.75\ p_H L + .25\ p_L L$) and \$25 for members of the low risk category (i.e., $.25\ p_H L + .75\ p_L L$). To simplify this example, suppose 80% coverage is offered

to members of both risk categories.[10] This being the case, the prices of

the "pooled" policies are $28 for members of the high risk category and $20

for members of the low risk category. The welfare implications in this

instance are straightforward and are stated in Proposition 3 below.

Proposition 3: If all equilibria (before and after categorization) are pooling

Wilson E2 ones then individuals assigned to the low risk category are made

better off as a result of categorization while high risk types are made worse

off. That is, categorization leads to Pareto-wise ambiguous welfare results.

In this case one might expect that since (i) none of the equilibria

are no-subsidy separating ones and (ii) imperfect information improves the

ability of firms to assign individuals to their appropriate risk type, that

categorization leads to an "overall reduction in price discrimination". It

is illustrated below that such a conclusion is justified _if_ one is willing

to define price discrimination in a restrictive manner (i.e., as a linear

concept).

Let us define price discrimination for a specific individual as the dif-

ference in the actuarially fair price for full coverage insurance and the

price actually paid.[11] Before categorization low risk types must pay $30

(i.e., $0.5\ p_H L + 0.5\ p_L L$) for full coverage insurance while the actuarially

fair price of insurance is $20. Therefore, they face unfavorable price dis-

crimination in the amount of $10. Low risk types who are assigned to the

low risk category must pay $25 (i.e., $0.75\ p_L L + 0.25\ p_H L$) for full coverage

insurance while low risk types assigned to the high risk category must pay

$35 (i.e., $0.75\ p_H L + 0.25\ p_L L$). Therefore, low risk types face unfavorable

price discrimination in the amounts of $5 if assigned to the low risk cate-

gory and $15 if assigned to the high risk category. As stated in the above

paragraph, _if_ one is willing "to simply add up across individuals in a

linear fashion" to determine the aggregate extent of price discrimination

then the per person level of unfavorable price discrimination against

low risk types is $10 before categorization and $7.5 after categorization

(i.e., 0.75 X $5 + 0.25 X $15). The latter result follows since 75%

of low risk types are assigned to the low risk category and 25% to the

high risk category.[12]

From the above example the procedure of "adding up" dollar amounts of

(unfavorable) price discrimination which low risk types face gives the result

that price discrimination is indeed reduced by imperfect categorization.

A similar result follows for high risk types. However, a closer analysis

of this example begs the question of whether or not a linear method of

aggregating price discrimination is appropriate. Notice, for example, that

low risk types who are assigned to the low risk category face a level of

price discrimination of $5 while those assigned to the high risk category

are discriminated against in the amount of $15. Therefore, with respect to

horizontal equity, similarly situated individuals are treated differently

after categorization while they are treated identically before categorization.[13]

Also, it is not noncontroversial to assert that the impact of one individual

being discriminated against by an additional amount of $5 (relative to the

pre-categorized situation) is exactly compensated by a reduction of $5 in

price discrimination for another individual. Yet this is precisely the

conclusion which is derived by applying the linear definition of aggregate

price discrimination suggested in the above paragraph. Although the linear

method (using equal weights for each individual) of aggregating the extent

of price discrimination imposed on individuals is a convenient one and always

suggests that categorization leads to a reduction in dicrimination, it has

no compelling ethical significance.[14] Some reader may reply, justifiably, that the above statement is in some sense a value judgement about value judgements and hence also has no compelling ethical appeal. However, one could continue the process by arguing that since the aforementioned reader's reply is a value judgement about a value judgement about a value judgement, it also has no compelling ethical appeal. In order to limit the length of this paper the above argument is terminated and a different approach, which should at least be appealing to those who believe that consumers' sovereignty is an ethically desirable value, is considered below. Using this approach, it is argued that a "linear type" assessment concerning the consequences of price discrimination cannot be extended to consumers' own assessments of the process of categorization. However, the following remark is stated first.

Remark 2. In the case where all equilibria (i.e., before and after categorization) are Wilson E2 pooling ones, imperfect categorization leads to an overall reduction in price discrimination if aggregation over the extent of individuals' price discrimination is done in a linear fashion (with equal weights). However, "horizontal discrimination" is always increased as a result of imperfect categorization. Furthermore, the use of a "linear aggregation procedure" is not ethically compelling.

The alternative analysis of categorization which will be considered next examines the way in which consumers view the process of imperfect categorization. To do this it is assumed that the consumer is not yet aware of the particular characteristic that will be used to (imperfectly) classify risks. Therefore, a consumer does not know whether he will be properly classified or misclassified. However, it is assumed that consumers do know the

parameters (e.g., the post-categorized prices) associated with the categorization scheme. Since individuals know their own risk type their expectations concerning the possibilities of being assigned to the two risk categories are not identical.[15] In particular, low risk types hold a subjective probability of being assigned to the low risk category which is higher than that held by high risk types. In this sense categorization favors low risk individuals, as expected.

The impact of imperfect categorization when viewed from this particular perspective of the consumer is that it randomizes his premium. This phenomenon will be called premium risk. In terms of the previous example we see that the result of anticipating a particular categorization scheme is to alter a low risk type's certain premium rate of $30 for full coverage (i.e., with no categorization) to possible premium levels of $35 if he is misclassified into the high risk category and $25 if he is properly classified into the low risk category. Since 75% of low risk types are assigned to the low risk category[16] and 25% are assigned to the high risk category it follows that the expected price of insurance resulting from such a categorization scheme is $27.50 for low risk types. Although this expected price is less than the price if no categorization occurs, it does not follow that risk averse (low risk) consumers will necessarily prefer the randomized outcome that a prospective categorization scheme presents to the certain one of no categorization. Unless consumers are risk neutral they will not treat the process of categorization in an analogous manner to the linear aggregation principle of price discrimination discussed earlier in this section (see Remark 2). Furthermore, if consumers are risk neutral, insurance markets will not exist and the issue of price discrimination becomes irrelevant.

The result of the previous paragraph is stated below in Proposition 4 (see Hoy [1981b] for a more rigorous treatment).

Proposition 4: If all of the equilibria (i.e., before and after categorization) are pooling Wilson E2 ones then it is possible that the anticipation of a categorization scheme will make even low risk types worse off. Not surprisingly, high risk types in these cases are also made worse off. That is, from the perspective of individuals who do not yet know the assignment rule associated with a prospective categorization scheme, such a scheme may lead to a Pareto-type worsening of welfare.

The results stated in Proposition 4 reinforces the statement that the use of a "linear aggregation procedure" is not ethically compelling (see Remark 2) since risk averse consumers do not assess categorization schemes in a linear fashion. The result in Proposition 4 also has some significance beyond the issue of price discrimination. For example, suppose that insurance firms are unable to write contracts which exclude the use of possible future categorization.[17] A possible implication of this phenomenon is consumer support for a government insurance scheme which does not allow categorization on the basis of personal characteristics. Alternatively, government regulations prohibiting the use of categorization may be desired.

Before concluding this section, one more comment should be made. It is not the case that low risk types will judge imperfect categorization schemes as being harmful only in those cases where the quality of information is poor (i.e., the probability of misclassification is high). Such a conclusion is unwarranted because as the quality of information improves, the consequence of being misclassified becomes worse (i.e., the price of insurance to misclassified low risk types increases). Therefore, as far as low risk types

are concerned, as the quality of information improves so does the probability of being properly classified but the consequence of misclassification becomes less desirable.  The result of this tradeoff is that an increase in the quality of information does not guarantee a more favorable outlook of categorization from low risk types.  Perfect information, of course, provides an exception to this statement.

## Part II

### V. Categorization and Other Objectives of Insurance

Insurance is a business which is generally treated as one which is different from most commodity-producing enterprises.  This statement is illustrated by the following quotations.

> 'The insurance business is among the types of private enterprise subject to much government regulation.  It is generally classed as a business which is 'affected with a public interest'.'
>
> ...Magee and Bickelhaupt [1964, p. 177]

> 'whether insurance essentially is a business aiming at making money or a benevolent social service is a point which probably will never be finally settled.'
>
> ...Borch [1974, p. 140]

Whether or not insurance ought to be treated differently is of course arguable and provides in part the motivation of this paper.

Economic theory suggests, in principle if not in practice, that regulation may be desirable in any market which is faced with either one of the problems of adverse selection (e.g., see Dahlby [1981]) or moral hazard.  Although these phenomena are pervasive in insurance markets they may also occur in other markets, such as the labour market (e.g., see Miyazaki [1977]).  Therefore, the desirability of government regulation does not in itself provide a means for demarcating between insurance and other markets.  For example, although the result of Proposition 4 suggests

that it is desirable (if possible) for the government to suppress categorization (at least in some instances), analogous results could be derived for labour markets where information is also both asymmetric and increasing (imperfectly). It is, nevertheless, probably true that these types of "information difficulties" are likely to lead to more significant consequences in insurance than in other markets.

A second reason that insurance is generally treated as a "special" market is associated with the overlapping areas of activity of social institutions (including governments and charitable organizations) and private insurance markets. For whatever reason, governments often are concerned with "distributional" problems, such as (ex post) care for the sick, which are sometimes also dealt with through the purchase of market insurance. If private insurance firms make use of information in a "socially undesirable" fashion (i.e., according to the government's objectives) then government regulation or provision of insurance (often termed "socialization of an insurance market") is likely.

For example, the result of Proposition 4 suggests that government regulation may be desirable from a welfare point of view. It will also be shown in this section that regulations which suppress imperfect categorization may reduce income inequality. Many economists, however, argue that "distributional problems" should be handled entirely by (lump sum) redistribution of income, not through policies which affect prices and hence the efficiency of markets. This argument loses some force in the context of markets described by asymmetric information since the required lump sum income transfers are likely to be dependent on individuals' risk types which are by assumption unidentifiable. Therefore, adverse effects on distribution which result from categorization may be more effectively dealt with by government regulation of insurance markets than

by the more usual methods of income redistribution. This issue represents the first topic of this section (in particular, see Proposition 5 below). A discussion concerning the effects of categorization with respect to another government objective--namely, stability of the insurance market-- is considered later in this section.

In the previous section it was shown that imperfect categorization may impose undesirable premium risk on individuals. As the result of Proposition 4 demonstrates, this risk may be sufficiently important that even low risk types prefer to avoid it. Since imperfect categorization (in some cases) increases the price of insurance to some individuals (i.e., those assigned to the high risk category) and decreases the price charged to others (i.e., those assigned to the low risk category) it also seems plausible that categorization leads to an increase in income inequality. However, as those who have investigated the issue of income inequality know, it is not easy to define an unambiguous and universally acceptable measure of income inequality (see, for example, Sen [1973]). Nevertheless, sufficient conditions (concerning the effects of categorization on the demand for insurance) which allow comparison of income distributions using the generally accepted but ambiguous Lorenz criterion can be found. This is described below.

The Lorenz curve maps out the proportion of total wealth obtained by the poorest k percent of the population with k ranging from zero to one hundred. If a Lorenz curve corresponding to distribution A lies everywhere below that for another distribution B, this implies that the poorest k percent of the income distribution receives less wealth in situation A than in situation B for any k (with $0 < k < 100$) and, therefore, it is said that A represents unambiguously a less equalitarian distribution

than does B. The shortcoming of the Lorenz criterion is that if Lorenz curves corresponding to two distributions intersect each other then any comparison concerning income inequality varies with k and, therefore, becomes ambiguous.

However, under the condition that the proportion of insurance does not vary with the price of insurance (i.e., with respect to the proportion of coverage, the demand for insurance is price inelastic) it follows that if all of the equilibria are pooling Wilson E2 ones then categorization leads, according to the Lorenz criterion, to an unambiguous increase in the inequality of income. This result is presented in Proposition 5 below.

Proposition 5. Suppose that the equilibria before and after categorization are pooling Wilson E2 equilibria. Suppose further that the proportion of insurance offered is the same in each situation. This being the case, categorization leads to an unambiguous increase in income inequality according to the Lorenz criterion.

The proof of Proposition 5 is algebraically messy and so is omitted (it is included in Hoy [1981b]). The result demonstrates that if a government is concerned with income inequality then, since categorization introduces variable prices for insurance and hence effectively creates income inequality, there are cases when the government may wish to suppress information which leads to categorization. Although the result of Proposition 5 is stated only for rather special circumstances, it does provide a benchmark case for comparison with instances which include more realistic demand assumptions. Furthermore, as shown in Hoy [1981b], the result is weakly robust to these restrictive demand assumptions.

It is sometimes suggested that governments are (or at least ought to be) concerned with individuals' ex post well-being rather than with their

ex ante well-being. Those in favour of this view argue, as does Starr [1973, p. 82] that

> 'the achievement of an Arrow (ex-ante) optimum is a
> normative dead end. After all, we are not so much
> interested in expectations as in results.'

In effect this view implies that a consumer's own evaluation over risky alternatives need not be respected. It suggests that governments should, for example, concern themselves with the ex post problem of care for the sick rather than worrying about individuals' ex ante choices over various insurance schemes. Although somewhat tangential to this paper,[18] this viewpoint certainly has important implications with respect to regulation in the insurance industry. For example, such a view may lead to such possibilities as compulsory insurance schemes or public provision of medical care. In these ways governments deal only with ex post care rather than individuals' expectations of possible future needs.

Without concerning ourselves with the issue of which viewpoint (i.e., ex ante or ex post) is appropriate let us consider an argument in favour of the public provision of medical aid (or compulsory health insurance) from the perspective of ex post efficiency. It is a generally accepted proposition of liberal economics[19] that an income transfer of $x is a more efficient means of improving an individual's well-being (utility) than is the provision of $x worth of medical care. However, by combining an ex post perspective of welfare with considerations of administrative costs one can provide a counter argument to this efficiency theorem. For example, suppose a government is concerned with the ex post needs of those requiring a specific type of medical care. Provision of $x worth of medical care is in one sense less efficient than a direct income transfer of $x since the former policy simply reduces the choice set of the individual in

question (i.e., relative to the latter policy). However, it seems quite

plausible that the former policy may reduce the incentives for and hence

the costs of cheating since medical care can often not be resold (at least

not at zero cost). Therefore, if the government wishes to transfer aid to,

say, those who are both poor and sick, it may be more efficient to require

compulsory medical insurance with premium relief for those with low incomes

than to redistribute income ex post. In this way the incentive for an

individual to "cheat" by feigning an illness is reduced since he can only

receive medical care if he is in fact judged to be in need of it. Further-

more, it is likely to be the case that such medical aid will have zero (or

even negative) value to him if in fact he is not in need. Consequently,

if it is impossible or costly to resell medical aid, the incentive for

cheating is reduced by use of "public" health schemes. Although this

type of argument is probably quite an important one in describing government

behaviour and also in assessing the desirability of government regulation

of insurance, it is not considered further in this paper.

Thus far in this section only issues concerning the relationship

between distribution and categorization have been considered. The govern-

ments in most countries have also taken upon themselves the objective of

ensuring stability in the insurance market. A principal concern in this

area is the solvency of firms. Although many methods are used to regulate

the solvency level of firms, the main one is a cash reserve requirement.

The implication of this requirement is that firms must maintain a specified

level of cash reserves which are to be used in the event of "excess" losses

(i.e., losses in excess of general premium income). Since this requirement

imposes a cost on firms the price of insurance is higher with such a policy

than it would be without it. Nevertheless such regulatory requirements can

easily be justified. As Borch [1974, p. 345] notes

'the public complains only too often, about difficulties
in understanding and interpreting the fine print in the
insurance contract. If in addition the public should be
asked to read the company's balance sheet and evaluate
the company's ability to fulfill the promises made in
big print, the public may well revolt and ask for govern-
ment protection...(as a result) in most countries the
government has stepped in to protect the insurance-
buying public. Often the government supervision has
been established at the explicit request of the insurance
companies, simply because they found it difficult to do
business without some official stamp of approval.'

The introduction of a bankruptcy condition which, for firms,

is costly to maintain has the same effect as assuming that firms are

risk averse. That is, since firms must hold larger cash reserves if their

portfolios are "riskier", they will prefer, ceteris paribus, less risky sets

of insurance contracts. Imperfect information which leads to categorization

improves the ability of firms to determine, albeit imperfectly, the risk

type of each consumer. Therefore, it is possible for firms to determine

more accurately the proportions of the various risk types within a given

set of clients. The result of increasing this ability of firms is that the

probability of bankruptcy falls and firms can reduce their cash reserves.[20]

The reduced cost of holding reserves will, presumably, be passed onto

consumers. This argument is presented in detail in Hoy [1981c].

Although premium risk persists as an implication of imperfectly categoriz-

ing risks, the introduction of imperfect information does lead to a reduction

in the average price of insurance if firms face a "costly to maintain"

bankruptcy constraint. It is even possible that all individuals will face

a lower price of insurance as a result of categorization. This result contrasts

to the one in Proposition 4 since in this case it is possible that all

individuals will be made better off as a result of categorization. There are,

therefore, possible conflicts in satisfying objectives when allowing or

suppressing the use of categorization schemes.  The appropriate policy

solution may be piecemeal regulation; that is, suppressing some categorization

schemes for which premium risk is considered relatively more important than

the associated reduction in the cost of maintaining the solvency condition

while allowing categorization schemes for which the opposite holds.  Although

government policies which include the advantage of reducing the cost of

maintaining the solvency constraint but eliminate the premium risk associated

with categorization are considered in Hoy [1981c], these policies are likely

too difficult to be successfully implemented.

In this section the relationship between categorization and two goals

of insurance and government have been examined.  These two goals are (i) the

distributional (or, more generally welfare) aspects of insurance and (ii) the

solvency of insurance firms.  Although categorization no doubt affects other

aspects of insurance, the analysis of these two specific areas reflects

what seems to be (along with price discrimination) the major areas of concern

in the literature regarding insurance regulation.  It is noted in Bickelhaupt

and Magee [1970, p. 171] that 'the general purpose of insurance regulation

is to protect the public against insolvency or unfair treatment by insurers'.

They also note [p. 195] that[21]

'The role of government in regard to insurance is not
limited to regulation.  In addition, government serves
quite frequently as an insurer or as an instigator of
private insurance systems.  Sometimes, government
participation takes on characteristics of a partnership
with private insurers, while at other times it appears
to be directly competing with them in the quest for
economic security.  Societies, as well as individuals,
families, and businesses, logically have goals which
the technique of insurance helps achieve. ... (underlining my own)

In Section IV a third aspect of categorization--namely, its effect

on price discrimination--was examined.  It is suggested by the discussion of

Section II in this paper that this aspect of categorization has been more

recently considered an important concern.[22] In the following section some problems of regulations which try to satisfy these various objectives are analyzed.

VI.   Problems Associated with Regulation

The following results which have already been mentioned in this paper are restated here for convenience. They are relevant to the discussion on problems of regulation.

(i)   Categorization may improve or reduce welfare according to the Pareto criterion. The particular result which obtains depends on the types of the various equilibria (i.e., before and after categorization) and also on the behaviour of firms (i.e., whether they behave according to the Nash assumption of myopia or with Wilson foresight).

(ii)  Categorization may alter a situation which exhibits no price discrimination to one with price discrimination. This paradoxical result occurs because of the possibility of the no subsidy separating contracts outcome.

(iii) Categorization will reduce the "average" level of price discrimination if all equilibria (i.e., before and after categorization) are pooling Wilson E2 ones. However, this result depends on the assumption of a linear definition (with equal weights) of price discrimination. Furthermore, horizontal price discrimination increases as a result of imperfect categorization.

(iv)  It is possible that although the "expected" level of price discrimination is reduced in favour of low risk types as a result of categorization, low risk types may prefer that the process of imperfect categorization be suppressed.

(v)   If all equilibria are pooling Wilson E2 ones and the proportion of insurance offered in each case (i.e., before and after categorization) is

identical, then categorization (according to the Lorenz criterion) leads to an unambiguous increase in income inequality.

(vi) Imperfect information which leads to categorization enables firms to determine more accurately the riskiness of their portfolios. The implication of this phenomenon is that the use of this information reduces the cost of risk bearing and, in effect, relaxes any solvency condition. Under competitive pressures, this leads to a reduction in the average price of insurance.

Upon reading the above results, one can immediately ascertain some of the possible difficulties that regulatory measures which attempt to influence the use of categorization schemes will face. Suppose, for example, that it is decided to suppress the use of "personal characteristics" which allow firms to imperfectly determine the risk class membership of consumers. Although this policy will in some instances lead to Pareto-type improvements in welfare, it may in other cases eliminate schemes which would lead to Pareto-type welfare improvements. Therefore, a general attitude towards the issue of categorization (i.e., pro or con) cannot be substantiated by the resultant welfare implications. A piecemeal policy approach, on the other hand, may be difficult or costly to implement.

Another obvious source of difficulty in choosing between policies of suppressing or allowing categorization is that of consistency among objectives. As result (iv) indicates, it is possible that categorization may reduce the "average" level of price discrimination but be considered undesirable from the welfare point of view by all consumers. It was argued in Section IV that price discrimination is not a very appealing objective so that this particular conflict will not be very disturbing except to those who are not convinced by that argument. More important conflicts

may, however, arise. For example, it is clear that while the suppression of information leading to categorization may lead to "desirable" consequences regarding welfare and distribution (see results (i), (iv), and (v)), such a policy will also eliminate the benefits that such information represents in terms of improving the solvency position of firms. It is also possible that categorization will lead to ambiguous welfare implications. Once again, a single policy which can be applied in general to the issue of categorization appears not to be the most pragmatic attitude. A piecemeal approach which recognizes the relative tradeoffs among the various objectives may be preferred.

The stage has now been set for us to consider both (i) the policy of allowing or encouraging categorization and (ii) the policy of prohibiting categorization. Either policy may be recommended at least from a welfare point of view. Let us deal with the case where categorization is desirable since it is generally the less complicated of the two possibilities.

Suppose the equilibrium set of contracts is initially the no-subsidy separating contracts pair. If information of sufficiently high quality (concerning risk class membership) becomes available, a Pareto-type welfare improvement is possible (i.e., if firms behave according to the Wilson E2 equilibrium model). Although firms will certainly use such information if it becomes freely available, they may have little incentive to expend resources to acquire it. The reason for this result is that the only way in which an innovating firm can make profitable use of this information is either by altering his prices to attract more individuals from the low risk category and/or fewer from the high risk category[23] or by employing a screening device which rejects those individuals in the high risk category. However, other firms may benefit simply by following the innovator's behaviour

and also gain from the information. Competitive pressure is likely to reduce (almost to zero) the benefit that the innovator can obtain from the costly activity of acquiring information. Furthermore, since "followers" face zero costs for information gathering, there is an incentive to "let other firms spend resources" and wait for any benefits. This is likely to lead to a stalemate whereby no firms acquire information. Although this issue requires a more rigorous analysis which should include the possibility of strategic behaviour, the scenario does appear plausible.

The usual solution to the type of problem mentioned above is to allow firms to take out patents on any innovation, which in this case is information. If only the innovating firm is allowed to use the screening mechanism to sell insurance to those individuals who possess the characteristic associated with the low risk category, such a ruling gives an innovating firm monopoly power. Roughly speaking, the innovator could charge a price to members of the low risk category which is "almost" as high as the price before categorization (i.e., and still be able to attract customers). However, it is not necessarily the case that the firm will do so since the price corresponding to the maximum monopoly profit may be less than the price before categorization. Therefore, members of the low risk category may benefit from categorization schemes even when the scheme is protected by a patent.

In the particular case where the initial equilibrium is the no-subsidy separating policies outcome, a firm holding a patent for a categorization scheme may (although not necessarily) charge a price to members of the low risk category which is sufficiently high that low risk types buying this policy are only insignificantly better off than before categorization. However, high risk types who belong to the low risk category will also receive the "pooling" contract and in the process be made significantly better off.

Therefore, in this instance a strong case can be made for allowing firms to
patent information even though it provides them with monopoly power.[24]

Although it is possible that the acquisition of information which
leads to a categorization scheme may be desirable, it is also possible
that the suppression of a categorization scheme is desirable. Policies
which attempt to reflect this latter situation may incur several difficulties.
For example, insurers may attempt to circumvent these rulings or may react
to them in ways which have undesirable consequences. An example of each
of these methods is presented below.

Suppose that for reasons of welfare or distribution the government
decides to prohibit in the annuity life insurance market the use of
categorization schemes which are based on the characteristic of sex. If
such a policy were implemented and insurers recognized that (for example)
females impose higher costs on firms than do males (since females live
longer) it will be in firms' interests to use "proxy" characteristics in
order to differentiate among clients. For example, if occupation A is
composed of a greater percentage of males than is occupation B, then an
insurer may use an individual's occupation (instead of sex) as a screening
device. In this example the firm will offer members of occupation A a
lower premium in order to attract a higher percentage of "low risk types".
It may not even be relevant to determine whether members of occupation A
represent a lower risk category than do those in B because of sex or
because of some other factors associated with these occupations. Further-
more, insurance firms aren't necessarily concerned with the problem of
which underlying factors are responsible for the difference in costs. They
are concerned only with the relevant actuarial costs. In any case, the
knowledge of a relevant parameter, such as sex, in determining risk class

membership is likely to induce firms to search for proxy characteristics if categorization schemes based on the primary characteristic (sex) are prohibited. This type of phenomenon presents a problem to those who wish to employ a piecemeal approach to determine whether or not risk categories ought to be used since, at the least, some resources will have to be spent in order to determine appropriate policies for every scheme presented. The possible use of proxy characteristics increases the extent of this problem.

If the insurer and insured have a relationship which extends beyond that determined by the insurance contract then additional problems associated with the suppression of categorization may occur. Consider the above example with annuities replaced by an employer's pension plan. Once again, the cost of providing females (i.e., female employees) with a given stream of pension benefits will be greater than for males since females, on average, live longer. If employers are not allowed to require different contributions towards a pension plan then they will wish to give preference to hiring males or will offer females a lower wage for equal work.[25] These types of consequences of "no-categorization policies" may be viewed as even more undesirable than categorization itself. In this example further rulings which prohibit the use of discriminatory hiring or wage-setting policies may be employed. Nevertheless, a no-categorization policy increases the incentive to use discriminatory hiring and wage-setting policies and thereby increases the costs of sustaining these policies.

Although the set of problems discussed in this section does not represent a comprehensive list of the difficulties associated with regulation in the insurance industry, the problems examined do exhibit some of the complexities involved in attempting to improve welfare by regulating one

aspect of insurance (i.e., categorization). There are many other issues such as those of rate regulation and compulsory insurance requirements. Some of these, which are related to the problem of categorization, are discussed in Dahlby [1981].


## VII.   Other Related Issues

There are several more issues of concern to a study of insurance markets which have not been discussed in this paper. A few of the important ones are (i) market structure and firm behaviour, (ii) symmetric information and (iii) moral hazard. These topics refer to particular assumptions of the economic models considered in this paper and have important implications with respect to categorization.

### VII.1   Market Structure and Firm Behaviour

As noted in footnote seven, the Wilson foresight assumption cannot be made in the spirit of a perfectly competitive model. Many of the results of this section have depended on the use of this assumption and so may be considered to be rather questionable. However, in defence of these results it can be argued that if a price floor is placed on all insurance contracts and its value is set at the pooled fair odds level, then the type of firm behaviour which leads to the nonexistence of a Nash equilibrium will not occur. Furthermore, such a regulated equilibrium will in fact be equivalent to the Wilson E2 equilibrium. Although rate regulation in the U.S. varies significantly across states, there is some support for the above view. Bickelhaupt and Magee [1970, p. 183] note that, in general,

> 'Basic standards recognized by rating laws (include the
> requirement) that rates be reasonable...(and that...
> Rates are considered reasonable when they produce sufficient
> revenue to pay all losses, to pay expenses of doing
> business, and, in addition, to produce a reasonable profit.'

The impact of rate-making regulations on insurer behaviour is, admittedly, much more complex than has been suggested above. For example, many states require that the use of any "new" categorization scheme or the offer of any "new" contract be filed and subject to rejection. Furthermore, the precise impact of regulation will vary somewhat as do regulations vary across states. Nevertheless, the general flavour of rate regulation is to "help establish a floor for rates with competition setting the ceiling."[26]

From the point of view of economic model-building the use of the Wilson E2 equilibrium begs the question about whether or not there is a possible environment in which firms set prices competitively but still take into account the repercussions of their policy offers. Recall, a pooling contract is a possible equilibrium only if firms do not introduce innovating policies which earn positive expected profits until other firms, who as a result of the innovation earn losses, react by exiting the market (or adjusting prices upward). If the number of insurance firms is sufficiently small that each firm can monitor each other firm's behaviour, then the Wilson foresight assumption seems a reasonable one. However, the number of firms must be sufficiently large that collusion with respect to price setting is not possible if the Wilson E2 equilibrium is to represent an adequate description of an insurance market. A rigorous analysis of this type of problem is required and, if performed, would represent an important extension to the present literature. Given the problems involved with analyzing oligopolistic behaviour, this is not likely a simple task. There are also several other aspects of the relationship between market structure and regulation in the insurance industry that provide interesting problems for future research.[27]

## VII.2 Symmetric Information

Another important assumption made throughout this paper is the one concerning the increasing but asymmetric nature of insurance. Under this assumption the consumer always knows his own risk type and any increase in information alters only the firms' expectations concerning individuals' risk class membership. An alternative possibility is that both firms and consumers are initially unaware of risk class membership and any increase in information concerning risk type is symmetric. As an example, consider the possibility that two types of automobile (e.g., Vegas and Pintos) are initially indistinguishable from each other with respect to their propensities to incur costly damages due to accidents. Information which determines that one type of automobile is a higher risk automobile than the other later becomes available simultaneously to both insurers and insureds. If all of the remaining assumptions of the economic model used in Sections III and IV are maintained then categorization has a very different impact than for the asymmetric information case.

Under the assumption of symmetric information, consumers initially believe themselves to be "average risks" and are treated as such by firms. This being the case, firms will offer insurance at the pooled actuarially fair rate (before categorization) and consumers will purchase full coverage insurance. After categorization high and low risk types are costlessly identified and are offered insurance at their specific risk class actuarially fair rates. Although high risk types must pay a higher price than before categorization, they will continue to purchase full coverage insurance since they now believe that they are indeed high risk types and that the new (higher) price is in fact the actuarially fair one. Similarly, low risk types will also purchase full coverage insurance after categorization.

Therefore, there are no "consumption" or "production" efficiencies associated with categorization. This claim is reflected by the results that both the "average" price (cost) of insurance and the level of coverage chosen are identical before and after categorization. Furthermore, given that consumers do not initially (i.e., before categorization) know their risk class, they will view categorization as a process which randomizes their premiums. Under the assumptions mentioned above, therefore, categorization appears not to lead to any "economically useful" consequences. This claim is substantiated by noting that the possible result stated in Proposition 4 for the asymmetric information case <u>always</u> holds for the symmetric information case. That is, since individuals initially do not know their risk type, all consumers prefer that the process of categorization be suppressed. Therefore, the replacement of the assumption of asymmetric information with that of symmetric information strengthens the case for suppressing the use of categorization schemes.

### VII.3  Moral Hazard

This paper has dealt almost exclusively with the problem of adverse selection and the use of information in overcoming it. The problem of moral hazard which has created a much greater amount of concern among economists has been thus far ignored as a result of the implicit assumption that loss probabilities are invariant to individual behaviour. When individuals can affect loss probabilities by the use of certain costly activities (e.g., the utilization of safety devices) the purchase of insurance may reduce an individual's incentive to employ these activities. This phenomenon, called moral hazard, will occur if the insurer is unable to observe (at less than prohibitive costs) the use of such measures. That is, the problem of asymmetric information leads to the possibility of the

"inefficient" use of safety measures. Unlike the problem of adverse selection, the object of the asymmetry of information which causes moral hazard stems from the behaviour of consumers rather than their risk type. Nevertheless, since an individual's behaviour affects his loss probability, the precise source of the asymmetry of information may not even be known by the firm. Therefore, the introduction of information which allows firms to assess (even imperfectly) the use of safety measures by consumers may induce greater economic efficiency. If information concerning risk categories also possesses this attribute, then the conclusions concerning the desirability of categorization which have been examined in this paper should be modified.

An often overlooked aspect of the phenomenon of moral hazard is that its presence may actually lead to economically beneficial results. Consider, for example, the case of a risk averse individual who in the absence of insurance spends a certain amount of money on a safety measure in order to reduce the probability of a loss. Since he is risk averse it is quite possible that the amount he will spend is greater than the expected value of the savings associated with the reduction in his probability of a loss. Since insurance firms can more effectively absorb the costs of risk bearing, the abandonment of such an activity in this case may actually be an economically desirable consequence of purchasing insurance. This phenomenon is of particular economic interest when the activity being insured involves the use of various productive techniques. For example, suppose a farmer is faced with two possible techniques, one of which requires higher costs per unit of expected output. If the more costly technique produces a "less risky" pattern of output, the risk averse farmer may nevertheless use it even though he suffers a reduction in his expected value of profits. If the

purchase of insurance induces the farmer to use the more risky technique then he will receive a higher level of expected profits. Such a "switch" in technology is economically beneficial since the insurance firm effectively deals with the problem of risk while the farmer employs a technique which, in an expected value sense, is more efficient. This aspect of moral hazard creates no serious consequences for private insurance markets since the insurer need only increase his premium to account for the use of the "more risky" technology while farmers will purchase this insurance and make use of the "more efficient" technique of production.

If the purchase of insurance leads to the abandonment of economically efficient safety measures then moral hazard may represent a serious social problem. The source of this problem is the asymmetric nature of information. Firms, if unable to observe the use of costly safety measures made by clients, must take into account the fact that the purchase of insurance generally reduces incentives to employ such measures. The price of insurance must be adequately high to compensate for this phenomenon. This phenomenon is a social problem since consumers would prefer to increase the use of "efficient" safety oriented activities provided insurance firms are willing to make a corresponding adjustment to the price of insurance. However, if each individual (correctly) perceives that his own use of costly safety measures results in only a negligible contribution to the reduction in aggregate losses and hence the price of insurance, the employment of these measures will be abandoned. If firms could observe the use of such safety measures then contracts which hold each individual accountable for his behaviour could be constructed and these contracts would be economically efficient.[28] It is the problem of asymmetric information which leads to the misallocation of resources (i.e., away from "efficient" safety techniques).

There are various methods of dealing with this problem. The simplest one is the use of only partial insurance coverage. If consumers must pay for a portion of their losses then some incentive remains for individuals to employ costly safety measures. This outcome, however, will not be a first-best efficient one; that is, it will represent a less efficient allocation of resources than the full information situation. Several other methods of dealing with moral hazard (in particular, legal ones) are discussed in Brown [1978-79]. In the remainder of this section the possibility that the acquisition of information relating to loss probabilities will lead to improvements in the allocation of resources is examined.

If categorization leads to an increase in the use of safety measures or a reduction in the extent to which individuals (especially high risk types) participate in risk-creating activities then the adverse effects of insurance purchasing under conditions of asymmetric information (i.e., moral hazard) may be mitigated. In the models employed in this paper the assumption that loss probabilities are exogenous precludes the possibility of reducing aggregate losses. Even if this assumption is relaxed, however, the use of categorization schemes will not necessarily lead to such a result. Suppose that we consider losses associated with driving automobiles and, as for the example used earlier, assume that the probability of a loss depends on the number of miles driven per year. If the characteristic sex is imperfectly correlated with mileage driven then firms will use a premium schedule which assesses a relatively higher premium to males.[29] The increase in the price of insurance to males may (i) induce males (i.e., members of the high risk category) to purchase less insurance and substitute for it by increasing expenditure on safety measures (if available) or

(ii) induce members of the high risk category to abstain altogether from the risk-creating activity. Either of the above effects will reduce aggregate losses and hence may be economically more efficient than the situation before categorization. However, a thorough analysis which includes the effects of categorization on members of the low risk category ought to be undertaken before making any general statements concerning the effectiveness of categorization in dealing with the problem of moral hazard. With respect to the automobile accident example, if members of the high risk category are not induced to stop driving and safer driving habits are not encouraged by the increased price of insurance then the adverse effects of moral hazard will not be reduced as a result of categorization.

An important point to note about the above example is that there is no direct incentive for males to drive fewer miles (except possibly not to drive at all) even though it was assumed that mileage driven was the underlying factor leading to the categorization scheme. The reason for this phenomenon is that by driving fewer miles an individual is not as a result assigned to the low risk category. Also, by assuming that characteristics are unalterable a sex change is also excluded as a method which males can employ to obtain a lower premium.[30] Furthermore, even if the information is extremely accurate (e.g., even if a male is a high risk type with probability 0.99) no direct incentive to reduce losses is necessarily provided by a categorization scheme if the characteristic used is itself not an underlying factor in determining the loss probability.[31] This, of course, need not be the case. If, for example, insurance is offered to teetotalers at a lower price than to others then an incentive is provided to individuals to become teetotalers. If people are safer drivers as a direct result of not drinking alcohol (i.e., if being a teetotaler isn't simply

correlated to some other underlying factor) then those who become abstainers (at least while driving) actually become safer drivers. It is, therefore, possible that categorization will lead directly to safer habits.

At this point in time there appears to be no adequate treatment of the relationship between the problems of adverse selection and moral hazard. Given the importance of moral hazard, this fact represents a serious omission from the study of insurance problems. Such a study is required before a truly comprehensive set of recommendations for dealing with the issue of categorization can be compiled. If, however, the risk-creating activity being considered is one in which (i) individuals' participation is not influenced by the price of insurance, (ii) economically efficient safety measures are either nonexistent or their use is unaffected by changes in the price of insurance and (iii) characteristics used by categorization schemes are unalterable or are not direct underlying factors influencing the "riskiness" of the activity, then the problem of moral hazard can be ignored when considering the welfare implications of categorization.

## VIII. Summary and Conclusions

The problem of choosing policies concerning the categorization of risks is a complex one. It involves issues related to economic efficiency such as moral hazard, adverse selection, and risk management of the firm. It also involves normative issues such as price discrimination and income inequality. Many of these issues have not been examined extensively enough to provide a comprehensive set of guidelines by which to assess the desirability of categorization schemes. However, the analysis in this paper does suggest a piecemeal (i.e., case by case) approach rather than a single general policy. Furthermore, the policy of laissez-faire is seriously questioned.

In Part I of this paper some simple economic models of insurance markets are presented in order to investigate some of the normative issues of categorization. The essential purpose of this part of the paper is to discredit the use of price discrimination as a criterion by which to judge the merits of schemes which imperfectly categorize risks. The principal conclusions of this part of the paper are:

(i) All individuals (including low risk types) may prefer an equilibrium with price discrimination to one without price discrimination (see Proposition 1).

(ii) Given an initial equilibrium with no price discrimination, the use of imperfect information to categorize risks may lead to a situation with price discrimination (see Remark 1).

(iii) For a general class of equilibria imperfect categorization leads to a reduction in overall price discrimination if aggregation over the extent of individuals' price discrimination is done linearly with equal weights applied to all individuals. However, "horizontal" price discrimination is always increased by imperfect categorization (see Remark 2).

(iv) That the use of a linear method of aggregation over the extent of individuals' price discrimination is not ethically compelling is strengthened by the fact that it is possible that even low risk types will prefer that the process of categorization be suppressed. That is, even though the use of categorization schemes favours low risk types in terms of average (or expected) price discrimination, the anticipation of a prospective categorization scheme may make low risk types worse off relative to the prospect of no categorization. This implies that consumer's sovereignty is not consistent with the notion of price discrimination (see Proposition 4).[32]

Although the results from Part I of this paper can be extended to some other problems (e.g., in the labour market) it is not intended here to suggest that the general issue of discrimination has no ethical relevance or that it should be ignored. However, a concern over price discrimination doesn't seem appropriate (for reasons given above) in the context of the problem of imperfectly categorizing risks in the insurance industry.

The economic models used to develop the arguments in Part I of this paper are not sufficiently complex to capture many of the important phenomena of insurance markets (i.e., other than adverse selection). Therefore, although these models are adequate tools with which to investigate the issue of price discrimination, they are not sufficiently "realistic" to provide a comprehensive set of criteria by which to form policies concerning the desirability of categorization. An attempt to include some of these problems in the analysis is made in Part II of this paper. The results of this undertaking are very tentative (some more so than others) and future areas of research are indicated by them.

The principal conclusions from Part II are:

(i) Other aspects of insurance markets may also be affected by categorization. For example, income inequality may be increased as a result of categorization (see Proposition 5). Also, if firms face a "costly to maintain" bankruptcy constraint, categorization will diminish the risk management problem of firms and lead to a reduction in the average price of insurance. Therefore, the objectives of income equality and increased solvency for firms (or reduced prices of insurance) may be affected in opposite directions as a result of categorization. Hence, conflicts over policies concerning categorization may arise.

(ii)  The problem of moral hazard is precluded from the models in Part I of this paper by the implicit assumption that loss probabilities are exogenously determined.  If individual behaviour has an impact on loss probabilities (e.g., through self-insurance, self-protection or by reducing participation in the risk-creating activity) then information may alter, at least indirectly, total losses sustained in the economy.  Therefore, economic efficiency may be enhanced by the use of imperfect categorization.

(iii)  If information is symmetric rather than asymmetric then the case for suppressing the use of categorization is strengthened.  That is, suppose both consumers and firms are initially unaware of the existence of risk classes and that information which relates risk type to some characteristic becomes available (simultaneously) to consumers and firms.  This being the case, the impact of categorization is to randomize premiums.  In the absence of adverse selection, moral hazard or a risk management problem, categorization has no economically beneficial consequences.[33]

After taking into account the above aspects of categorizing risks in insurance markets and after making whatever tradeoffs among objectives desired, problems involved with implementing a successful policy may still persist.  For example, when information is "socially desirable" there may be no incentive for firms to acquire such information if it cannot be patented.  Since information may be transmitted via the price that a firm charges, it may be the case that costly information gathering will not provide any private benefits.  Therefore, a policy of laissez-faire may not be optimal when categorization is desired.  Alternately, suppose information is socially undesirable and costless to firms.  If the government wishes to suppress its use for categorization then firms will try to circumvent such a policy by, for example, (a) use of proxy characteristics to categorize risks or (b) by using other discriminatory measures such as different hiring policies if the insurer also happens to be the employer of the insured.

## Footnotes

[1]There are other implications of insurance firms being faced with a heterogeneous population of risks. One of these is the risk management problem faced by firms. Although this issue is also discussed in this paper, the problem of adverse selection receives much more attention.

[2]This result is derived in Schmalensee [1981] where the effects of employing imperfect information with respect to price discrimination are carefully investigated.

[3]From Sen [1970, p. 59]; 'A value judgment can be called "basic" to a person if the judgment is supposed to apply under all conceivable circumstances, and it is "nonbasic" otherwise.' Since the use of price discrimination as a criterion by which to assess categorization may depend (at least in part) on whether the information supporting the scheme is perfect or imperfect (i.e., upon which of two different factual circumstances exists) then the choice is concerned with a nonbasic value judgment.

[4]It should be noted, however, that in this paper no significance is placed on the type of characteristic used to categorize risks (e.g., sex vs. geographic location).

[5]An actuarially fair price is one which is equal to the expected value of losses.

[6]A formal demonstration of this nonexistence result is given in Dasgupta and Maskin [1977]. They also consider the possibility of firms using mixed strategies. The nonexistence result continues to hold in this case also.

[7]The issue of whether or not the Wilson foresight assumption accurately reflects firm behaviour is not considered in this section. Although it is not characteristic of a perfectly competitive model, Wilson [1976, p. 57] observes that

> 'what is missing in this model...is an adequate description of how firms' expectations are formed...(as well as) a more complete description of...their past histories.'

Dasgupta and Maskin [1977] take a small step in this direction.

[8]To make clear the nature of imperfect categorization consider the following example. Suppose that the probability of having an automobile accident depends only on the number of miles driven per year and that, although consumers know how many miles they will drive each year, firms initially are unable to obtain any information concerning this factor. In this case information is said to be asymmetric. Suppose it is discovered later by firms that, although some females drive more than some males, on average males drive more miles per year than do females. Insurance firms could then use sex as an imperfect signal which determines whether an individual is more likely to be a high or a low risk type. It is imperfect since some males who drive a "small amount" and so are actually low risk types (assuming a positive relationship between mileage driven and accident probabilities) will, nevertheless, be assigned to the high risk category. The opposite would hold true for females. Therefore, although the high risk category (males) will contain a larger proportion of high risk types than does the aggregate population (males and females), some misclassification will persist. A similar result holds for the low risk category (females).

[9]If low risk types are not better off in the pooling equilibrium then it will not be offered. The less trivial result that high risk types also prefer the pooling contract is shown in Hoy [1981a].

[10]Since firms design their policies to attract (as much as is possible) low risk types, they will offer that pooled contract which is most preferred by low risk types. That is, firms will offer a coverage level which low risk types most prefer. Since members of the high risk category are faced with a price which is higher than the one before categorization, we need to investigate the manner in which individuals alter their demand for insurance as a result of price changes. This is done in Hoy and Robson [1981] where it is argued that it is empirically implausible that consumers will not wish to consume less insurance when the price rises (i.e., insurance is not likely a Giffen good). Nevertheless, the assumption that the proportion of insurance purchased is not altered after categorization is theoretically possible and does provide a benchmark case from which to analyze the issue of price discrimination.

[11]Clearly, this definition would not suffice if there were other costs associated with categorization.

[12]This conclusion follows in a more general context because low risk types are always more likely to be assigned to the low risk category than are high risk types.

[13]This fact is noted in Schmalensee [1981] where he provides a much more comprehensive (and illuminating) discussion of the effects on price discrimination of using imperfect information to differentiate among consumers.

[14]At least none that I can think of.

[15]In fact, it is assumed that each individual's expectations are rational in the sense that his probabilities are substantiated by the actual relative frequencies of individuals of similar risk type. This behaviour is consistent with the initial assumption of asymmetric information.

[16]This follows from the assumptions that (i) the aggregate population has 50% low risk types, (ii) 75% of the low risk category is made up of low risk types and (iii) the two risk categories are made up of equal numbers of individuals.

[17]In this sense markets are incomplete. Reasons for such an outcome generally focus on transactions costs or nonobservability (by consumers) of the various states of nature. A sufficient reason for nonexistence of such "no-categorization" contracts is nonenforceability of long-term contracts.

[18]Those in favour of an ex post viewpoint often argue for its relevance in situations where individuals' subjective probabilities of future states of the world differ. From the consumers' perspectives this assumption does not hold in the models underlying the analysis in this paper. For illuminating discussions of this issue see Hammond [1976] and Harris and Olewiler [1979].

[19]That is, accepted by economists who favour a nonpaternalistic role for government.

[20]This result follows if government regulation is sufficiently sophisticated to reflect this relationship. Such is not always the case.

[21]Note that this quotation corresponds to the intersecting spheres of activity between government and private insurers which was mentioned at the beginning of this section.

[22]Klock and Pfeffer [1974, p. 190] suggest that for lines of insurance other than life the purpose of regulation is to ensure that rates are 'adequate, reasonable, and not unfairly discriminatory' (underlying my own).

[23]For a general discussion on the way information can be transferred through prices see Grossman and Stiglitz [1980].

[24]An alternative policy is for the government to take on the task of costly information acquisition.

[25]At an "equal wage for equal work" females impose a greater cost on firms than do males because of the relatively higher cost of providing females with pension benefits. A natural consequence of this phenomenon is that firms will want to give preferential hiring or wage treatment to males.

[26]See Klock and Pfeffer [1974, Chapter 13] for a discussion of this view.

[27]For example, rating bureaus which allow firms to pool information concerning the loss experience of their clients may well affect the behaviour of firms. The particular effects are likely to depend on the underlying market structure of the industry.

[28]Furthermore, all consumers would prefer such contracts.

[29]Recall, it was assumed that "on average" males drive more miles per year than do females.

[30]The assumption that characteristics are unalterable is, of course, more drastic than is required. One only need assume that the cost of changing characteristics is greater than the benefits.

[31]As Brown [1978-79, p. 142] notes:

> 'Certain classes of motoring can be identified and higher
> premiums charged to those classes more likely to result
> in accidents or more likely to have a high incidence of
> serious injuries (such as driving by young people or motor
> cycling). This could perhaps discourage some people from
> participating in that type of motoring but it would, of
> course, not do anything to encourage safer habits among
> those who chose still to participate.'

This excerpt requires the qualification that the increased price of

insurance does not induce the purchase of less insurance and hence stimulate

the use of safe driving habits which represent a substitute to insurance.

[32]The welfare implications of categorization are sometimes ambiguous,

as illustrated by Proposition 3. In addition, welfare analysis may lead to

conflicting results when various perspectives of the consumer are taken.

Nevertheless, the analysis in this paper does demonstrate some serious

inadequacies of the use of price discrimination as a criterion by which

to judge the relative merits of categorization schemes.

[33]See Hoy [1981c] for a discussion of categorization under conditions

of symmetric information and the existence of a risk management problem.

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