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INTRODUCTION

This paper examines the effects of alternative regulatory regimes which seek to remove so-called gender-based 'discrimination' in the market for insurance when it is costless to categorize differences in risk, both in cases where individual risk differences are uniquely signalled by observations on gender, and also in cases where they are not. The alleged discrimination in insurance markets arises because of gender-based differences in the price of insurance. Where risks can be perfectly and costlessly categorized by gender, it is difficult to see how the market discriminates against one or other gender group. Indeed, if price differentials solely reflect actuarial differences in risk, it is arguable that discrimination against low-risk groups is *created* by policies that serve to remove these differentials. For example, in the context of United States employer-based pension plans, McCarthy and Turner (1993) argue that gender-based risk classification results in less gender discrimination than a unisex approach consistent with the Civil Rights Act (1964), and estimate that unisex policy results in discrimination equal to 23.4 percent of male pension compensation.

While the 'actuarial' approach to discrimination is both defensible and appealing, it is less likely to appeal to those who argue that people should not have to pay more for something merely because they have suffered the bad luck of Nature's draw. Further, where gender is imperfectly correlated with risk, intervention in insurance markets is sometimes justified on the grounds that low-risk females, say, should not pay more for insurance than similarly low-risk males just because markets cannot separate low-risk females from their high-risk counterparts merely by utilizing the costless signal of gender. Regulators taking these arguments seriously are then faced with the problem of either how to compensate high-risk gender groups for their bad luck, or how to compensate low-risk subsets of relatively high-risk gender groups for their apparently arbitrary treatment.

In practice, legislators appear to favour some form of unisex pricing. In the United States, for example, two decisions by the Supreme Court (*Los Angeles Water and Power vs. Manhart* (1978) and *Arizona Governing Committee vs. Norris* (1983)) interpret the legal definition of discrimination in the Civil Rights Act (1964) to include the use of separate mortality tables for females and males in calculating employer-based pension benefits, and which has been extended to include any form of employee benefit in a 1986 decision of the Equal Employment Opportunity Commission. In 1990, the European Court of Justice ruled similarly in prohibiting gender-based differences in pension benefits in the European Community. Unisex insurance pricing statutes covering automobile, life, and disability insurance exists in Montana and Massachusetts, and in six other states for automobile insurance in the United States. Puelz and Kemmsies (1993, p. 290) argue that unisex statutes "indicate political victories for those constituencies who define fairness in insurance pricing as the equalization in the premium disparity between some observable categories of policyholders" and rather than correcting for market failure as conventionally interpreted, note that "constraining insurers from using their informational content is not efficiency enhancing in insurance markets".

Against the tide, however, the New Zealand Human Rights Act (1993) maintains an existing exemption for insurance in the area of gender-based discrimination, Section 48 providing that it shall not be a breach of the Act to offer annuities, life, accident or other insurance policies on different terms and conditions for different gender groups provided there is an accepted actuarial, statistical or other relevant basis for differentiated prices. What is particularly interesting is that Parliament rejected adoption of contrary propositions in the Human Rights Bill (1992). There, it was proposed that when the exemption of gender-based premiums was removed on January 1, 1995, it would be unlawful for any person supplying goods, facilities, or services to the public or any section of the public -

> (a) to refuse or fail on demand to provide any other person with those goods, facilities or services; or
>
> (b) to provide any other person with those goods, facilities, or services on less favourable terms than those upon or subject to which he or she would otherwise make them available -

by reason of any prohibited ground of discrimination, gender being one such ground. It is arguable that if enacted, such legislation may have borne different interpretations. These are considered in the next section.

In what follows, it is demonstrated that the welfare effects of alternative regulatory regimes can be quite different depending on the nature of the regime, whether or not risks are perfectly or imperfectly categorized, and whether or not insurers can enforce exclusive contracts. Rather than addressing the effects of insurance market regulation *per se*, much of the literature addresses the related issue of the efficiency (and distributional) effects arising when insurers begin using information on characteristics such as gender to categorize risks. Examples include Hoy (1982, 1984), where categorization is costless but where a characteristic such as gender is imperfectly correlated with risk, and Crocker and Snow (1986), who use a similar model to show that competitive equilibrium with costless categorization is potentially Pareto superior to a market equilibrium where categorization is absent, although the result does not necessarily hold if categorization costs are positive (see also Borenstein (1989) and Rea (1992)). In an empirical analysis of the annuities market, Rea (1987) considers a specific regulation implying that firms cannot refuse to sell insurance to a potential customer on the basis of the customer's gender, but only considers the case of perfectly categorized risks and where exclusive contracts cannot be enforced. Hoy (1989) also only considers perfectly categorized risks, but introduces moral hazard effects by permitting insureds to have different capacities to transform self-protection efforts into risk-reduction. In a model of automobile insurance, Riley (1983) demonstrates how the nature of equilibrium depends on the way in which risks differ by gender, and where a subset of males have the highest risk. Apart from Rea (1987) and Hoy (1989), the nature of gender-based risks is such that along with informational asymmetries between insurers and insureds, adverse-selection equilibria emerge. Properties of such equilibria are surveyed by Dionne and Doherty (1992), while the general area is surveyed by Harrington and Doerpinghaus (1993). While closely related to the 'risk categorization' literature, the present paper emphasizes the welfare effects of specific regulatory regimes designed to reduce or remove 'discrimination', although in one case the regulation serves to remove the source of information which insurers may be using to categorize risks.

ALTERNATIVE REGULATORY REGIMES

Five alternative regulatory regimes which seek to reduce or eliminate 'discrimination' in insurance markets are considered. Most of these embody some form of unisex pricing requirement, consistent with the norms of practice. One regime, however, prohibits insurers from requesting gender-based information from potential customers. In all cases, either explicitly or implicitly, the assumption of Rea (1987, p. 56) that "A ban on sex-based insurance is assumed to mean that it is unlawful to refuse to sell insurance to a customer because of his or her sex" is adopted. Rea's further assumption that policies incorporating less than full insurance may be offered is adopted in only three cases, however. For purposes of illustration, it is assumed that females, at least on average, are a higher-risk group than males.

Regime 1

Any insurer must offer full insurance contracts, and no person can be denied the right to purchase an offered contract on the basis of gender.

Regime 2

Any insurer must set a uniform price of insurance for females and males, and insureds are free to optimize at this price.

Regime 3

Any insurer must set a uniform price for females and males. Full-insurance contracts need not be offered, but no contract can be denied to any potential customer on the grounds of gender.

Regime 4

Conditions as for Regime 3, except for an additional requirement that any contract observed to be purchased by males (but not females, even though available to females) at a price in excess of that for contracts observed to be purchased by females (but not males, even though available to males) is not permitted.

Regime 5

No direct question relating to gender may form part of an insurance proposal.

Regarding Regime 1, if risks are costless to categorize perfectly, unregulated insurance market equilibrium will be characterized by full insurance of females and males, and regulators may believe it to be appropriate that the full insurance characteristic is maintained in a regulated equilibrium.[1] Regime 2 might be justified on the grounds that under perfectly categorized risks, full insurance contracts are consistent with optimizing behaviour of agents, and that regulators believe that this property should be maintained in a regulated equilibrium. It might also be justified if regulation would otherwise lead to quantity-constrained contracts being offered to one or other gender group, in response to protests from one group that they are quantity-constrained while the other is not. Regime 3 embodies many features of anti-discrimination legislation and proposals for reform, and its conditions are strengthened in Regime 4 to capture the unease that may be felt when regulators discover that high-risk groups may still be paying a higher premium per dollar of insurance cover than low-risk types even when Regime 3 is in operation. Regime 5 has no unisex pricing requirement, although regulators may believe that unisex pricing will be the outcome, and is similar in spirit, say, to United States anti-discrimination legislation which seeks to prevent information on such matters as gender, marital status, and ethnicity from influencing the terms of employment contracts.

A SIMPLE MODEL OF THE INSURANCE MARKET

It is assumed that there are two states of the world. In state 1 (the good state) a person suffers no disability, while in state 2 (the adverse state), a disability is suffered which results in a given level of income loss D. Further, assume that the probability of disability is, on average, higher for females than for males, that is $p_F > p_M$.[2] A distinction is made between perfectly and imperfectly categorized risks. In the former case, all females have a higher probability of disability than all males, while in the latter, a small proportion of females are low-risk types and a small proportion of males are high-risk types. In both cases, insurers can costlessly observe the gender of their potential customers (except under Regime 5), but with the case of imperfectly-categorized risks, while providing a unique signal of average risk, gender provides no information about whether a particular person of given gender is high-risk or low-risk. Insureds, however, are assumed to possess this information. This approach follows Hoy (1982), who adapts the model of Rothschild and Stiglitz (1976) for the purpose.

Insurers are assumed to be risk-neutral and to maximize expected profits, while risk-averse insureds maximize identical state-independent concave expected utility functions. An insurance contract is described as a vector $\alpha = (\alpha_1, \alpha_2)$, where α_1 is the premium and α_2 is the net payout. Define the price of insurance $q = \alpha_1/\alpha_2$ as the premium per dollar of net payout. Further, assume that for $q \in [p_M/(1-p_M), p_F/(1-p_F)]$, the solution to any agent's unregulated market optimization problem is interior.

The equilibrium concepts used include (a) the Nash equilibrium of Rothschild and Stiglitz (1976) which requires zero expected profits across all contracts offered by a firm, along with the condition that there exists no contract outside the equilibrium set that would make a nonnegative profit if offered, (b) the Wilson (1977) E2 equilibrium which replaces the second requirement in (a) by the condition that there exists no set of contracts making positive profits even when those which make losses as a result of this entry are withdrawn, and (c) the generalization of the Wilson equilibrium due to Spence (1978) and Miyazaki (1977) which permits internally cross-subsidized contracts within firms.[3] In addition, any regulatory constraint must also be satisfied.

The regulatory equilibria emerging under each regime are now examined.

Perfectly Categorized Risks

In an unregulated perfectly competitive insurance market, equilibrium will be characterized by zero profits being earned on any insurance contract sold. Risk-averse insureds will choose to insure fully so as to equalize their incomes across states. The price of insurance will be higher for females, reflecting their excess risk, so an insured female will have less income (and consumption possibilities) in each state than a corresponding male. Figure 1 illustrates the outcomes, where W_1 is income in the good state, W_2 is income in the adverse state, and EM and EF are respective zero expected profit loci (fair-odds lines) for males and females. Females buy the contract α_F* and males buy α_M*, which are welfare superior to the zero insurance point E. The locus EC is the market fair odds line. Any contract along EC sold to both females and males makes zero expected profits.

The contracts offered and purchased under Regimes 1-5 depend in part on whether insureds can supplement a partial insurance contract bought from one firm with another contract bought from another firm. No restriction *per se* on the number of contracts that a firm can offer is imposed. On most occasions, however, it is assumed that firms can impose exclusive contract requirements on their customers, and so prevent insureds from supplementing their purchases.[4]

Regime 1 Equilibria

Regime 1 produces a pooling equilibrium contract $\hat{\alpha}$ in Figure 1. Females and males buy the same contract, are fully insured, and have the same income in each state of the world. Females are subsidized by males, and the size of the welfare loss for each male is increasing in the proportion of females in the insurance pool. Females are compensated for the vagaries of Nature to the best extent possible assuming a balanced budget for insurers. The contract $\hat{\alpha}$ could not be sustained as a Nash equilibrium in the absence of the regulatory constraint, since there exists a contract in the neighbourhood of $\hat{\alpha}$ which would attract males (but not females) and which would make positive profits. Such a contract, however, involves partial insurance, which is not permitted under Regime 1. Similarly, a Wilson equilibrium contract α_M^0 which maximizes utility for males along EC, and is sold to everybody when it is introduced and $\hat{\alpha}$ is withdrawn (since $\hat{\alpha}$ makes losses when sold only to females), cannot satisfy Regime 1 since although the same contract is offered to both females and males, it also involves partial insurance. A Spence-Miyazaki equilibrium involves full insurance for females, but only partial insurance for males, and so fails to meet the regulation. However, $\hat{\alpha}$ is a regulated Nash equilibrium, since full insurance contracts offering more cover than $\hat{\alpha}$ will make losses, while full insurance contracts offering less cover will attract no buyers.

Regime 2 Equilibria

Regime 2 permits the possibility of quasi-Walrasian equilibria, where females and males buy their desired insurance contracts at a uniform price, and zero expected profits are made on sales of all contracts, requiring subsidisation of females by males. Consider Figure 1. If $q = p_M/(1-p_M)$, females and males purchase contracts $\tilde{\alpha}_F$ and α_M*, respectively. Zero profits are made on sales of male contracts, and losses are made on female contracts. Now let $q = \bar{p}/(1-\bar{p})$, where $\bar{p}$ is the weighted average probability of disability, the weights being the shares of each gender group in the insurance pool. Consider the full insurance contract $\hat{\alpha}$ on EC. If both females and males buy $\hat{\alpha}$, zero profits across all sales are made. If insurance is offered under these terms, however, neither group will choose $\hat{\alpha}$. The optimality of full insurance for each group at prices reflecting respective gender-based disability probabilities along with the result that the demand for insurance is strictly decreasing in price[5] implies that males will underinsure while females will overinsure. Since zero profits would only be made if high-risk females also bought the contract purchased by males, losses will be made across all sales. Further, let $\hat{\alpha}'$ be a full insurance contract purchased at price q in the open interval $(\bar{p}/(1-\bar{p}), p_M/(1-p_M))$. Since $\hat{\alpha}'$ lies to the right of

EC, losses on sales of $\hat{\alpha}'$ to females exceed profits on sales to males when both buy this contract. At price q, however, neither males nor females will choose this contract. Again, males will be underinsured and females overinsured. As a consequence, profits on optimal male contracts will be lower, and losses on female contracts higher, than on sales of $\hat{\alpha}'$ to both groups. Since $\hat{\alpha}'$ loses money overall, even greater losses are sustained on optimal female and male contracts. Thus, no uniform price equilibrium exists with a price of insurance at least as small as $\bar{p}/(1-\bar{p})$.

Now let $q = p_F/(1-p_F)$. Zero profits are made on sales of the full insurance contract α_F^* to females, while positive profits are made on sales of $\tilde{\alpha}_M$ to males. Since profits are negative for prices less than or equal to $\bar{p}/(1-\bar{p})$ and are positive for $q = p_F/(1-p_F)$, given that the expected profit function is continuous in the price of insurance, the intermediate value theorem assures the existence of at least one price q* for which profits are zero in the open interval $(\bar{p}/(1-\bar{p}), p_F/(1-p_F))$.[6] Figure 1 illustrates such an equilibrium, where females purchase their optimal contract α_F^1 along ER, males purchase their optimal contract α_M^1, and zero profits are made across sales of both contracts.[7] Females are overinsured while males are underinsured. Males, however, are not quantity-constrained since they choose to be partially-insured at price q*.

As with Regime 1, compared to the unregulated situation, females are better off and males are worse off.[8] Regimes 1 and 2 cannot be unambiguously ranked, however, since α_F^1 may be either better or worse than $\hat{\alpha}$ for females, while α_M^1 may similarly be either better or worse than $\hat{\alpha}$ for males.

Regime 3 Equilibria

Regime 3 permits insurers to offer quantity-constrained contracts, but prevents them from denying customers access on the basis of gender. Figure 1 illustrates the two possible equilibria where firms can enforce exclusive contracts, namely, the separating equilibrium contract pair $\{\alpha_F^*, \alpha_M^2\}$ and the pooling equilibrium α_M^0. The former are sustained as a Nash equilibrium, while both are sustained under the Wilson E2 equilibrium concept. For the pair $\{\alpha_F^*, \alpha_M^2\}$, females are fully insured at a price reflecting female disability probability while males are quantity-constrained at a price reflecting male disability probability. For α_M^0, males are underinsured but are not quantity-constrained since this contract maximizes male utility at a price reflecting market odds. Although females purchase the same contract as males, they are quantity-constrained at this price since α_F^0 is their optimal contract along EC.

The reasons for these outcomes are as follows. Suppose that males consider α_M^2 at least as good as α_M^0. If α_M^0 is offered along with α_M^2, only females will purchase α_M^0, in which case it will make losses and be withdrawn. Contract α_M^2 offers the highest utility to males along EM that can be sustained without also attracting female buyers, while α_F^* is the best contract that can be offered to females along EF. The (Nash) equilibrium is $\{\alpha_F^*, \alpha_M^2\}$. Males are now worse off compared to the unregulated situation, while females are no better off, and buy the same contract as they would prior to regulation. The outcome is Pareto-inferior to the unregulated situation.

Suppose, however, the males prefer α_M^0 to α_M^2 . The Nash equilibrium cannot now be sustained, since if α_M^0 is offered, males will desert α_M^2 for α_M^0 while females will desert α_F* for α_M^0 . Since α_M^0 lies on the market fair odds line EC, it makes zero profits when sold to both groups. A contract along EC offering a little more insurance than α_M^0 will attract females but not males, and will make losses, while a contract offering a little less insurance than α_M^0 will attract nobody. The pooling equilibrium α_M^0 involves a reduction in male utility relative to the unregulated equilibrium, and an increase in female utility. Females and males are both underinsured, but males are optimizing their insurance purchases at a price of insurance reflecting market odds. Females, however, are quantity-constrained at this price. The contract α_M^0 is sustained as a Wilson E2 equilibrium in that although there exists a contract γ that would be purchased only by males and would make positive profits, such a contract will not be introduced since α_M^0 would make losses when sold only to females, and would be withdrawn. Females would then buy γ, which makes losses when both groups purchase it. Under the Wilson perfect foresight assumption, γ will not be introduced.

If exclusive contracts cannot be enforced, however, Rea (1987) shows that α_M^0 is the unique Nash equilibrium. The reason is that females will now purchase α_M^2 even when the contract α_F* (to which it is indifferent) is available, and will supplement this contract with sufficient additional insurance at price q_F to leave themselves fully insured. It may even pay males to supplement α_M^2 with purchases of (partial) insurance at price q_F. But firms selling α_M^2 to both females and males will make losses on overall sales, and will be forced to withdraw α_M^2, leaving α_M^0 as the pooling equilibrium.

The pooling equilibrium α_M^0 clearly yields a higher level of utility for males than the full insurance contract $\hat{\alpha}$ on EC which is the equilibrium under Regime 1, since α_M^0 is maximizing for males for the same constraint. Contract $\hat{\alpha}$, however, is better for females than α_M^0, since females would prefer to be overinsured at price $\bar{q}$. Further, α_M^0 is welfare superior to the equilibrium contract α_M^1 for males under Regime 2, since males are maximizing in both cases, but at a lower price of insurance in Regime 3, a fact which prevents Regime 2 equilibria from being candidates for equilibrium under Regime 3. For females, however, welfare can be either higher or lower between regimes 2 and 3, depending on their ordering of α_F^1 and α_M^0. If, however, the separating equilibrium $\{\alpha_F^*, \alpha_M^2\}$ applies, compared to Regime 2, females must be worse off, while males are either better or worse off, depending on their ordering of α_M^1 and α_M^2.

The enforcement of Regime 3 has some interesting implications for the structure of the insurance industry. Prior to regulation, all firms could be offering different full-insurance contracts to females and males, respectively. Since these involve gender-specific prices, they are outlawed under Regime 3. If the pooling equilibrium α_M^0 applies, all firms can offer the same contract at the unisex price $\bar{q}$. But if the separating equilibrium $\{\alpha_F^*, \alpha_M^2\}$ applies, no firm can offer *both* contracts, since a lower price is being offered on the contract sold to males, even though females are not denied the right to purchase α_M^2. As a consequence, the market segregates into firms offering full insurance to females at price q_F and firms offering partial insurance to males at price q_M.

Regime 4 Equilibria

Regulators may be concerned about the properties of the equilibria under Regime 3 for two reasons. First, under the separating equilibrium $\{\alpha_F^*, \alpha_M^2\}$, low-risk males are observed to be still purchasing insurance at a lower price than high-risk females, who are not benefitted by the regulation since they continue to buy the same contract. This may be seen as discriminatory, and against the spirit, if not the letter, of the regulation. Regime 4 prevents those insurers selling the partial insurance contract α_M^2 to males at price q_M from continuing their practice, even though females are able to purchase α_M^2 if they want. Alternatively, if all firms are offering α_M^0, females may complain that they cannot purchase their desired quantity of insurance at price $\bar{q}$. The tightening of the constraint under Regime 4, however, has no impact in this case, since the pooling equilibrium α_M^0 meets Regime 4's requirements in any case. If the regulator meets this objection by reverting to Regime 2, however, it is *not* the case that females will necessarily be better off by being able, as are males, to optimize at a break-even price of insurance, since the (separating) equilibrium price under Regime 2 exceeds the (pooling) equilibrium price under Regime 3.

Under Regime 4, α_M^2 can no longer be offered by some firms in conjunction with α_F^* being offered by other firms. If females prefer α_M^0 to α_F^*, then α_M^0 becomes the pooling equilibrium, raising the welfare of females at the expense of males. There is one case, however, where α_M^0 is *not* the equilibrium under Regime 4, namely, where females prefer α_F^* to α_M^0. Under Regime 3, such a case is irrelevant, since males necessarily prefer α_M^2 to α_M^0 in these circumstances, but under Regime 4, α_M^2 cannot be offered to males in conjunction with α_F^* since it carries a lower price. But if α_M^0 is offered, only males will buy it, females preferring to stick with α_F*. Although sales of $\alpha_M{}^0$ to males will make positive profits, its associated price $\bar{q}$ is less than that associated with α_F*, and so $\alpha_M{}^0$ must be withdrawn. The equilibrium then becomes either $\bar{\alpha}^1$, as illustrated in Figure 1, or the separating pair $\{\alpha_F{}^1, \alpha_M{}^1\}$. The pooling contract $\bar{\alpha}^1$ maximizes male utility at market odds subject to the constraint that female utility does not exceed the level consistent with female purchases of α_F*.

If the pooling equilibrium $\bar{\alpha}^1$ applies, the effect of imposing Regime 4 rather than Regime 3 is to further reduce the welfare of males without increasing the welfare of females. If the separating equilibrium $\{\alpha_F{}^1, \alpha_M{}^1\}$ applies, female welfare increases at the expense of males, since females prefer $\alpha_F{}^1$ to α_F* while males give up access to $\alpha_M{}^2$ which they necessarily prefer to $\alpha_M{}^0$ in these circumstances, and $\alpha_M{}^0$ is preferred to $\alpha_M{}^1$ since both contracts are optimizing for males but $\alpha_M{}^0$ carries a lower price.

Regime 5 Equilibria

If insurers cannot observe the gender of insureds, and possess no other unique signals of gender,[9] they will set contracts in such a way that females and males will reveal their gender by their choice of contract. Figure 2 illustrates these equilibria as either the Nash separating contract pair $\{\alpha_F*, \alpha_M{}^2\}$ or the Spence-Miyazaki separating pair $\{\alpha_F\#, \alpha_M\#\}$. Unlike Regimes 1-4, there is neither an explicit nor implicit requirement of unisex pricing. Consequently, all firms can offer the Nash contract pair, each of which break even when sold to females and males, respectively, and which maximize male utility subject to female utility not exceeding the level consistent with their purchase of α_F*. Again, females are no better off and males are worse off. The condition for the Nash pair to constitute equilibrium is that males weakly prefer α_M^2 to $\alpha_M\#$. The Spence-Miyazaki equilibrium holds where males prefer $\alpha_M\#$ to α_M^2, where the former contract maximizes utility for males at price q_M subject to the constraint that female utility does not exceed the level associated with the purchase of $\alpha_F\#$, and where $\alpha_F\#$ is a full-insurance contract for females at price q_F involving a unit subsidy from males at a rate such that sales of both contracts break even. In a Spence-Miyazaki equilibrium, males are worse off and females better off than without the regulation, and both are better off than under the Wilson pooling equilibrium contract α_M^0 under Regime 3 (or the pooling equilibrium $\bar{\alpha}^1$, if relevant under Regime 4). On the other hand, it is unclear whether $\hat{\alpha}$ offers a higher or lower level of utility than either $\alpha_F\#$ for females, or $\alpha_M\#$ for males.

Table 1 summarizes the signs of welfare changes for females and males under each regulatory regime. It is evident that even if it is assumed that low-risk males would choose to buy insurance at prices higher than that reflected by their probability of disability, it is not always the case that high-risk females will find their welfare levels improved under the various regulatory regimes considered in this paper. In the cases of Regimes 3-5, there are equilibria in which either females are offered the same contract as in the absence or regulation, or they are offered a lower-priced partial-insurance contract which makes them no better off. In each of these cases, however, males are worse off and so these equilibria are inefficient. In the remaining cases, females are better off at the expense of males.

In the absence of regulation, full insurance of both females and males implies that income can be distributed within households comprising one female and one male so that consumption levels of household members are state-independent. Apart from Regime 1, however, all regulatory equilibria, however, involve partial insurance for males. As a consequence, consumption of females and males will not be state-independent even with an equal income-sharing rule in the household. These issues become more pronounced for households in which the male is the sole or major breadwinner. While no attempt at a full treatment of optimal household insurance decisions in regulated markets is attempted here, two cases will be considered so as to illustrate the different implications for household consumption under different regulatory regimes when females and males make independent insurance decisions, and then combine to form a household.

Define the following four possible states for the household: in state 1, neither female nor male is disabled; in state 2 the female is not disabled, but the male is disabled; in state 3, the female is disabled but the male is not; in state 4, both are disabled. In terms of aggregate household consumption, if no insurance is purchased, the household ranking would be 1, 2=3, 4. If full insurance was purchased in unregulated markets, the ranking would be 1=2=3=4. If insurance market regulation leads to either of the pooling equilibria α_M^0 or $\bar{\alpha}^1$ as outcomes, given that these involve partial insurance for both females and males, the ranking of consumption across states is the same as in the zero-insurance situation, although the across-state variance in consumption will be smaller. However, if the regulated equilibrium is the separating pair $\{\alpha_F^1, \alpha_M^1\}$, the ranking is 3, 1, 4, 2. Household consumption is maximized when the female is disabled and the male is not, since the female is overinsured for the disability while the male is underinsured and consequently is paying out little by way of insurance premiums.[10] Further, the household has greater consumption when both females and males are disabled compared to a situation when only one party is disabled. Comparing states 4 and 2, for example, if both are disabled, the male's contribution to household consumption is limited because of his partial insurance, but this is compensated by the female being overinsured. If only the male is disabled, however, the household fares badly since the female is making considerable premium payments (without any payout) while the male is only partly compensated when he suffers a disability.

Imperfectly Categorized Risks

With perfect categorization, the set of high-risk types includes only persons of one gender, while the set of low-risk types also includes persons of one gender. This assumption is maintained in Rea's (1987) study of the annuities market, for which the low-risk type is the set of males. Rea argues that issues of adverse selection are unlikely to arise in this market, so that insurers have similar information on classes of risk as have insureds. However, the issues of adverse selection and overlapping risk classes are, in principle, separate. Perfectly informed insurers would offer full insurance to each risk type, and high-risk females would buy the same contract as high-risk males, for example. If females were riskier on average, though, a larger proportion of the female population would buy the high-risk contract than would the male population. The more interesting case is where females, say, are riskier than males on average, although some males are high-risk and some females are low-risk, and where this fact is known to insurers. What insurers do not know, however, is whether a given female or male belongs to the low-risk or high-risk group, whereas each individual knows the group to which they belong. This is the case analysed by Hoy (1982), Crocker and Snow (1985,1986) and Bond and Crocker (1991), who also introduce moral hazard.

The literature is not always clear in its distinction between Regimes 3 and 5; as seen above, they are not generally equivalent. Regimes 1,2 and 4 do not appear to be addressed. The motivation is generally of the form "What would be the nature of adverse selection equilibria if a costlessly observable and unchangeable characteristic, for example, gender, was suddenly made available to insurers and that this attribute was known to be imperfectly correlated with risk?". In the present paper, Regime 5 reverses this question, and inquires as to the welfare effects of denying information about gender to insurers. Consequently, the properties of unregulated adverse selection equilibria are the appropriate starting point. Hoy (1982) demonstrates that the unregulated equilibrium would be either (1) the Nash contract pair $\{\alpha_F^*, \alpha_M^2\}$, (2) the quadruplet $\{\alpha_F^*, \alpha_M^2; \alpha_H', \alpha_L'\}$, or the quadruplet $\{\alpha_H'', \alpha_L''; \alpha_H', \alpha_L'\}$ as illustrated in Figure 3, where H and L refer to high-risk types and low-risk types, respectively, and where EC_H and EC_L are fair odds lines for the sub-populations of high-risks and low-risks, respectively. These generalize the Spence-Miyazaki equilibria to situations involving imperfectly categorized risks.[11] Situation 1 is relevant when low-risk types weakly prefer α_M^2 to α_L' and insurers can enforce exclusive contract equilibria. Situation 2 is relevant if low-risks strictly prefer α_L' to α_M^2, and also prefer α_M^2 to α_L'', or when exclusive contract equilibria cannot be enforced. Situation 3 is relevant when low-risks prefer α_L'' to α_M^2.

In each of these equilibria, all high-risk types (which include a relatively large proportion of the insured female population and a relatively small proportion of the insured male population) are fully insured at a price reflecting their probability of disability, while all low-risk types (which include a relatively large proportion of the insured male population and a relatively small proportion of the insured female population) are partially insured at a price reflecting their (lower) probability of disability. Low-risks cannot be offered full insurance at price q_M since the risk class for any individual cannot be identified by observations on gender alone. In situation 1, the contract α_M^2 is the best that can be offered to all low-risk types at price q_M without also attracting all high-risk types. In situation 2, low-risk males pay a unit tax which is used to subsidize high-risk males while the relatively few low-risk females are better off by purchasing α_M^2 rather than subsidizing their relatively numerous high-risk counterparts. In situation 3, however, it pays all low-risks of a given gender to subsidize high-risks of the same gender since the greater coverage offered by α_L' (for low-risk males) and α_L'' (for low-risk females) compared to α_M^2 more than compensates for the optimal cross-subsidization of the respective high-risk contracts α_H' (for high-risk males) and α_H'' (for high-risk females).

It transpires that the regulated equilibria in each regulatory regime are independent of whether or not risks are perfectly or imperfectly categorized. The welfare effects of regulation are more complicated to analyse in the latter case, however, both because a distinction is drawn between low-risk and high-risk types by gender, and because of the alternative possible unregulated equilibria which serve as a benchmark for welfare comparisons.

Regime 1 Equilibria

Each firm will offer the contract $\hat{\alpha}$ as in Figure 1. This contract breaks even when sold to all agents. A full-insurance contract which breaks even when sold to males only will make losses when sold to everybody, and females cannot be denied access to such a contract. A full-insurance contract which breaks even when sold to females only is unattractive to everybody compared to the lower-priced full-insurance contract $\hat{\alpha}$.

If the unregulated equilibrium is situation 1, the effect of imposing Regime 1 is to raise the welfare of high-risk females and males, and to either raise or lower the welfare of low-risk females and males depending on whether or not $\hat{\alpha}$ is preferred to α_M^2. There is the possibility that the regulation may be Pareto-superior to the unregulated equilibrium in a world of asymmetric information and imperfectly categorized risks, a result which cannot arise under perfectly categorized risks. In these circumstances, low-risks prefer the higher-priced full insurance contract $\hat{\alpha}$ to the lower-priced but quantity-constrained contract α_M^2. If so, all members of the high-risk gender (females) are made better off by the regulation, as may be the intention, and the outcome does not come at the expense of any male.

If situation 2 applies initially, however, high-risk males will be worse off under the regulation, if, as Figure 3 illustrates, they prefer α_H' to $\hat{\alpha}$. If this ordering is reversed, they are better off with the regulation, although their welfare gain is smaller than when situation 1 applies initially. Low-risk males can also be either better off or worse off under the regulation, depending on their ranking of α_L' and $\hat{\alpha}$. Low-risk females can also be better off or worse off depending on their ranking of α_M^2 and $\hat{\alpha}$. However, if low-risks consider $\hat{\alpha}$ to be at least as good as α_L' (so that low-risk men are no worse off and perhaps better off under the regulation), low-risk females must be better off under the regulation since low-risks prefer α_L' to α_M^2. High-risk females must be better off under the regulation, and they may be the only group whose welfare increases. Similar conclusions hold for situation 3. High-risk females must be better off, although their welfare gain is smaller than in the other two situations. If low-risk females are better off with the regulation, their welfare gain is similarly smaller compared to the cases where they initially buy α_M^2. Again, males can be either better off or worse off.

Regime 2 Equilibria

In situation 1, a given firm could be offering the Nash contract pair prior to regulation, but must abandon α_M^2 once Regime 1 is imposed since it offers a lower price than α_F* and involves a quantity constraint. The firm will offer the contract pair $\{\alpha_F^1, \alpha_M^1\}$ shown in Figure 1. High-risk females and high-risk males are both better off buying the first of these contracts rather than α_F*, while low-risk females and low-risk males are both worse off when they purchase α_M^1, since they weakly prefer α_M^2 to α_L', which in turn is preferred to α_M^1 since α_L' is preferred to the optimal contract α_M^0 for low risks along EC, and which is better for low-risks than the optimal contract α_M^1 bought at a higher price than $\bar{q}$.

In situation 2, a firm offering $\{\alpha_H', \alpha_L'\}$ cannot continue to offer these contracts since they involve different prices, a quantity constraint for α_L', and females are prevented from buying either contract. Further, α_M^2 involves a quantity constraint and must be withdrawn. When the regulated equilibrium becomes $\{\alpha_F^1, \alpha_M^1\}$, all males are worse off since high-risk males prefer α_H' to α_M^1 and low-risk males prefer α_L' to α_M^1, while high-risk females are better off. However, the change in welfare for low-risk females depends on whether low-risk types prefer α_M^1 to α_M^2; if they do, Regime 2 makes them worse off as well.

In the third situation, low-risk types prefer α_L'' to α_M^2. High-risk females and high-risk males are both optimizing at the same price of insurance, but low-risk females and low-risk males are both quantity-constrained at a lower price than the contracts offered to high-risk females and high-risk males, and the contract offered to low-risk males is not available to any female. When the regulated equilibrium becomes $\{\alpha_F^1, \alpha_M^1\}$, all males are again worse off. Either risk-class of female, however, may be either better off or worse off depending on whether α_F^1 is better than α_H'' for high-risk females, and whether α_M^1 is better than α_L'' for low-risk females. Under Regime 2, it is possible that the regulation makes everybody worse off.

Regime 3 Equilibria

In situation 1, firms may be offering both contracts in the equilibrium Nash pair $\{\alpha_F^*, \alpha_M^2\}$, with high-risks buying α_F^* and low-risks buying α_M^2. This contract pair cannot be maintained when the regulation is imposed, since the insurer is selling contracts carrying different prices, even though some females are buying (partial) insurance at the lower price q_M while some males are buying (full) insurance at the higher price q_F. However, since quantity-constrained contracts are permitted, while each insurer is required to set a unisex price and not to prevent customers making purchases on the basis of gender, the effect of the regulation is the segregation of the insurance market into firms offering α_F^* and firms offering α_M^2. This apart, the imposition of Regime 3 has no impact on the insurance market, and each agent buys the same contract as in the absence of the regulation.

In situation 2, a firm may be selling all contracts in the equilibrium set $\{\alpha_F^*, \alpha_M^2; \alpha_H', \alpha_L'\}$ but cannot maintain these under Regime 3. The pair sold to males must be withdrawn since females are denied access to both of these contracts on the basis of their gender, while the price associated with α_L' exceeds that associated with α_F^*. Although the prices associated with α_H' and α_L' differ, the regulation is not violated by this fact, since there is no requirement to sell insurance at the same price to customers of the *same* gender. As a consequence, a firm could continue to sell the pair $\{\alpha_F^*, \alpha_M^2\}$ as long as they were purchased exclusively by females. However, if low-risks prefer α_M^2 to the Wilson E2 equilibrium α_M^0 in Figure 1, and exclusive contracts are enforced, the insurance market will segregate into firms selling α_F^* to high-risk types and firms selling α_M^2 to low-risk types. All males are worse off as a result of the regulation, while no female is better off. Alternatively, if low-risks prefer α_M^0 to α_M^2, or if exclusive contracts cannot be enforced, all firms will offer the partial insurance contract α_M^0 at the unisex price $\bar{q}$. The result is that all males are worse off while all females are better off, with relatively large gains being made by high-risk females and relatively large losses being made by high-risk males.

In situation 3, prior to regulation, a firm may be selling all contracts in the equilibrium set $\{\alpha_H'', \alpha_L''; \alpha_H', \alpha_L'\}$ but cannot continue to do so under Regime 3 since the contracts sold to males are unavailable to females. Again, the insurance market will segregate into firms offering α_F^* or α_M^2, in which case *everyone* is worse off as a result of the regulation, or else all firms will offer α_M^0, so that females are better off at the expense of males.

Regime 4 Equilibria

Under Regime 4, no insurer can be offering a contract to any male that has a lower price than any contract being offered to any female. This prevents an insurer who might have been offering the Nash pair in an unregulated equilibrium from dropping α_F^* and continuing to offer α_M^2, since this involves a lower price than for α_F^*. Consequently, in situation 1, the Nash pair cannot continue to be offered even by independent firms, in which case the Wilson pooling contract α_M^0 is offered if it is preferred to α_F^* by high-risk types, raising the welfare of high-risk females and high-risk males, and lowering the welfare of low-risk females and low-risk males. If high-risk types weakly prefer α_F^* to α_M^0, however, either the equilibrium will be $\bar{\alpha}^1$ (in Figure 1) for all agents, or else the Regime 2 equilibrium contract pair $\{\alpha_F^1, \alpha_M^1\}$ (in Figure 1) applies. When $\bar{\alpha}^1$ applies, low-risks prefer $\bar{\alpha}^1$ to α_M^1, and, compared to the unregulated equilibrium, welfare is reduced for low-risk types while welfare of high-risk types is unchanged. When $\{\alpha_F^1, \alpha_M^1\}$ applies, all high-risks buy α_F^1 and are better off, while all low-risks buy α_M^1 and are worse off.

In the second situation, low-risks prefer α_L' to α_M^2. All males face reduced welfare whatever is the regulatory outcome. If α_M^0 is the regulated equilibrium, high-risk females will be better off, but low-risk females will be better off only if they prefer α_M^0 to α_M^2. If the pooling contract $\bar{\alpha}^1$ is the equilibrium, high-risk females are no better off and everyone else is worse off. If the unisex optimizing equilibrium prevails, all men are worse off, high-risk females are better off, and low-risk females are either better off or worse off depending on whether they rank α_M^1 above or below α_M^2.

In situation 3, low-risks prefer α_L'' to α_M^2. In this case, α_M^0 *must* be preferred by low-risk types to α_M^2, since α_M^0 is preferred to α_L'' by low-risk types. Consequently, α_M^0 *must* be preferred to α_F^* by high-risk types. In this case the Wilson pooling contract α_M^0 is the only possible regulatory outcome under Regime 4, in which case all females are better off and all males are worse off.

It is interesting to consider the Regime 4 equilibria in the context of a question posed by Harrington and Doerpinghaus (1993, p. 69), namely, that "in the case of unisex rating, even if market sorting would otherwise occur, would regulators permit the market to separate into price-coverage combinations primarily populated by either men or women?". Regime 4 clearly prevents some firms offering α_M^2 to a male-dominated subset of the insured population while at the same time other firms offer α_F^* to a predominantly female population. In all but one case, Regime 4 equilibria are pooling, so that everybody buys the same contract regardless of gender, and regardless of risk category. However, the optimizing contract pair $\{\alpha_F^1,\alpha_M^1\}$ which are bought by a predominantly female group and a predominantly male group, respectively, are a possible outcome under Regime 4. Although the price of insurance is uniform across gender groups, coverage is not uniform across males and females, and the predominantly-female group receives greater cover than the predominantly male group.

Regime 5 Equilibria

It is easily checked that in each of the three initial situations, the imposition of the requirement that insurers be denied information about the gender of their customers generates regulatory equilibria identical to those described for Regime 3 above.

Table 2 summarizes the signs of welfare changes for each gender group by risk category under imperfect categorization. Compared to the situation of perfectly categorized risks, a number of cases stand out. First, under Regime 1, it is possible that the regulated equilibrium may be efficient in that no group is worse off and some groups (maybe all groups) are better off.[12] Next, it is also possible under Regimes 2, 3 and 5, that *everyone* is worse off in the regulated situation. Further, under Regimes 3 and 5, it is possible that there is no change in the welfare of *any* agent in response to the introduction of the regulation. None of these results are possible when risks are perfectly categorized.

In addition, it is clear whose interests are supposed to be served under perfect categorization, namely, the high-risk group (females). Under imperfect categorization, although females are riskier on average, nevertheless, there are some high-risk males and some low-risk females. If the regulator seeks to improve the welfare of females on the grounds that they are riskier on average, there are only limited circumstances where *all* females are better off as a result of regulation; in many cases, low-risk females are no better off or worse off, and there are two circumstances where high-risk females are either worse off or at least potentially so. In the case of Regime 2 when situation 3 characterizes the initial equilibrium, it is even possible that low-risk females are better off and high-risk females are worse off. While Regime 1 permits the possibility that low-risk males are better off, in general, they are worse off, as may be expected. High-risk males do not necessarily do as badly as their female counterparts in some unregulated equilibria since they are sometimes pooled with the relatively numerous low-risk males. It still comes as some surprise to find that this group, which apparently suffers 'discrimination' because of its excess risk, is unambiguously worse off in ten of a possible sixteen regulated equilibrium situations, might be worse off in two situations, and is no better off in two situations.[13]

CONCLUDING REMARKS

This paper has examined the welfare effects of alternative regulatory regimes which intervene in competitive insurance markets in which one-period contracts are offered in an attempt to compensate for gender-based differences in risk. The regulations generally require or imply some form of unisex pricing by each insurer (although not necessarily requiring a uniform price of insurance across all firms), or else information used to categorize risks is denied to insurers. Although these regulations fail to enhance efficiency, they might reasonably be expected to at least raise the welfare levels of those agents allegedly suffering from 'discrimination' in insurance markets. For the case where females, for example, are an unambiguously riskier group than males, it is shown that females may not necessarily be better off as a result of regulation, although they will be so in a number of situations, whereas males are always worse off. Where females are riskier on average, but some females are low-risk types and some males are high-risk types, it is shown that if the information required to assign individuals to the correct risk class is private to those individuals, then while high-risk females are typically better off as a result of regulation, they need not be so, and can even be worse off. High-risk males are almost never better off, and are typically worse off, as are low-risk males. The welfare effects for low-risk females are extremely variable, and are critically dependent on both the form of the regulation and the underlying parameters of the problem.

A fairly comprehensive acount of different forms of regulation is provided, and which captures the regulatory intents of either forcing unisex pricing or denying insurers information which is seen as a basis for discrimination. However, the basic models analysed are relatively restrictive in that moral hazard effects are ignored so that probabilities of adverse states of the world are independent of any discretionary actions by agents, and the assumption that the categorization of risks by gender involves zero resource costs for insurers is maintained. Further work might encompass these issues, which do appear in related literature, and might also account for the insurance decisions of families in regulated insurance markets, an issue which appears largely ignored.

NOTES

1. Full insurance will not characterize an unregulated competitive equilibrium in the presence of either adverse selection or moral hazard. Regulators, however, may still believe it appropriate that full insurance be offered even when insurance markets refuse to oblige voluntarily. Each regulatory regime in this paper is considered to be exogenous, however, and it is an open question as to whether full insurance (or any other requirement considered here) is the solution to some social welfare maximization problem for a benign regulator.

2. Evidence suggests that females, on average, are riskier prospects for disability insurance. For example, the New York State Commissioner of Insurance (1976) noted that female claim costs for accident and sickness benefits are consistently higher than those for males up to age 60, with the highest differential in the 30-39 year age group, and recommended a female premium loading of between 31 and 122 percent for various age ranges up to 60, after which point the recommended loading was -2 percent. There is, however, some disagreement in the literature concerning the true marginal contributions to risk made by gender. For example, in the field of automobile insurance, the use of aggregate data by Dahlby (1983) suggests a substantial contribution of gender to premium determination. Using a disaggregated hedonic pricing model, however, Puelz and Kemmsies find a significant but much smaller contribution of gender, which is sufficiently small for the authors to bring into question the wisdom of introducing costly legislative practices to produce unisex statutes.

3. Under some circumstances, the Wilson and Spence-Miyazaki equilibria will correspond to the Nash equilibrium, although the converse is never true. For convenience, however, reference to each of the three types of equilibria will be *as if* they were distinct.

4. A necessary condition for imposition of exclusive contracts is the ability of firms to monitor the total insurance purchases of their customers, and there may be incentives for insurers not to reveal sales to other firms. On this, see Jaynes (1978), Hellwig (1988) and Arnott (1992), the last of whom notes, however, that apart from life and air flight insurance, all standard insurance contracts contain exclusivity provisions.

5. Cf., Ehrlich and Becker (1972).

6. Equilibrium will be unique only if the profit function is monotonic in q. Expected profits (per head of the fixed insured population) are given by

$$\pi/N = \lambda[(1-p_M)(\hat{W}_1-W_{1M})-p_M(W_{2M}-\hat{W}_1+D)] + (1-\lambda)[(1-p_F)(\hat{W}_1-W_{1F})-p_F(W_{2F}-\hat{W}_1+D)],$$

where λ is the share of males in the insured population pool, and $\hat{W}_1$ is the level of income when there is no disability suffered and no insurance is purchased. In general, there is no reason to expect monotonicity of the expected profit function. For example, under a logarithmic utility function, $W_{1i} = [(1-p_i)/(1-q)]\hat{W}_1 - [q(1-p_i)/(1-q)]D$ and $W_{2i} = (p_i/q)\hat{W}_1 - p_iD$, where $i = F,M$. Monotonicity requires that $d(\pi/N)/dq > 0$, the condition for which is that

$$\{[\lambda p_M^2+(1-\lambda)p_F^2)]/[\lambda(1-p_M)^2+(1-\lambda)p_F^2]\}[\hat{W}_1 /(\hat{W}_1 -D)] > [q/(1-q)]^2,$$

the satisfaction of which depends on all parameters of the system.

7. Although zero profits are made across all sales of this pair of contracts, ER is not a zero profit locus. Sales of any given contract along ER to all agents would result in positive profits being made, since this contract represents a point below the market fair odds line.

8. The assumption that males will buy a positive amount of insurance at price q_F assures this result. If males are driven from the market before the price of insurance rises as far as q_F, however, a quasi-Walrasian equilibrium may not exist, and will not exist if males buy zero insurance at price $\bar{q}$. If an equilibrium with positive quantities for both groups does not exist, the equilibrium contract set under Regime 2 is $\{\alpha_F^*,E\}$, so that firms offer a full insurance contract at price q_F which is purchased only by females and breaks even when they purchase it. Males are uninsured, and so females are no better off while males are worse off.

9. The nature of regulated equilibria when there exists a unique signal of gender other than by observations on gender is examined by Woodfield (1994). Here, different educational decisions by females and males (and related differences in earnings) arising in a labour market signalling context may, in some cases, provide information to insurers which enables them to offer different insurance contracts for different gender groups even when, as under Regime 5, gender is unobservable, in which case the regulation is thwarted. Another approach would be to follow Hoy (1989) and to permit disability probabilities to be determined by self-protection efforts which could vary systematically between gender groups because of gender-based differences in self-protection technologies. The outcomes would then depend on whether or not different effort levels are observable by insurers.

10. While moral hazard effects are excluded by assumption, this result might deter some females from joining their spouses in joint exercises such as roof painting!

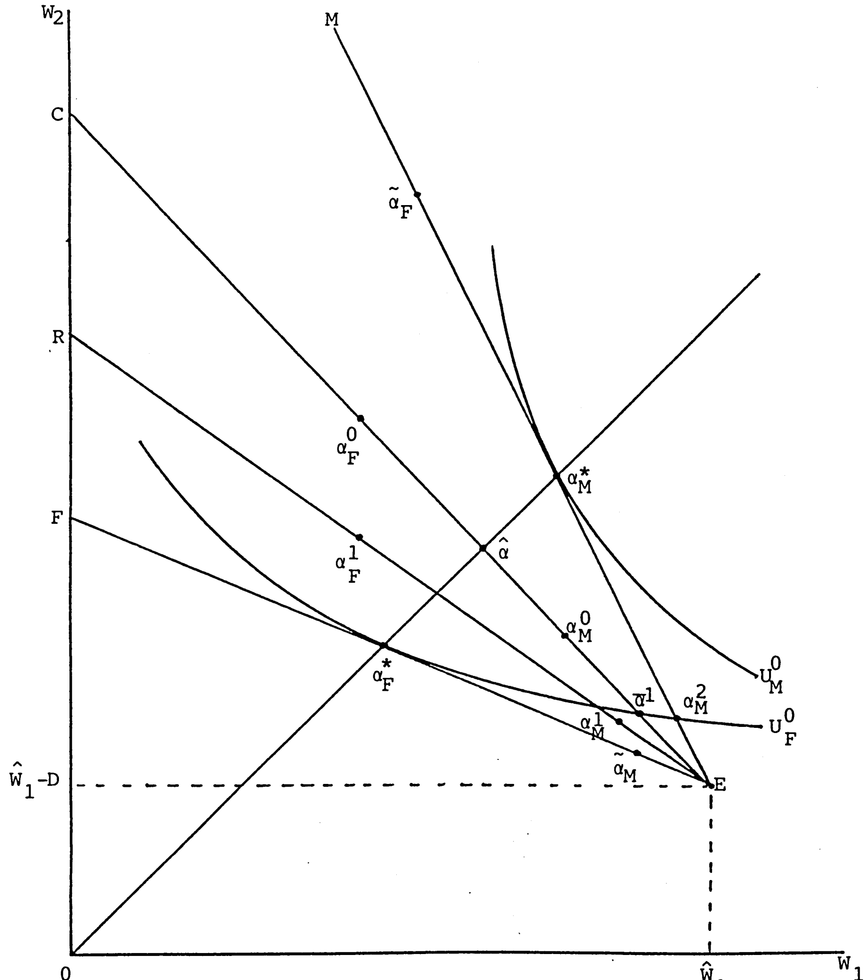
11. Low-risk types are better off in a Miyazaki-Spence equilibrium compared to a corresponding Wilson equilibrium since the (nonlinear) locus of break-even separating Spence-Miyazaki contract pairs lies above the corresponding market fair-odds line for all partial insurance contracts for low-risks, and the contract for low-risks is optimal with respect to the former locus in a Spence-Miyazaki equilibrium and is optimal with respect to the market fair-odds line in a Wilson equilibrium. See Dionne and Doherty (1992, Section 2.2) for a discussion and illuistration.

12. This raises the question as to why we do not observe regulations of the form captured in Regime 1. Apart from ignorance of the properties of regulated equilibria on the part of regulators, and the fact that not all equilibria are efficient under Regime 1, forcing contracts to offer full insurance may not be efficient in practice if moral hazard as well as adverse selection characterizes insurance markets. For example, coinsurance may be needed to provide incentives to make efforts to prevent disabilities from occurring. Further, partial insurance will characterize contracts in the presence of proportional transactions costs. Strictly speaking, however, these considerations lie outside the terms of reference of this

paper.

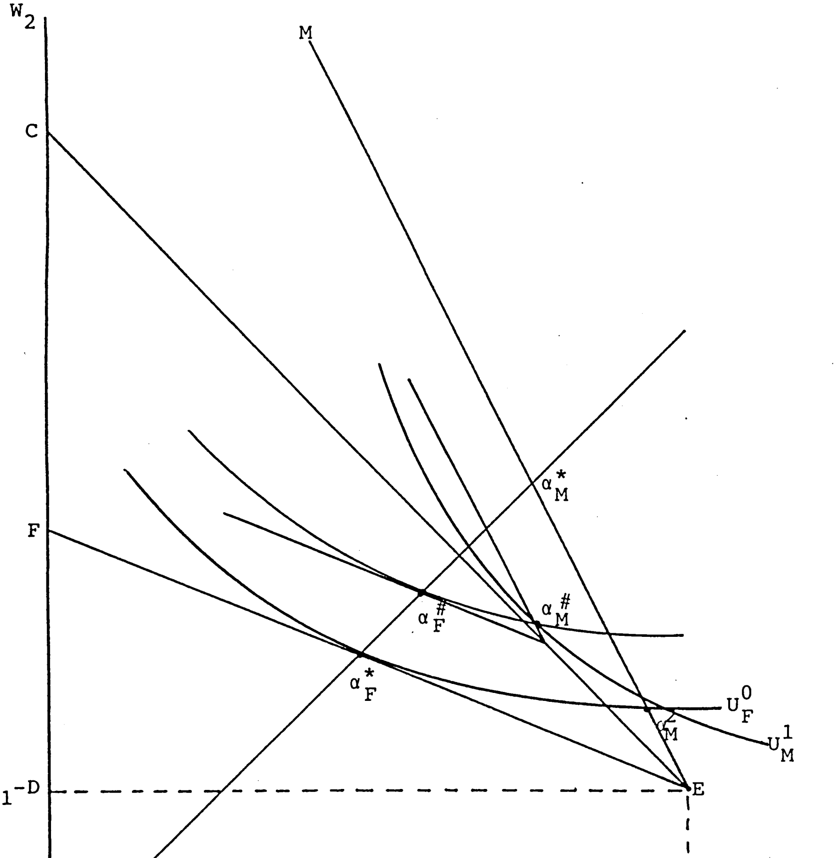
13. There is also no suggestion that in situations where at least one group is better off, it is possible to potentially compensate the losers from the regulation. Crocker and Snow (1986) for example, show that potential compensation is not possible for imperfectly categorized risks when information about gender is suddenly made available to insurers at zero cost. Crocker and Snow (1985, 1986) also demonstrate that a suitably designed tax system can support any efficient allocation as an equilibrium under any of the equilibrium concepts used in this paper.

FIGURE 1



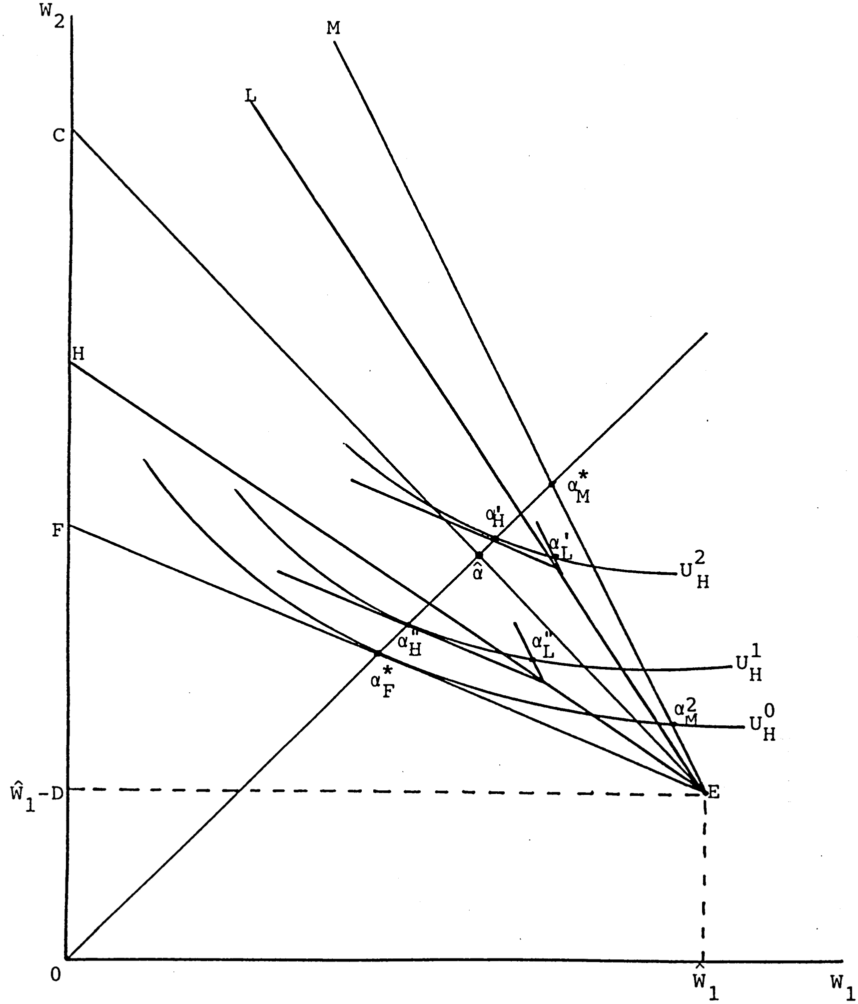
W_2
M
C
R
F
$\tilde{\alpha}_F$
α_F^0
α_F^1
α_M^*
$\hat{\alpha}$
α_M^0
U_M^0
α_F^*
$\bar{\alpha}^1$
α_M^2
α_M^1
U_F^0
$\tilde{\alpha}_M$
$\hat{W}_1$-D
E
0
$\hat{W}_1$
W_1

FIGURE 2



W_2
M
C
α_M^*
F
$\alpha_F^{\#}$
$\alpha_M^{\#}$
α_F^*
U_F^0
α_M^2
U_M^1
$\hat{W}_1$-D
E
0
$\hat{W}_1$
W_1

FIGURE 3



W_2
M
L
C
H
F
α_M^*
α_H'
α_L'
$\hat{\alpha}$
U_H^2
α_H''
α_L''
U_H^1
α_F^*
α_M^2
U_H^0
$\hat{W}_1-D$
E
0
$\hat{W}_1$
W_1

TABLE 1: SIGNS OF WELFARE CHANGES; PERFECT CATEGORIZATION

Equilibrium Contracts	Regulatory Regimes	Females	Males
$\hat{\alpha}$	1	+	-
$\{\alpha_F{}^1,\alpha_M{}^1\}$	2,4	+	-
$\{\alpha_F{}^*,\alpha_M{}^2\}$	3,5	0	-
$\alpha_M{}^0$	3,4	+	-
$\bar{\alpha}^1$	4	0	-
$\{\alpha_F{}^\#,\alpha_M{}^\#\}$	5	+	-

NOTE: Initial unregulated equilibrium contract set is $\{\alpha_F{}^*,\alpha_M{}^*\}$.

TABLE 2: SIGNS OF WELFARE CHANGES; IMPERFECT CATEGORIZATION

Equilibrium Contracts	Regulatory Regimes	Unregulated Equilibria	Low-risk Female	High-risk Female	Low-risk Male	High-risk Male
$\hat{\alpha}$	1	1	?	+	?	+
	1	2	?	+	?	?
	1	3	?	+	?	?
$\{\alpha_F{}^1,\alpha_M{}^1\}$	2,4	1	-	+	-	+
	2,4	2	?	+	-	-
	2	3	?	?	-	-
$\{\alpha_F{}^*,\alpha_M{}^2\}$	3,5	1	0	0	0	0
	3,5	2	0	0	-	-
	3,5	3	-	-	-	-
$\alpha_M{}^0$	4	1	+	+	-	-
	3,5	2	+	+	-	-
	4	2	?	+	-	-
	3,4,5	3	+	+	-	-
$\bar{\alpha}^1$	4	1	-	0	-	0
	4	2	-	0	-	-
	4	3	+	+	-	-

NOTES: Unregulated equilibrium contract sets as follows: (1) $\{\alpha_F{}^*,\alpha_M{}^2\}$; (2) $\{\alpha_F{}^*,\alpha_M{}^2;\alpha_H{}^1,\alpha_L{}^1\}$; (3) $\{\alpha_H{}^*,\alpha_L{}^*;\alpha_H{}',\alpha_L{}'\}$.

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