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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 different agents earn different levels of income and where income may be perfectly or imperfectly correlated with gender. The alleged discrimination in the insurance market arises because of gender-based differences in the price of insurance. However, if these 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 both less gender discrimination and less individual discrimination that 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 a product or service merely because they have suffered bad luck of the draw, having been born into a high-risk class. Regulators who take this argument seriously are then faced with the problem of how to compensate high-risk groups for their bad luck. In practice, legislators appear to favour some form of unisex pricing. For example, in the United States, 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 males and females 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 the Act 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 might have borne different interpretations. These are considered in the next section.

The closely-related 'categorization-of-risks' literature generally assumes that females and males differ in only one characteristic, namely, risk, and that other characteristics such as preferences and earnings are identical (Hoy (1982), Crocker and Snow (1985, 1986), Bond and Crocker (1991)). These assumptions are also maintained in studies specifically addressing the gender-neutrality issue (Rea (1987), Woodfield (1994)). The present contribution analyses the welfare effects of insurance market regulation where earnings can differ systematically by gender. Further, it considers situations where earnings differentials result from different labour market signals from females and males, and where these different signals represent a rational response to different gender-based educational requirements set by firms, and which themselves might be considered discriminatory (Spence (1974)). Thus, interactions between unregulated labour markets (which may exhibit discrimination in a sense that causes less discomfort to readers than so-called 'discrimination' in insurance markets) and regulated insurance markets exhibiting unisex pricing or denial of information used to categorize risks are jointly considered. In addition, some implications of jointly regulated labour and insurance markets are examined, both for the case when risks are perfectly categorized, and also where categorization is imperfect.

ALTERNATIVE REGULATORY REGIMES

A number of alternative regulatory regimes which seek to erode or eliminate 'discrimination' in insurance markets are now considered. A justification for this approach is that anti-discrimination legislation can and does vary across jurisdictions. While unisex pricing of insurance is the regulatory norm in practice, anti-discrimination legislation in the United States also prohibits employers from obtaining certain information from potential employees (including ethnicity, marital status and gender), which might be used as the basis for less favourable employment offers than if the information was unknown to them. Further, it is arguable that legislators may be unclear about the outcomes of their present regulatory behaviour, and may amend legislation in the light of the results of their intervention. These amendments may either tighten or relax constraints in the insurance market. In a number of regimes, 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 followed. In one regime, however, Rea's further assumption that insurers are permitted to sell policies with less than full insurance is dropped in favour of a requirement that insureds are free to optimize at the unisex price. For purposes of illustration, it is assumed that females, at least on average, are a riskier group than males. Insurance markets are assumed to be perfectly competitive.

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 of insurance for females and males. Full-insurance contracts need not be offered, but no contract offered 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 insurer may inquire as to the gender of a potential insured.

A justification for Regime 1 is that at least in the case of perfectly categorized risks, unregulated market equilibrium will be characterized by full insurance contracts, and in these circumstances (and perhaps even when the unregulated equilibrium does not involve full insurance) the regulator might feel that full insurance should also characterize the regulatory outcome.[1] Regime 2 might be justified on the grounds that the regulator may believe it appropriate for insureds to be rationed only by price in insurance markets (and perhaps in markets generally) while requiring unisex pricing. This regime might represent a response to complaints by one gender group that they are quantity-constrained while the other gender group is not. Regime 3 would appear to capture the main features of existing anti-discrimination legislation and proposals for reform. Regime 4 is more stringent than Regime 3, but is a possible candidate for adoption in response to the outcomes generated under Regime 3, for reasons to be explained. Regime 5 does not require unisex pricing, although regulators may believe that unisex pricing will be the outcome. This regime turns the 'categorization-of-risks' literature on its head in that it seeks the outcomes resulting from preventing insurers from otherwise costlessly acquiring information which would be the basis for firms setting difference prices of insurance for females and males.[2]

PERFECTLY CATEGORIZED RISKS AND DIFFERENTIAL EARNINGS

To make the discussion concrete, assume that there are two states of the world. In state 1 (the good state), a person suffers no disability, but in state 2 (the adverse state) a disability is suffered. Assume that the disability results in a given level of income loss D. Further, assume that the probability of disability for all females (p_F) is higher than for all males (p_M),[3] and that unless prevented by regulation, gender is a characteristic which insurers can observe without cost. Insurers are assumed to be risk-neutral and to maximize expected profits (hereafter 'profits'), while risk-averse consumers maximize identical state-independent concave expected utility functions. An insurance contract is described by the 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. Insurance contracts are for one period, so experience-rating is not possible.

Suppose that this standard problem is modified by assuming that there are two types of worker, more-productive (P) and less-productive (U), respectively. P-workers earn more than U-workers. In an unregulated perfectly competitive insurance market, equilibrium will be characterized by zero profits being earned on any insurance contract sold. Risk-averse consumers will choose to fully insure so as to equalize their incomes across states. All males will buy the same contract, as will all females, and since the price of insurance will be higher for females, reflecting their excess risk, a female worker of given type will have less disposable income for consumption or saving than will a male worker of that type.[4] Figure 1 illustrates the outcomes, where W_1 measures income in the good state, W_2 measures income in the bad state, E_P and E_U are the respective endowment points for P-workers and U-workers, E_PM_P and E_UM_U are respective zero expected profit loci (fair-odds lines) for P-males and U-males, and E_PF_P and E_UF_U are respective fair-odds lines for P-females and U-females. P-males buy the contract α_{MP}*, U-males buy α_{MU}*, P-females buy α_{FP}*, and U-females buy α_{FU}*. Clearly, the contracts α_{MP}* and α_{MU}* are identical, as are the contracts α_{FP}* and α_{FU}*. Figure 1 also illustrates the overall (that is, the pool of all insureds) market fair-odds lines E_PC_P and E_UC_U for the respective origins E_P and E_U. If an identical contract is sold to all agents, for example α_P^0 is sold to P-workers and α_U^0 is sold to U-workers so that all workers are paying the same premium and receive the same net payout in the event of disability, zero expected profits will be made by firms selling these uniform contracts.

FIGURE 1 ABOUT HERE

The contracts which will be offered and purchased under Regimes 1-5 will generally depend on whether insureds can supplement a partial insurance contract bought from one firm with another contract bought from another firm. In general, it is assumed that firms can enforce exclusive contracts.

The equilibrium concepts utilized include (a) the Nash equilibrium adopted by Rothschild and Stiglitz (1976), which requires zero 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, and (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.

The generalization of the Wilson equilibrium due to Spence (1978) and Miyazaki (1977) to situations where firms can offer multiple contracts, and which permit internally cross-subsidized contracts,[5] is also adopted. In addition, any regulatory constraint must also be satisfied.

The regulatory equilibria emerging under each regime are now examined on the assumption that the fraction of more-productive workers who are males is no less than the fraction of less-productive workers who are males. In what follows, j = P,U.

Regime 1

If all workers are type j, each worker will buy the same full-insurance contract $\tilde{\alpha}_j$, which breaks even when sold to both gender groups.[6] Since income loss in response to a disability is the same for all workers irrespective of gender, all workers will pay the same premium and receive full insurance cover. Females will receive more income, and males less income, in either state of the world compared to the unregulated equilibrium. Both female and male workers of type j receive the same state-independent income. The reduction in a male's income generated by the regulation is greater, the higher is the proportion of females in the insured population.

Not all workers, however, will be of type j. Suppose, however, that the proportion of males in the P-worker population (λ_M^P) equals the U-worker population share of males (λ_M^U), in which case the slopes of the market fair-odds lines are the same for both the P-population and the U-population. That is, the P-population market fair-odds line is given by E_PC_P and the U-market fair-odds line is given by $E_U C_U$ in Figure 1. In this case, all P-workers are offered the same contract $\hat{\alpha}_P$ and all U-workers purchase $\hat{\alpha}_U$ and these contracts are the same in that all workers pay the same premium for full insurance cover. P-workers will receive more income than U-workers in all states since their endowment is superior, but P-males and P-females will have equal incomes in either state as will U-males and U-females. Further, the reduction in male income and the increase in female income in any state is independent of whether an agent is a P-type or U-type.

FIGURE 2 ABOUT HERE

The above case, however, is very special. In general, λ_M^P and λ_M^U will differ. Suppose that $\lambda_M^P > \lambda_M^U$, in which case the slope of the market fair-odds line for the P-worker population $E_P C_P'$ exceeds the slope of the overall population fair-odds line, while the market fair-odds line $E_U C_U'$ for the U-population has a correspondingly lower slope, as illustrated in Figure 2. Insurers could offer the full-insurance break-even contract $\hat{\alpha}_P'$ which would attract P-workers away from $\hat{\alpha}_P$, since both female and male P-workers would be fully insured at a lower price and hence have more income in each state. Such a contract, however, would attract all U-workers, and the contract would make losses when sold to everyone since it lies to the right of the overall population fair-odds line. Under Regime 1, however, insurers can refuse to sell $\hat{\alpha}_P'$ to U-workers, and will be able to do so if productivity (or possibly some correlate such as earnings or education) is costlessly observable by insurers. The requirement that no worker be refused the opportunity to buy an offered contract on the basis of gender is satisfied, since gender is not the basis of the insurer's unwillingness to trade. Further, both U-males and U-females are denied access to

$\hat{\alpha}_P'$.[7] Instead, U-workers are offered the break-even contract $\hat{\alpha}_U'$ in Figure 2. The income reduction for U-males in each state is greater than for P-males, while the income increase is greater for P-females than for U-females. This results from the dominance of low-risk males in the P-population relative to the U-population. In the extreme case, where all males are P-types and all females are U-types, segmentation of the insurance market on the basis of productivity alone maintains the unregulated outcome under Regime 1, where males buy α_{MP}* and females buy α_{FU}*.[8]

Regime 2

Under Regime 2, an insurer must offer insurance at the same price to females and males but is not permitted to quantity-constrain either group. In the case where earnings are identical for all females and males, Woodfield (1994) shows that a zero profit equilibrium exists which is characterized by a uniform price of insurance $q^* \epsilon (\bar{q}, q_F)$, where $\bar{q} = \bar{p}/(1-\bar{p})$ is the price of insurance reflecting overall market odds.[9] Since market segmentation is possible when earnings differ, except where $\lambda_M^U = \lambda_M^P$ (in which case insurers will offer the same contracts to all females, and the same contracts to all males), Regime 2 equilibrium implies that one group of insurers will be selling a contract pair $(\alpha_{FU}^1, \alpha_{MU}^1)$ to U-workers while remaining insurers will be selling the pair $(\alpha_{FP}^1, \alpha_{MP}^1)$ to P-workers. Figure 3 illustrates the case where $\lambda_M^P > \lambda_M^U$. In each sector, males are subsidizing females. The subsidy per male is greater in the U-sector for which the population share of males is relatively small, and the price of insurance is correspondingly greater in the U-sector than in the P-sector. As a consequence, females will be overinsured and males will be underinsured whether they are U-workers or P-workers, but P-females will be more heavily overinsured than U-females while U-males will be more heavily underinsured than P-males.[10]

FIGURE 3 ABOUT HERE

Compared to the unregulated market, females are better off and males are worse off unless all males are P-types and all females are U-types, in which case the regulated and unregulated equilibria again coincide. The gains made by P-females are greater than those made by U-females, and the losses made by U-males are greater than the losses made by P-males, if $\lambda_M^P > \lambda_M^U$. If most females are U-workers and most males are P-workers, the welfare gains to most females are likely to be very small, and come at the expense of serious welfare losses to the few low-earning males available to subsidize them.

Regime 3

Consider Figure 4. Under Regime 3, the regulated equilibrium can be (a) jointly separating, (b) separating/pooling, or (c) jointly pooling.

FIGURE 4 ABOUT HERE

(a) In a jointly separating equilibrium, the (Nash) equilibrium contract set is $\{\alpha_{Fj}^*, \alpha_{Mj}^2\}$, j = U,P. Since preferences and income losses are identical across agents, the contracts bought by all females involve full insurance at a price $q_F = p_F/(1-p_F)$ reflecting female risk, while the contracts bought by all males involve partial insurance at a price $q_M = p_M/(1-p_M)$

reflecting male risk. The contract α_{Mj}^2 maximizes male utility subject to the constraint that the resulting contract offered to j-type males is not more attractive to j-type females than is the contract they are offered. If it were more attractive, males and females would both purchase this contract and it would make losses. The outcome is that no female is better off and all males are worse off under the regulation.

There are interesting implications here for the structure of the insurance market. For example, suppose that prior to regulation all firms are offering the contract set $\{\alpha_{Fj}^*, \alpha_{Mj}^*\}$, j = U,P. Under Regime 3 , a firm cannot be observed to sell insurance at different prices to males and females. Consequently, in the regulated equilibrium, the insurance market will be segmented into firms selling α_{Fj}^* and firms selling α_{Mj}^2. That is, some firms will be selling the same full-insurance contracts to females as before, while remaining firms will be selling partial insurance contracts to males at the same price as before.

It would appear that the jointly separating equilibrium for males and females under Regime 3 is independent of the proportions of males and females in each earnings category, so that there would be no advantage to being a high-productivity person (if the P-category was dominated by males) as far as buying insurance in a regulated market was concerned. However, the proportions of males and females in each productivity category partly determine whether or not the jointly separating equilibrium is applicable. For (a) to be relevant, two conditions must be satisfied. First, α_{MP}^2 must be considered by males to be at least as good as the contract α_{MP}^0 that maximizes their utility along the P-worker market fair-odds line $E_P M_P'$. If it were not, some insurers would offer α_{MP}^0 which would be bought by all P-workers and would break even. Second, firms offering α_{MP}^2 must be able to enforce exclusive contracts, that is, they must be able to require that their customers buy insurance from their firm alone.[11] Contract α_{MP}^2 must be marginally unattractive to P-females, since if they also buy this contract, it will make losses. If P-females buy α_{MP}^2 and supplement this policy with another bought at a price reflecting their disability probability so as to be fully-insured, they can raise their utility above that obtained if they buy α_{FP}^* alone.[12] Firms offering α_{MP}^2 would not offer supplementary insurance to females even if Regime 3 permitted them to do so since this would ensure them making losses on sales of α_{MP}^2 to females, and they could only just break even on their sales of supplementary insurance to females. Other firms, however, will offer supplementary insurance to females buying α_{MP}^2 from a given firm since they will make nonnegative profits from these sales.

(b) In a pooling/separating equilibrium, high-productivity males and females purchase the pooling contract α_{MP}^0, U-females buy α_{FU}^*, and U-males buy α_{MU}^2. Each contract involves a different price, and so must be sold by a different firm. The contract α_{MP}^0 is sustained as a Wilson equilibrium since although there exists a contract γ_P in the neighbourhood of α_{MP}^0 which makes positive profits when it initially attracts males but not females, under the Wilson foresight assumptions, firms introducing γ_P realize that losses will be made on sales of α_{MP}^0 when females are the only customers. Since this contract will then be withdrawn, females will then buy γ_P, but this contract makes losses when both males and females buy it. Correctly anticipating these responses, it is argued that the rational insurer will not introduce γ_P in the first place.[13]

For α_{MP}^0 to constitute a P-worker equilibrium, it must be the case either that males prefer α_{MP}^0 to α_{MP}^2 (whether or not supplementary insurance is available to females, since such insurance is irrelevant if males would not choose α_{MP}^2), or that α_{MP}^2 is weakly preferred by males to α_{MP}^0 but that supplementary insurance is available to females (in which case sales of α_{MP}^2 to both males and females will make losses and α_{MP}^2 will be withdrawn). For the U-worker equilibrium to be separating, males must weakly prefer α_{MU}^2 to α_{MU}^0 and contracts must be exclusive. If the U-worker and P-worker markets display perfect gender balance and the P-worker equilibrium is pooling, however, both markets must be pooling and all workers will buy an identical insurance contract. If males dominate the P-market, as illustrated in Figure 4, it is certainly possible that males prefer both α_{MP}^0 to α_{MP}^2 and α_{MU}^2 to α_{MU}^0 since the fair-odds line in the P-market reflects a lower price of insurance than in the U-market. Figure 4 illustrates this case. The outcome is that the regulation makes both P-males and U-males worse off, and the welfare loss is greater for U-males than for P-males. Further, P-females are better off but U-females are not, and the size of the welfare gain to P-females depends directly on how few they are relative to P-males.

(c) A jointly pooling equilibrium must result if the U-worker and P-worker markets display perfect gender balance and the P-worker equilibrium is pooling. All workers will buy an identical quantity of insurance at the same price, and be partially insured. The market fair-odds line will have the same slope in each market. In this case, low-risk males subsidize high-risk females by an amount which is independent of observed productivity. However, a jointly pooling equilibrium may also exist when males constitute a larger proportion of the P-worker pool than the U-worker pool. This occurs if males prefer α_{MU}^0 to α_{MU}^2 and/or supplementary insurance is available to U-females. In this case, however, the price of insurance is higher in the U-market than in the P-market, so the insurance market must segment in order to meet the regulation. Since the optimal quantity of insurance is strictly decreasing in price (Ehrlich and Becker (1972)), U-workers are more heavily underinsured than P-workers, and are correspondingly worse off if they suffer a disability than if P-workers suffer a disability. Their expenditure on insurance premiums may also be higher. U-workers can be denied the right to purchase the contract $\alpha_{MP}{}^{0}$ which is lower-priced than $\alpha_{MU}{}^{2}$ on the basis of their observed lower productivity.

These outcomes may motivate Regime 2, since, under Regime 3, one gender group might protest that they suffer discrimination by paying a higher price for insurance, or by being unable to buy all the insurance they want, compared to the other group (or even other members of the *same* group). On the other hand, these outcomes may also motivate Regime 4.

Regime 4

The results under Regime 4 are motivated by the fact that unless the equilibrium is jointly pooling under Regime 3 *and* the proportion of males in the P-worker population is the same as the U-worker population, the Regime 3 equilibria will always be characterized by the condition that some (perhaps all) males will be observed to be buying insurance at a lower price than that faced by some (perhaps all) females. This can be sustained under Regime 3 because the market is segmented. Firms offering different contracts are permitted to have different prices. Any given insurer, however, will be offering a single contract at a uniform price to both males and females, although some males and females may be unable to purchase the contract not because of their gender, but because the insurer can observe another characteristic (for example, productivity, income, or education) which can be used to exclude them. Of course, not all males and females will want to purchase a given contract. For example, in (b) under Regime 3, all U-workers would buy the pooling contract offered to all P-workers if it were available to them, but no P-worker would buy either of the contracts offered to U-workers. Regime 4, however, bans these equilibria.

It might be thought that the outcome under Regime 4 will be unique, namely, that insurers will offer a single contract which maximizes utility for males along the overall market fair-odds line and which breaks even when all agents buy it. Although this contract can be sustained as a Wilson equilibrium, it is not the only possible outcome. Consider market j, where α_{Mj}^0 maximizes utility for males along E_jC_j. Such a contract is insurance-equivalent for j = U,P. If males prefer α_{Mj}^0 to α_{Mj}^2, then α_{Mj}^0 is the equilibrium contract. Suppose, however, that α_{Mj}^2 is weakly preferred by males to α_{Mj}^0. Under Regime 3, α_{Mj}^2 would be offered to type j males while type j females would be offered a full-insurance contract α_{Fj}^* at price q_F which is utility-equivalent for females to α_{Mj}^2. But under Regime 4, α_{Mj}^2 involves a quantity-constrained contract for males at a lower price than the contract sold (by other firms) to females, and cannot be offered. This would appear to reinstate α_{Mj}^0 as the equilibrium under Regime 4, and it will be so if females prefer α_{Mj}^0 to α_{Fj}^*. It is possible, however, that they do not. If this is the case, it must also be true that males prefer α_{Mj}^2 to α_{Mj}^0, and under Regime 3, α_{Mj}^2 would be offered by some firms along with α_{Fj}^* being offered by others. But under Regime 4, α_{Mj}^2 cannot be offered if α_{Fj}^* is available. In this case, the regulatory equilibrium is characterized by either one of two possible configurations. Figure 4 illustrates the first of these as the (pooling) equilibrium contract $\bar{\alpha}_j^1$ (where it is again assumed that $\lambda_M^P > \lambda_M^U$). This contract maximizes male utility along the overall market fair-odds line subject to the constraint that female utility is held at the level consistent with the purchase of α_{Fj}*. Any contract along the overall market fair-odds line offering less insurance than $\bar{\alpha}_j^1$ would be rejected by both males and females in favour of $\bar{\alpha}_j^1$. Any contract offering more insurance than $\bar{\alpha}_j^1$ along E_jC_j would be bought by females but not by males, and would make losses.

For $\bar{\alpha}_j^1$ to represent a Wilson pooling equilibrium in market j, it must be preferred by males to contract α_{Mj}^1 described under Regime 2. If it is not, then $\{\alpha_{Fj}^1, \alpha_{Mj}^1\}$ constitutes the equilibrium contract set. Type j females will be better off in this equilibrium since they are indifferent between α_{Fj}* and $\bar{\alpha}_j^1$, and prefer α_{Fj}^1 to α_{Fj}* since they are optimizing at a lower price of insurance for α_{Fj}^1 than for α_{Fj}*.

Regime 5

In Regime 5, regulators are assumed to be able to costlesly suppress information concerning the gender of potential insureds which insurers would usually utilize in setting price differentiated contracts for females and males. Amongst other things, this would require both physical separation of customers from insurers and prevention of access to gender information on birth certificates. For the moment, however, the assumption that insurers can observe productivity is maintained.

FIGURE 5 ABOUT HERE

Since gender cannot be observed, and assuming exclusive contracts can be enforced, insurers will offer informationally-consistent contracts as follows. First, if $\lambda_M^P = \lambda_M^U$, then in each sector j, males will be offered the partial insurance contract α_{Mj}^2 while females will be offered the full-insurance contract $\alpha_{Fj}*$ if males weakly prefer α_{Mj}^2 to contract $\alpha_{Mj}\#$ as illustrated in Figure 5. If males instead prefer $\alpha_{Mj}\#$ to α_{Mj}^2, the regulated equilibrium is the Spence-Miyazaki contract set $\{\alpha_{Fj}\#,\alpha_{Mj}\#\}$. In sector j, the contract pair involves subsidization of high-risk females by low-risk males, the females buying full-insurance at price q_F and the males buying partial insurance (though more insurance than offered by α_{Mj}^2) at price q_M. Females are better off than in the unregulated equilibrium since they remain fully-insured and receive a lump-sum transfer. Males are worse off than without the regulation because they pay a tax and receive only partial insurance since the contract offered to males must not also attract the high-risk females. Males, however, are better off than in the Wilson pooling equilibrium α_{Mj}^0.[14] Further, and unlike a pooling equilibrium, gender is revealed by the choice of contracts made by males and females.

When $\lambda_M^P > \lambda_M^U$, the insurance market again segments into separate markets for U-workers and P-workers. In the P-market, if males prefer α_{MP}^2 to $\alpha_{MP}\#$, they will be offered this contract while females will be offered $\alpha_{FP}*$. Next, due to a closely-related argument by Hoy (1982), the optimal Spence-Miyazaki subsidy to each female in the P-market exceeds that paid to each female in the U-market, and, as a consequence, the contract $\alpha_{MP}\#$ which is indifferent to $\alpha_{FP}\#$ for females involves a greater quantity of insurance for males than the corresponding contract $\alpha_{MU}\#$.[15] Since males prefer full insurance at price q_M, males prefer the contract with the lowest coinsurance rate at this price. Consequently, if α_{MP}^2 is preferred to $\alpha_{MP}\#$, it is also preferred to $\alpha_{MU}\#$, in which case the contract set offered in the U-market is $\{\alpha_{FU}*,\alpha_{MU}^2\}$. In this case, all females buy the same contract as in the unregulated equilibrium, while all males buy partial insurance at their original price, and are uniformly worse off as a consequence.

FIGURE 6 ABOUT HERE

If males prefer $\alpha_{MP}\#$ to α_{MP}^2, P-males will be offered the former contract while P-females will be offered $\alpha_{FP}\#$, raising the welfare of P-females at the expense of P-males. In the U-market, either males weakly prefer α_{MU}^2 to $\alpha_{MU}\#$, as Figure 6 illustrates, in which case the contract set is $\{\alpha_{FU}^*, \alpha_{MU}^2\}$ as before, or else males prefer $\alpha_{MU}\#$ to α_{MU}^2, in which case the equilibrium contract set is $\{\alpha_{FU}\#, \alpha_{MU}\#\}$. In this last case, all females are better off under the regulation, but high-earning females make larger welfare gains than low-earning females. However, it is also clear that high-earning females can be better off while low-earning females are no better off. Further, although all males are always worse off, except for the case where P-males buy α_{MP}^2, the greater burden of the regulation is felt by low-earning males. Finally, since P-workers can be segregated from U-workers for insurance purposes, if all males are P-types, the regulated and unregulated equilibria again coincide.[16]

Summary

The above results include several that may cause some unease to the regulator who is presumably expecting to make females better off in any regime. This outcome is by no means guaranteed. Further, where all females are made better off, the largest gains may be made by females whose earnings are relatively high, even though their probability of disability and their income losses from disability are the same as low-earning females. Further, the largest income reductions may be made by the relatively poorly paid males if they have to compensate a large number of similarly paid females. To prevent these outcomes from occurring, the regulator must also prevent signals other than gender from being used to screen customers, since high-productivity types frequently gain from being pooled together, and not pooled with low-productivity types.[17] This could be achieved by requiring each firm to offer one policy to all potential customers, whatever their characteristics, or by preventing insurers from using signals such as productivity (or income, or education) to segment markets. With regard to the latter, it is interesting that the New Zealand Human Rights Act makes none of these sources of 'discrimination' illegal.

IMPACTS OF LABOUR MARKET SIGNALLING

Perfectly Categorized Risks

This section examines some of the interactions between educational signalling in the labour market in the presence of asymmetric information between buyers and sellers concerning the productive capabilities of potential employees and regulated insurance market equilibria. The analysis is meant to be illustrative of some results rather than comprehensive, and does not consider the more general case where decisions about education, employment and insurance are made simultaneously.

A common theme in the previous analysis is that if high-productivity females can pool themselves with high-productivity males, they can often make greater welfare gains than their low-productivity counterparts. Their gains will be greater, *ceteris paribus*, the smaller is their representation in the P-worker population pool. High-productivity males will also frequently do better if they are pooled with high-productivity females in that their welfare losses will be smaller than if pooled with the population at large. More generally, revealing information on productivity-type to insurers is a dominating strategy for all P-workers. Low-productivity types would also prefer to be pooled with P-workers, but if insurers can observe a unique signal of productivity such as income or education level, the insurance market will be segmented on this type of criterion. Further, if all males are P-workers and all females are U-workers, the regulated and unregulated equilibria will coincide. Males will be no worse off, and females no better off, as a result of regulation.

A question arises as to when the proportion of males who are P-workers (λ_M^P) will exceed the proportion of females who are P-workers (λ_F^P), with $\lambda_M^P = 1$ and $\lambda_F^P = 0$ as special cases of interest. The focus is on the use of educational signals in the labour market that generate these outcomes. The framework of Spence (1974) is adopted. An employer can costlessly observe the gender of a potential employee, but this information merely signals that productive capacity is either $\hat{W}_{1P}$ with probability θ_i or $\hat{W}_{1U}$ with probability $(1-\theta_i)$, where θ_i is the proportion of more-able persons in gender i's population and $(1-\theta_i)$ is the proportion of less capable persons, i = F,M. In the absence of further information, an employer (for whom θ_i is assumed to be known) will pay an amount $\bar{W}_i = \theta_i\hat{W}_{1P} + (1-\theta_i)\hat{W}_{1U}$ to all workers of gender i. Employees, however, can invest in education which, without loss of generality, is assumed to have no impact on productivity but may signal productive capacity, and which more-able workers can acquire at lower marginal cost than less-able workers. Signalling costs may also differ by gender. Employers are assumed to hold homogeneous expectations regarding the minimum level of education that is required to signal that a given worker is more-able rather than less-able, and these effective job prerequisites can also be gender-specific. A signalling equilibrium exists where educational decisions and labour market outcomes coincide with these expectations. Spence shows that an important property of signalling equilibria is that persons of similar ability *may* have different levels of earnings.

Consider first the circumstances where insurance market regulation is impotent. A sufficient condition is that the earnings of males are uniform and exceed the uniform earnings of females. In the absence of educational signalling, all males have the same earnings as do all females.[18] However, if $\theta_M > \theta_F$, $\bar{W}_M > \bar{W}_F$ (where $\hat{W}_{1P} > \bar{W}_M > \bar{W}_F > \hat{W}_{1U}$), and if insurers can observe the earnings levels of their customers, the insurance market will segment into a pool of more-highly-paid males and a pool of less-highly-paid females (of varying abilities in each case). Since earnings and gender are perfectly correlated in this case, some insurers can legitimately use the former signal to offer insurance at low prices to males while other insurers offer high-priced insurance to females since no female is denied the right to buy low-cost insurance on the basis of gender.[19]

Now consider cases where educational signalling occurs. Let signalling costs be the same for all P-workers, irrespective of gender, and which are lower at each level of education than the uniform signalling costs for all U-workers. Further, let the level of education that signals a worker as more-able be independent of gender. Suppose that it pays more-able workers to signal, but not less-able workers. Then more-able females and males receive $\hat{W}_{1P}$ and less-able males and females receive $\hat{W}_{1U}$. If $\theta_M = \theta_F$, then $\lambda_M^P = \lambda_F^P$, and the impact of regulated insurance markets on males and females will depend on gender alone. If $\theta_M > \theta_F$, however, λ_M^P will exceed λ_F^P so that males will relatively dominate the high-earning sector. These are the circumstances under which high-earning females can gain more than low-earning females as a result of insurance market regulation, and where high-earning males can lose less than low-earning males.

In the previous case where $\theta_M > \theta_F$ and signalling does not occur, more-able males save their signalling costs but earn less because the labour market pools them with less-able males. Their net income in the absence of disability is higher with signalling if $(\hat{W}_{1P}-\hat{W}_{1U}) > C_S(E_0)/(1-\theta_M)$, where $C_S(E)$ is the signalling cost function for more-able types and E_0 is the minimum education level required for the higher-paid job. The effect of signalling by both more-able males and females, however, means that more-able males will now be pooled with more-able females for purposes of insurance, and the welfare of more-able males will be lower than if they were instead pooled with less-able males, as will occur if signalling costs are too high for it to be profitable for anyone to signal. On the other hand, if it pays more-able females to signal, their net incomes in the absence of disability will increase if $(\hat{W}_{1P} - \hat{W}_{1U}) > C_S(E_0)/(1-\theta_F)$. Compared to more-able males, their net incomes are more likely to increase under signalling when $\theta_M > \theta_F$. Further, they make welfare gains when they are pooled with low-risk but highly paid more-able males compared to when they are pooled with other high-risk females. If more-able females are signalling, less-able females receive $\hat{W}_{1U}$ rather than $\bar{W}_F$, and so suffer an earnings reduction compared to the case when signalling is absent. However, they receive some compensation from the fact that they are now pooled with low-risk males for insurance purposes, and unless their regulated equilibrium insurance contract remains as α_F*, they are better off in the insurance market even though they are worse off in the labour market. Finally, if more-able males are signalling, less-able males suffer a reduction in income from $\bar{W}_M$ to $\hat{W}_{1U}$ (which is a larger reduction than for less-able females when $\theta_M > \theta_F$), and also suffer a reduction in welfare as a result of their being pooled with less-able, high-risk females.

Signalling, therefore, can produce circumstances where gender-neutral regulatory insurance regimes can have widely-different welfare impacts on persons of the same gender. Thus far, however, these arguments have rested on the assumption that signalling costs are a decreasing function of unobservable ability, but are the same for males and females of the same ability levels. Suppose, however, that the costs of signalling for females of each level of ability are greater than the corresponding costs for males.[20] If employer expectations are that if $E < E_i$ (for $i = M,F$), then earnings will be $\hat{W}_{1U}$, otherwise earnings are $\hat{W}_{1P}$, then a signalling equilibrium may exist in which all more-able workers acquire the educational signal while no less-able worker acquires the signal, in which case the above arguments continue to hold. One example would be where $E_F = E_M$ ($= E_0$) as before, that $\hat{W}_{1P} > C_S^M(E_0)$, and where the difference in signalling costs between more-able males and females is small. In this case, the income net of signalling costs will be smaller for more-able females than for corresponding males. Another example would be where E_M exceeds E_F by an amount sufficient to compensate more-able females for their excess signalling costs.[21]

Different results, however, are possible. Signalling costs may be significantly greater for females, and educational job prerequisites for females may not be adjusted sufficiently to compensate. More to the point, educational requirements may be greater for females than for males, representing an example of 'informational discrimination' if not necessarily prejudice. For example, let employer expectations be given as follows: (a) if male and $E < E_0$, then $W = \hat{W}_{1U}$; (b) if male and $E \geq E_0$, then $W = \hat{W}_{1P}$; (c) if female and $E < E_0$, then $W = \bar{W}_F$; (d) if female and $E \geq E_0$, then $W = \hat{W}_{1P}$. The condition for more-able persons to signal is that $\hat{W}_{1P} - \hat{W}_{1U} \geq C_S^i(E_0)$, $i = M,F$. Suppose that this condition holds for more-able males, and that they alone signal. Employer expectations are realized by the pattern of educational choices made. However, this case modifies the situation in the insurance market since more-able males earn $\hat{W}_{1P}$, less-able males have the lower earnings level $\hat{W}_{1U}$, and all females have the intermediate earnings level $\bar{W}_F$.

More-able males do very well here, since they earn the most of any group, and cannot be prevented by insurance market regulations from buying their unregulated insurance contract α_{MP}*. Less-able males do badly in that they are the lowest-earning group, but, like more-able males, they are not pooled with any high-risk females for insurance purposes, and are offered the same full-insurance contract at price q_M. More-able females do badly in that they earn less than their male counterparts, and are offered the same full-insurance contract at price q_F that they would face in an unregulated insurance market. Less-able females fare similarly in the insurance market, although their earnings are greater than their male counterparts. The effect of labour market signalling in these circumstances is to render insurance market regulation completely ineffective.

An interesting case to consider is where labour market and insurance market regulators combine to arrest discrimination by suppressing information concerning gender to employers *and* insurers. In the labour market, the effect of gender-suppression on a group apparently suffering discrimination may or may not aid that group, depending on whether the source of earnings differences is due to different educational requirements by gender, or to gender-based differences in signalling costs.[22]

In the first of these cases, let educational signalling costs depend on ability but not gender, and that in the absence of gender-suppression, educational signalling requirements are such that only more-able males are educated. This requires that $E_F > E_M$. Gender-suppression removes the possibility of implementing differential educational requirements by gender, so that $E_F = E_M$ ($= E_0$). If it pays more-able males to acquire education, it must now also pay more-able females to acquire education. Suppose that under gender-suppression, more-able females and males acquire education, and less-able females and males do not., Gender-suppression in the labour market generates equal earnings for workers of similar abilities, independently of their gender. Earnings of more-able males remain unchanged at $\hat{W}_{1P}$, while earnings of more-able females increase from $\bar{W}_F$ to $\hat{W}_{1P}$. Earnings of less-able females, however, fall from $\bar{W}_F$ to $\hat{W}_{1U}$ since they are no longer pooled with more-able females, while earnings of less-able males remain at $\hat{W}_{1U}$. Gender-suppression in the labour market raises the welfare of more-able females at the expense of less-able females while leaving the welfare of males unchanged.

Now suppose that there is also gender-suppression in the insurance market, so that Regime 5 is relevant. Prior to the suppression of information in the labour market, suppression of information about gender in the insurance market would have had no effect on the welfare of any group. All males and all females would be fully insured at prices reflecting their respective probabilities if disability, since insurers can use observed differences in income to uniquely signal gender. Although males earn either $\hat{W}_{1P}$ or $\hat{W}_{1U}$, and all females earn $\bar{W}_F$, the essential point is that *no* male has similar earnings to *any* female. The effect of gender-suppression in the labour market, however, now pools more-able males with more-able females, and less-able males with less-able females, with earnings $\hat{W}_{1P}$ and $\hat{W}_{1U}$ respectively. Earnings no longer signal gender. Consequently, the insurance market equilibria change from the set $\{\alpha_F^*, \alpha_{MP}^*, \alpha_{MU}^*\}$ (where α_F^* is the full-insurance contract sold to all uniform-earnings females) to one of the following: (a) $\{\alpha_{FP}*;\alpha_{MP}^2;\alpha_{FU}*,\alpha_{MU}^2\}$; (b) $\{\alpha_{FP}\#,\alpha_{MP}\#;\alpha_{FU}*,\alpha_{MU}^2\}$; (c) $\{\alpha_{FP}\#,\alpha_{MP}\#;\alpha_{FU}\#,\alpha_{MU}\#\}$. Consider the situation for more-able females. Without gender suppression in either market, they earn $\bar{W}_F$ and buy full insurance at price q_F. Gender-suppression in the insurance market alone does not change their situation. When combined with gender-suppression in the labour market, however, more-able females find themselves still fully-insured at price q_F, but enjoy a higher level of earnings $\hat{W}_{1P}$ and, in cases (b) and (c), enjoy an income transfer from more-able males as well. More-able males maintain their earnings at $\hat{W}_{1P}$, but lose out by being only partially insured at price q_M. Less-able females remain fully-insured at price q_F but lose out in cases (a) and (b) because their earnings fall from $\bar{W}_F$ to $\hat{W}_{1U}$ (which is required in order to remove 'informational discrimination' against more-able females). In case (c), however, they are compensated by transfers from less-able males, and if their optimal subsidy exceeds their fall in earnings, they are better off by the joint regulations. Less-able males continue to earn $\hat{W}_{1U}$ but lose out in the insurance market since they are partially insured at q_M in all cases, and pay a subsidy to less-able females in case (c).

In the second case, assume that female signalling costs exceed those of males. Employers recognize that differential signalling costs penalize more-able females, and set E_F at a level sufficiently *lower* than E_M for it to be profitable for both more-able females and more-able males to acquire education. In the absence of gender-suppression in the labour market, more-able types earn $\hat{W}_{1P}$ and less-able types earn $\hat{W}_{1U}$. If gender is suppressed in the insurance market, Regime 5 equilibria are one of (a) - (c) above. If gender is now also suppressed in the labour market, employers can no longer set educational requirements in such a way as to compensate for higher female signalling costs, and instead set the common requirement E_0. As a consequence, assume that it is now too costly for more-able females to acquire education, but that it still pays more-able males to continue signalling. Let employer expectations be as follows: (a) if $E < E_0$, $W = \bar{W}_\theta = \theta\hat{W}_{1P} + (1-\theta)\hat{W}_{1U}$; (b) if $E \geq E_0$, $W = \hat{W}_{1P}$ with probability 1. The labour market impact is that more-able males earn $\hat{W}_{1P}$ while the remaining population earns $\bar{W}_\theta$. Then, θ is the proportion of more-able females in the population of all females plus less-able males. Although more-able males continue to earn $\hat{W}_{1P}$, more-able females receive lower earnings as a result of gender-suppression in the labour market, while all less-able workers earn more as a result of being pooled with more-able females in the labour market. In the insurance market, insurers now offer full insurance at price q_M to males earning $\hat{W}_{1P}$. Since males are the only workers earning $\hat{W}_{1P}$, these contracts break even. The introduction of gender-suppression in the labour market, in conjunction with suppression in the insurance market, is the best of all worlds for more-able males since their earnings are unchanged and they are no longer pooled with any high-risk females in the insurance market. Their female counterparts, however, are disadvantaged. First, their earnings fall. Second, in case (a), they remain fully insured at price q_F and are neither better nor worse off. But if either cases (b) or (c) describe the initial equilibrium, they are now also worse off in the insurance market. They are no longer pooled with the relatively numerous more-able, low-risk males. Instead, they are pooled with the relatively few less-able, low-risk males and the relatively numerous less-able, high-risk females. Although still fully-insured, either they receive no subsidy from less-able males or else their optimal subsidy declines. In any case, their welfare level is identical to that of less-able females, whose own welfare increases in response to the increase in income resulting from now being pooled with more-able females (as well as less-able males) in the labour market, although in case (c), their optimal subsidy falls in response to the diminished share of less-able males in their insurance pool.

A clear general message emerges. Suppression of information regarding gender in the labour market can rebound against legislators seeking to prevent 'informational discrimination', in this case against more-able females, and when it does, suppression of gender-based information in the insurance market tends to compound the problem. The circumstances for this to occur are that educational signalling costs are greater for females than for males of similar ability, but that allowance for this is being made by employers, the result of which is that not only are more-able females paid the same as more-able males, but as a result of this earnings structure, these females become pooled with a group of low-risk males which provides them with the potential for further welfare improvement.[23] If the ability of employers to set differential educational requirements is denied on the misplaced assumption that employers are setting too high standards for females, then more-able females may be doubly disadvantaged if at the same time insurers are being denied information about gender.

Imperfectly Categorized Risks

The case of imperfectly categorized risks has been examined extensively in the 'categorization of risks' literature, for example, by Hoy (1982), Crocker and Snow (1985,1986) and Bond and Crocker (1991), and this literature is surveyed in Dionne and Doherty (1992, Section 2.4) and Harrington and Doerpinghaus (1993). While it is possible to analyse the various equilibria as for the case of perfectly categorized risks outlined above, the presence of a wide range of initial unregulated equilibria makes this a task too extensive to consider here.[24] Instead, two cases of labour market signalling in conjunction with imperfect (but costless) categorization of risk will be considered in the context of Regulatory Regime 3 to provide examples of some possible outcomes and issues involved in their determination.

It is again required to distinguish more-able from less-able workers, who, as a result of educational signalling, may have different levels of earnings. Further, while it is still the case that females are a riskier category than males, this holds only on average. Consequently, there is a small proportion of males who are high-risks, along with a small proportion of females who are low-risks.[25] While insurers know these proportions, information on which individuals are high-risk and which are low-risk are private to the individuals concerned. The model now exhibits both signalling and screening characteristics, where informed potential employees are 'first movers' in terms of their education decision, and where the education/labour allocation process is completed prior to uninformed insurers being 'first movers' in a second game in which earnings in the good state are given, and where insureds respond by choosing from a menu of offered contracts.

In the first signalling situation considered, prior to labour market regulation, the educational requirement for females is set at such a high level that only more-able males are signalling. Educated males earn $\hat{W}_{1P}$, uneducated males earn $\hat{W}_{1U}$, and all females earn the intermediate income level $\bar{W}_{1F}$. This information is known to insurers. However, what they do not know, for example, is which of the educated male group are high-risks and which are low-risks, although they do know the proportion of high-risks in this group. It is assumed that risk is uncorrelated with either ability or earnings, *per se*, and is imperfectly correlated with gender.

In these circumstances, insurers will not distinguish males by their income level. Assuming exclusive contracts can be enforced, all males will be offered either one of two pairs of contracts $\{\alpha_H*, \alpha_L^2\}$ or $\{\alpha_H\#, \alpha_L\#\}$. Contract α_H* is the optimal high-risk contract at price q_H, while α_L^2 is the best quantity-constrained contract that can be offered to low-risks at price q_L such that high-risks are not also induced to buy it, in which case it would make losses on overall sales. This is the familiar Rothschild-Stiglitz (1976) Nash equilibrium. Females can be excluded from buying these contracts, not because they are female, but because their (uniform) earnings level $\bar{W}_{1F}$ fails to coincide with the earnings levels of either educated or uneducated males. However, if the Nash pair is an equilibrium for males, it must also be an equilibrium for females, since female risk is greater, on average, and if the Spence-Miyazaki contract $\alpha_L\#$ is rejected by low-risk males in favour of α_L^2, the related contract which carries a higher tax and less insurance cover must also be rejected by low-risk females.

Now when Regime 3 is introduced, there are *no* welfare effects in the insurance market since the unregulated equilibria are maintained. Firms offering both contracts cannot continue to do so since they would be offering insurance at different prices to females and males, although they might reasonably defend their position since they will be selling high-priced full-insurance contracts to *both* high-risk females and males, and low-priced, quantity-constrained contracts to both low-risk females and males. Apart from the possible segmentation of the insurance market in terms of risk-class, the regulation has no impact whatever.

The Nash equilibrium, however, may not apply. Since the relatively low-risk males can be separated from females on the basis of income differences, the Spence-Miyazaki contract pair $\{\alpha_H\#, \alpha_L\#\}$ may apply for all males. These contracts offer the best quantity-constrained deal at price q_L for low-risk males subject to the constraint that the resulting contract does not attract high-risk males and that the optimal subsidies paid to high-risk males are exactly financed by taxes paid by low-risk males. Contracts with similar properties might also be an equilibrium for females, except that their greater average risk implies a lower quantity of insurance (and hence a lower welfare level) for low-risk females compared to their male counterparts, and a lower subsidy (and hence a lower level of welfare) for high-risk females compared to high-risk males. If the Spence-Miyazaki equilibria apply, prior to insurance market regulation, a firm might be offering four contracts at two separate prices and tax-subsidy regimes. After Regime 3 is introduced, the firm will have to withdraw from either the female or male market in order to meet the unisex pricing requirement, yet will still offer contracts to either females or males at different prices for different risk-classes of the same gender group. Again, females will be denied access to the more attractive male contracts on the grounds that their income level is 'inappropriate' for these contracts to be offered to them, and insurance market regulation will again have zero welfare effects. Similar conclusions hold if the male market equilibrium is the Spence-Miyazaki pair while the female market equilibrium is the Nash pair.

Suppose, however, that labour market regulators deny information on gender to employers, so that uniform job entry standards must be applied, and that as a result, both more-able males and females acquire education and are paid $\hat{W}_{1P}$ while less-able males and females remain uneducated, and earn $\hat{W}_{1U}$. Earnings of more-able females increase, while those of less-able females fall. Insurers can no longer use the justification of different income levels to exclude females from the male market. Assume, however, that the proportion of females who are educated is less than the proportion of males acquiring education. Insurers will then form two insurance pools, not of females and males, but of higher-paid and lower-paid workers, respectively, unless the (same) Nash contract pair is offered to everyone. The reason is that while the P-pool is no longer exclusively male, who are the low-risk category, it is (relatively) dominated by males whereas the U-pool is (relatively) dominated by the high-risk female category.[26] These factors tend to promote the prospects of a Spence-Miyazaki equilibrium in the P-market, and mitigate against a Spence-Miyazaki equilibrium in the U-market.

Suppose that prior to insurance market regulation, a Spence-Miyazaki equilibrium applies in the P-market while a Nash equilibrium applies in the U-market. When Regime 3 is introduced, U-market firms will have to offer either α_H^* or α_L^2, but not both, since they would be observed to be violating the unisex pricing requirement. Apart from forcing firms to specialize in a single contract, there are no other impacts of the regulation. This is not the case in the P-market, where low-risk females and males are buying low-priced partial insurance contracts and are internally cross-subsidizing the high-priced full-insurance contracts bought by high-risk females and males. These violate the unisex pricing requirement and must be withdrawn, either in favour of a Wilson pooling contract offering partial insurance at a price reflecting the P-market overall probability of disability, which reduces low-risks' welfare level and may also reduce high-risks' welfare level, or else the Nash contract pair will be offered (by different firms) reducing the welfare of all P-workers.

Insurance market regulators may hope that their efforts raise the welfare of all females because they are the high-risk group even if they are aware that some females are low-risk. Alternatively, they may at least hope that most females are better off, and the remainder no worse off, or, at worst, that most females are better off and perhaps a few are worse off. The above example shows that it is possible for the majority of females to be no better off, while a minority are worse off. There is another possibility, however. Given that the labour market is regulated so that both more-able females and males are signalling (or if labour market information is symmetric so that employers can identify more-productive workers without them having recourse to acquiring education), if a Spence-Miyazaki equilibrium characterizes the pre-regulation situation in both the P-market and the U-market, and a Nash equilibrium characterizes the post-regulation situation in both markets, *all* females will be worse off, as will all males. This differs from the case of perfectly categorized risks, for which females (all of whom are high-risks) are offered the same contract in the pre-regulation equilibrium as in a post-regulation Nash equilibrium.

In the second signalling situation, imagine that employers are compensating females for their high signalling costs by reducing their educational requirement for a high-paid job below that of males, and, as a consequence, both more-able females and males acquire education. Now if employers are denied information on gender, and signalling costs are such that more-able females no longer acquire education, the insurance market will separate by income (and hence gender) and the introduction of insurance market regulation will have no welfare effects in insurance markets.

CONCLUDING REMARKS

This paper has examined the welfare effects of alternative regulatory regimes which intervene in competitive insurance markets offering one-period contracts with a view 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) but differ as to whether and how insurers can constrain the quantity of insurance purchased by insureds. One regime also denies gender-based information to insurers. Compared to the related 'categorization of risks' literature, the analysis differs in permitting different agents to have different earnings, and, on the assumption that earnings (or some perfect correlate thereof) are costlessly observable by insurers, it is found that properties of regulated equilibria can be substantially different from the case where earnings are uniform across agents, where in many (but by no means all) cases, high-risk types are made better off as a result of the various regulations.[26] The various regulations tend to be less effective, or impotent, in their attempt to raise welfare of high-risk types. A major reason is that if earnings differ systematically by gender groups, information on earnings can be used to segment the insurance market by gender, rendering insurance market regulations impotent. Even in more realistic cases where the distribution of earnings by gender overlap, a large proportion of high-risk types may be no better off or receive only modest benefits since income differences may permit insurers to create a high-income risk-pool which is dominated by low-risk types, leaving only a few low-risk types to subsidize the numerous high-risk types in a low-income risk-pool. These results can be even more emphatic in the presence of labour market signalling, especially if labour market regulators deny gender-based information to insurers which, as a result, lead to educational decisions by agents such that high-risks become pooled in the labour market and consequently face a different level of earnings from low-risks.

While most of the analysis deals with the case of perfectly categorized risks, so that one or other gender group contains either low-risk types or high-risk types, but not both, the case of imperfectly categorized risks in an insurance market characterized by adverse selection phenomena is also addressed in conjunction with labour market signalling. It is shown that insurance market regulation may have no impact on welfare outcomes in many circumstances when the risk-class of individuals is private information to insureds, although it is also possible to generate the result that in one case, *all* agents may be worse off under insurance market regulation, which is not possible under perfectly categorized risks in a similar situation.

The models analysed are relatively restrictive, however, in that moral hazard and the effects of insurance transactions costs are ignored while the assumption that the costs of categorization of risks by gender are zero is also maintained. Further work might address these issues, as well as the interesting possibility of accounting for joint education and insurance decisions of families in regulated insurance and labour markets.

NOTES

1. Full insurance will not characterize an unregulated competitive equilibrium in the presence of moral hazard or proportional transactions costs, but these issues are assumed away here.

2. Each regulatory regime is treated as exogenous. It is an open question whether any can be considered to be solutions to some social welfare maximization problem for a benign regulator.

3. Evidence suggests that females, on average, are riskier prospects for disability insurance. For example, the New York State Superintendent of Insurance (1976) reported 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 concerning the true marginal contributions to risk made by gender. Using a disaggregated hedonic pricing model, Puelz and Kemmsies (1993) find a significant contribution of gender to premium determination for automobile insurance, but which is much smaller than that found by Dahlby (1983) using aggregated data.

4. If earnings differentials are relatively small, and risk differentials relatively large, it is possible that all females will have lower consumption possibilities than all males in every state of the world.

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

6. The contract $\hat{\alpha}_j$ is a regulated equilibrium since it breaks even and because it can be purchased by both gender groups. A contract offering a little more (full) insurance to both groups would make losses, and a contract offering a little less insurance to both groups involves a higher price for all agents, and will be rejected in favour of $\hat{\alpha}_j$. Further, a contract β_j in the neighbourhood of $\hat{\alpha}_j$ which would make profits by attracting the low-risk males (but not the high-risk females) cannot be offered for two reasons. First, it does not offer full insurance. Second, it would make losses if sold to both groups, so females must be excluded from buying it on the basis of their gender. Each of these violates the regulatory constraint.

7. This fact should prove a suitable defence to the charge that high-risk, low-earning females are denied access to low-cost insurance because of their gender.

8. This result is characteristic of every regime considered.

9. The reason why the upper bound for q^* is a price greater than $\bar{q}$ is that for a price less than or equal to $\bar{q}$, profits are negative since (a) profits are strictly decreasing in the quantity of female insurance purchased, (b) profits are strictly decreasing in the amount of male insurance purchased, (c) females are overinsured and males are underinsured, and (d) full insurance contracts make zero profits for $q = \bar{q}$ and make losses for $q < \bar{q}$. The existence argument relies on the continuity of the demand and cost functions, along with the assumption that males choose to buy a positive quantity of insurance at price q_F, in which case positive profits are made on these sales while zero profits are made on sales of the full-insurance contract purchased by females at q_F.

10. Insurers may decide to place an upper bound on the indemnification of females in order to dissuade moral hazard from raising its ugly head in a situation where it would not otherwise appear. If so, a likely possibility is that no female will receive more than her income loss in the event of disability. In that case, the regulated equilibrium price will fall in each sector, and males will buy more insurance. In each sector j, the regulated equilibrium price will fall *below* the corresponding market odds price $\bar{q}_j$, since the full-insurance contract at price $\bar{q}_j$ will break even only if both groups buy it and it makes positive profits if only females buy it while males optimally choose a lower quantity of insurance. It is the latter case that is relevant, since males only choose to buy full insurance at the lower price q_M.

11. This requires that firms can observe the total insurance purchases of their customers and exclude liability if claims are made from other firms. The nature of competitive equilibrium when moral hazard is present is also affected by this consideration; see Arnott (1992) for a discussion. Arnott (p. 344) notes that apart from life and air flight insurance, all standard contracts contain exclusivity provisions.

12. This result, in a related context, is demonstrated by Rea (1987), and results from the nonlinearization of the high-risk group's budget constraint. Rea also notes that the high-risk group might also be better off by supplementing their insurance purchases. The possibility that an equilibrium exists where P-males and P-females both buy $\alpha_{MP}{}^2$ plus supplementary insurance at a price reflecting female risk from a given insurer such that the resulting contract set makes nonnegative profits is not pursued here, since it involves the firm selling insurance at more than one price, which is not permitted under Regime 2. It does, however, raise a question of interpretation concerning unisex pricing under Regime 2. Suppose a firm does find it profitable to jointly sell quantity-constrained insurance at a low price to males and females and supplementary insurance at a high price to both groups. It might argue that since it is not offering any male contracts under better terms or conditions than any female, the firm is meeting the regulation. The regulatory response under Regime 2 is that a *given* firm is not permitted to sell any insurance to a male at a low price if it is simultaneously selling a positive quantity of insurance to a female at a higher price. Regime 2, however, does not prevent *different* firms from offering different prices. Under Regime 2, regulators may be surprised to discover this outcome, which may motivate the introduction of Regime 3.

13. Riley (1979) criticizes the Wilson equilibrium concept in the context of imperfect categorization in part because a pooling contract cannot reveal information about the risk-classes of its buyers. This is not a problem under perfectly categorized risks, however, since insurers can tell who is high-risk and who is low-risk merely by observing its customers. Informational consistency is satisfied trivially.

14. Hoy's analysis differs in that instead of markets being distinguished by productivity, they are distinguished by gender in a world in which the 'male' market has a small proportion of high-risk types and the 'female' market has a small proportion of low-risk types. Instead of insurers being uncertain about the gender of a type-j worker, and hence whether the worker is high-risk or low-risk, they are uncertain about the risk class of a person of either gender. The two cases are formally equivalent, however.

15. Note that a Spence-Miyazaki equilibrium is only possible under Regime 5. In any market segregated by productivity, regulatory Regimes 1-4 require that males and females are either offered the same contract (implying a uniform price), or must face the same price of insurance (even if this does *not* imply a uniform contract). A Spence-Miyazaki equilibrium involves both different quantities and different prices for females and males.

16. This provides an interesting twist to the debate on restricting the use of information in insurance markets. A regulator interested in efficiency will not generally place restrictions on the use of costless signals. Rea (1992), however, argues that it is rational for insurers and society at large not to invest in relatively costly signals, but also provides an example where investment in a costly signal by insurers is beneficial to them, but not to society overall, so that it may aid efficiency to restrict their use. Some 'politicized' regulators, however, appear to argue that if some signals are not used, then no signals should be used, which can never be efficient unless all signals are prohibitively costly to insurers, in which case regulation is otiose in any case. In the case given in the text, however, either signals other than gender and productivity do not exist, or it is implicit that they are too costly for insurers to acquire. The regulator, however, is attempting to prevent the use of only one of two costless signals, and the permitted signal may be (perfectly or imperfectly) correlated with the outlawed signal. For the regulator to attain the desired outcome, insurers may have to be effectively required to give up the use of all available signals even in the case where all available signals are costless, and their use efficiency-enhancing.

17. Absence of signalling can arise for a number of reasons. One is that all workers find that the cost of acquiring the (minimal) signal exceeds the earnings differential for being educated. Another is that more-productive males find it profitable to signal given that less-productive males do not signal, but less productive males also find it profitable to signal, given that more-productive males do not signal, while no female finds it profitable to signal. If all males signal, employers learn nothing about capability from the signal, since every male has the signal yet not all males are equally-productive. All males then receive $\bar{W}_M$ which is the same level of earnings as when they do not signal. Since signalling is costly,

and there is no payoff, the best response for any male is not to signal.

18. The population shares of more-able persons in the respective female and male labour forces need only be ϵ-different for this result to occur. Note that θ_M will exceed θ_F if the shares of more-able persons in the respective female and male populations are identical but that the labour force participation rate of more-productive persons is smaller for females than for males.

19. This may arise, say, because of less effective education for females at an earlier stage in the education process than that for which educational signalling is relevant, for example, at the level of elementary or secondary education in a world where employers set a tertiary educational requirement for signalling ability.

20. Spence (1974, p. 41) argues that unprejudiced employers will tend to compensate more-able females for their higher educational costs without introducing 'reverse discrimination' since equally-able males and females will have the same earnings in the resulting signalling equilibrium. Their incomes net of signalling costs will not be the same, however, unless (E_F,E_M) pairs satisfy particular values. This point is important, given Spence's emphasis on the nonuniqueness and possible inefficiencies of signalling equilibria.

21. See the Proposition in Spence (1974, p. 42).

22. This argument raises the possibility that it may pay some females to acquire education even when apparently unprofitable in order to be pooled with a relatively large group of low-risk males.

23. These cases are examined in Woodfield (1994) but only for the situation where male and female earnings are identical. In a related context, Crocker and Snow (1985, 1986) show that costless imperfect categorization always enhances (second-best) efficiency, and demonstrate the existence of a balanced-budget tax-subsidy system that gives incentives to use costless categorization such that no agent is worse off as a result of categorization. Bond and Crocker (1991) introduce endogenous categorization via the choice of commodities that are correlated with individual risks in a model incorporating moral hazard in addition to adverse selection, and show that categorization both improves efficiency and increases the likelihood of a Nash equilibrium existing. The introduction of Regime 5 would deprive the economy of these welfare gains from costless categorization.

24. McCarthy and Turner (1993) note that the United States Supreme Court favoured unisex pension benefits in part because gender-based mortality tables allegedly cause gender-discrimination against females because it cannot be guaranteed that an individual female will outlive an individual male.

25. Even so, there will be some high-risk females and males in the P-pool.

26. The equilibria for the uniform-earnings case possess quite diverse properties, depending on the parameters of the problem and the nature of the regulatory regime considered. See Woodfield (1994).

FIGURE 1: Unregulated Insurance Market Equilibria

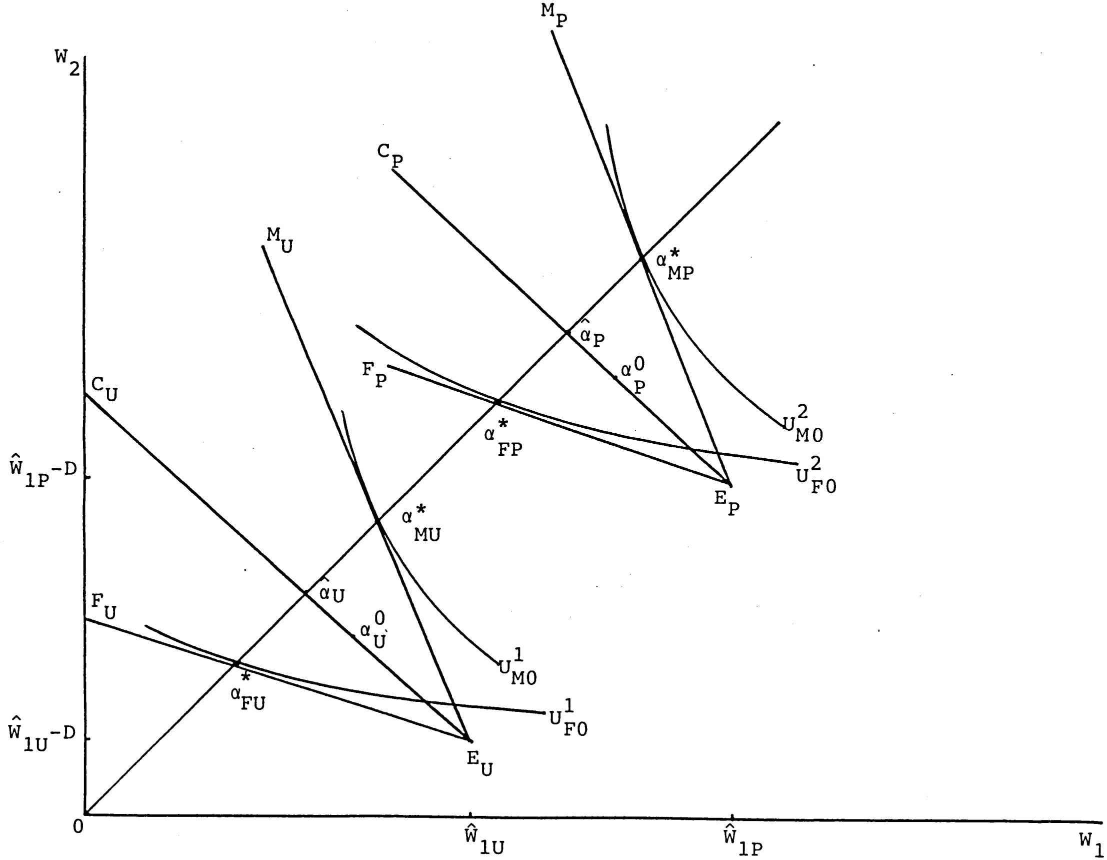


FIGURE 2: Regime 1 Insurance Market Equilibria

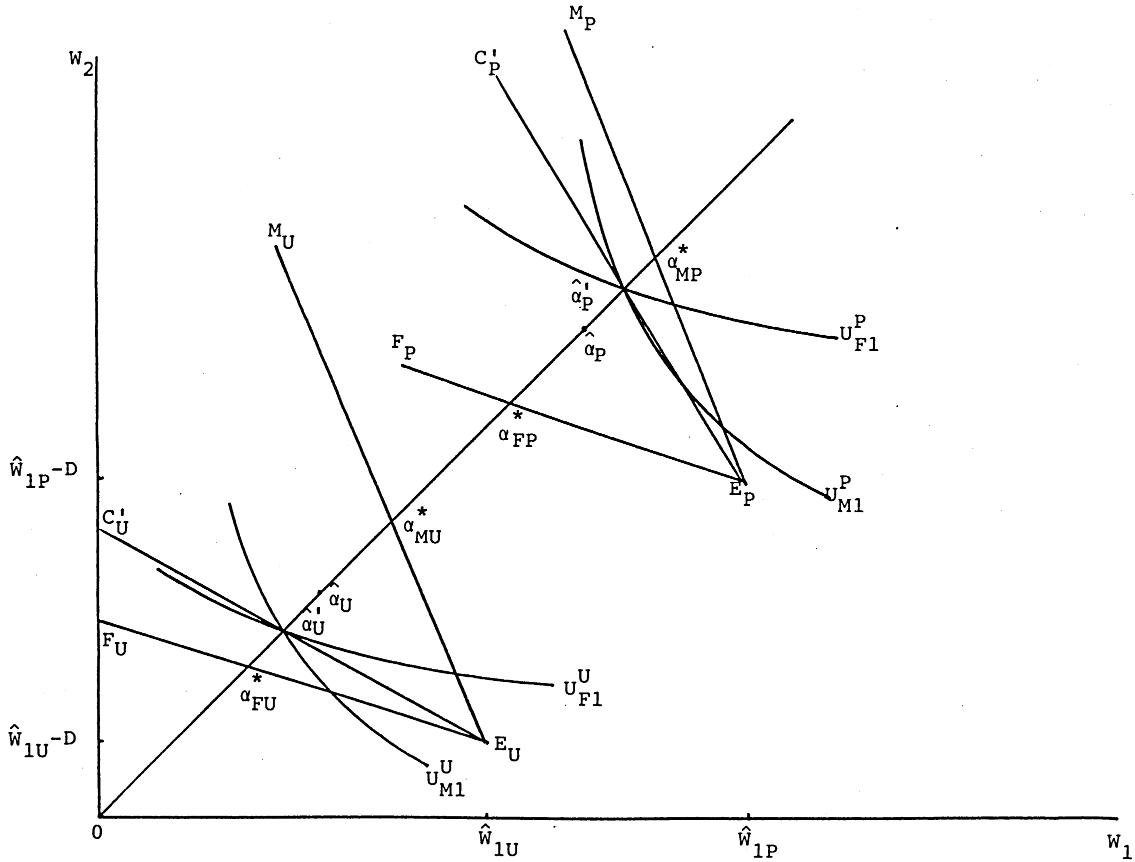


FIGURE 3: Regime 2 Insurance Market Equilibria

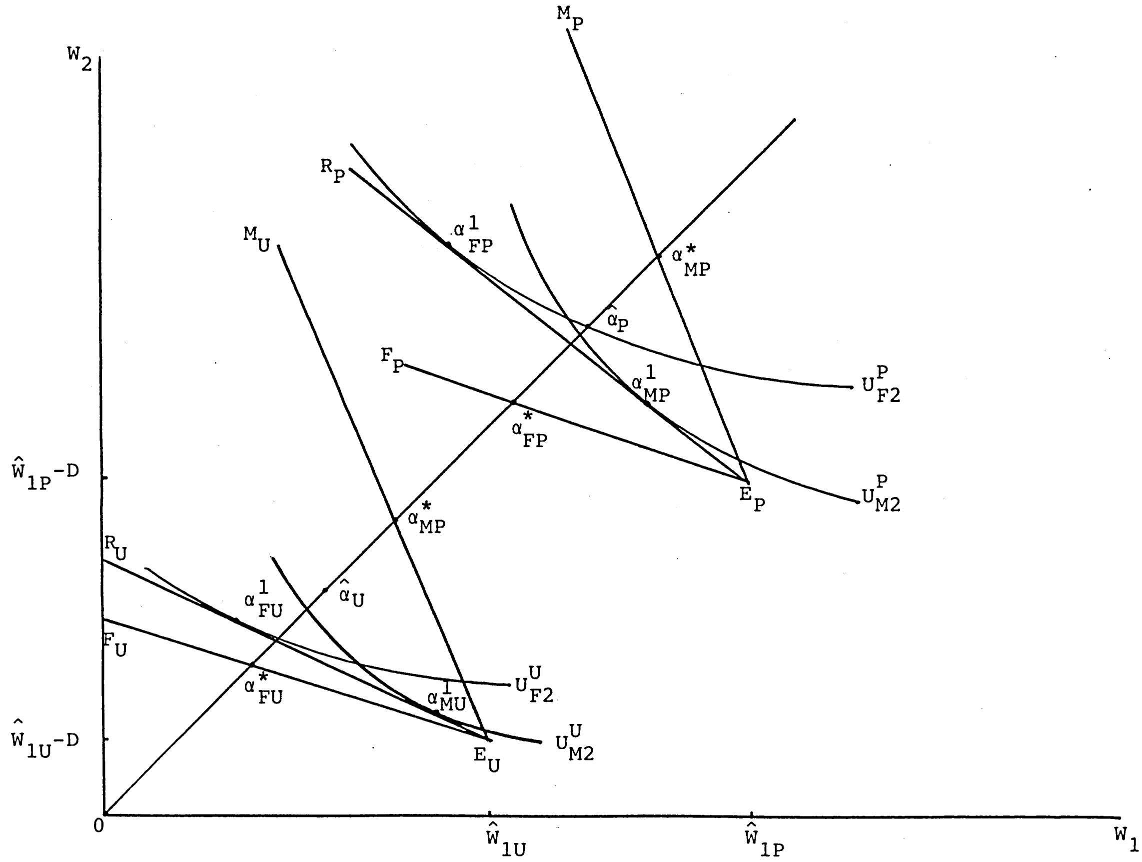


FIGURE 4: Regime 3 Insurance Market Equilibria

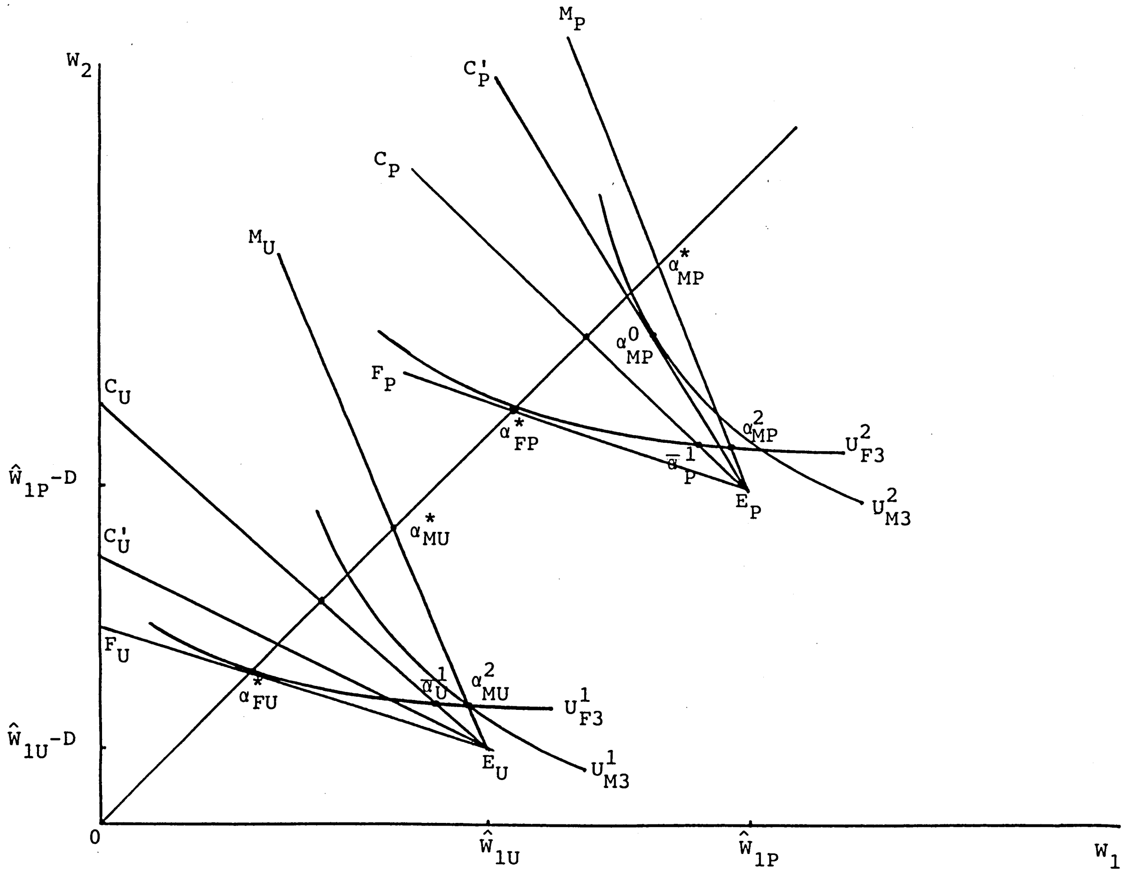


FIGURE 5: Regime 5 Insurance Market Equilibria for $\lambda_M^P = \lambda_M^U$

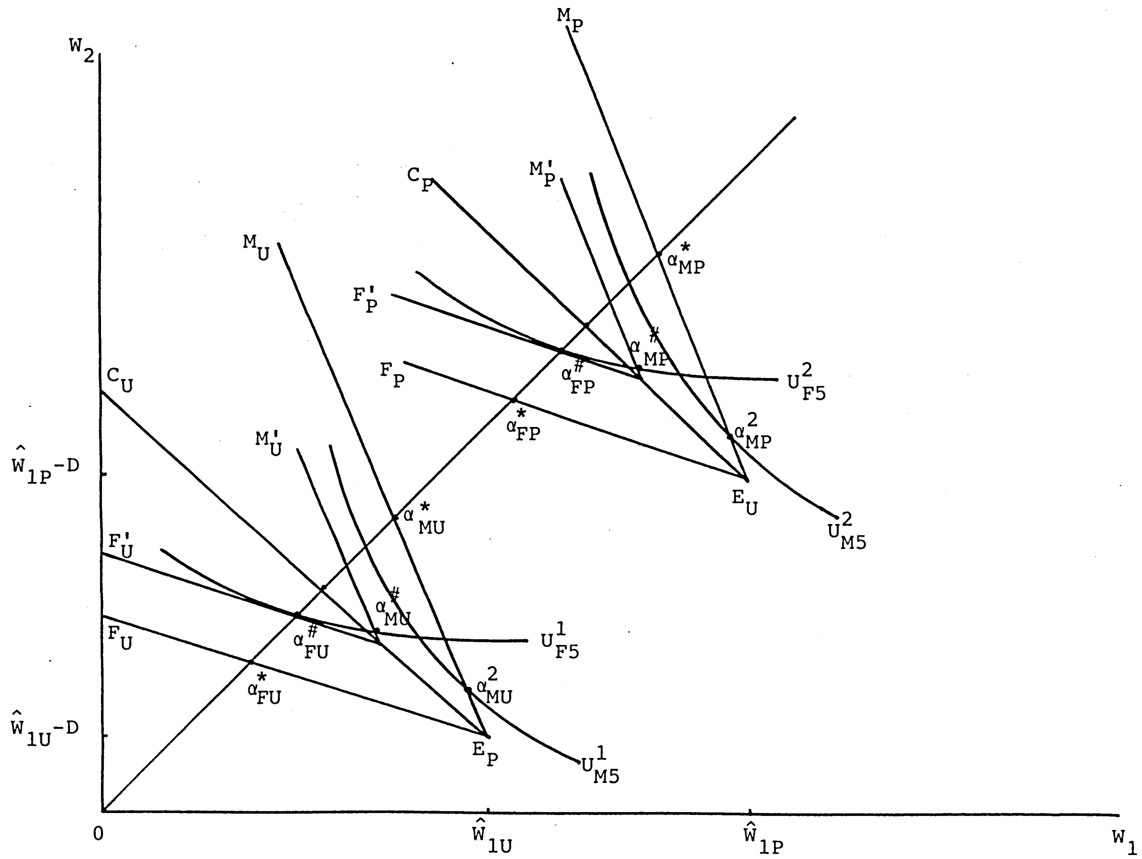
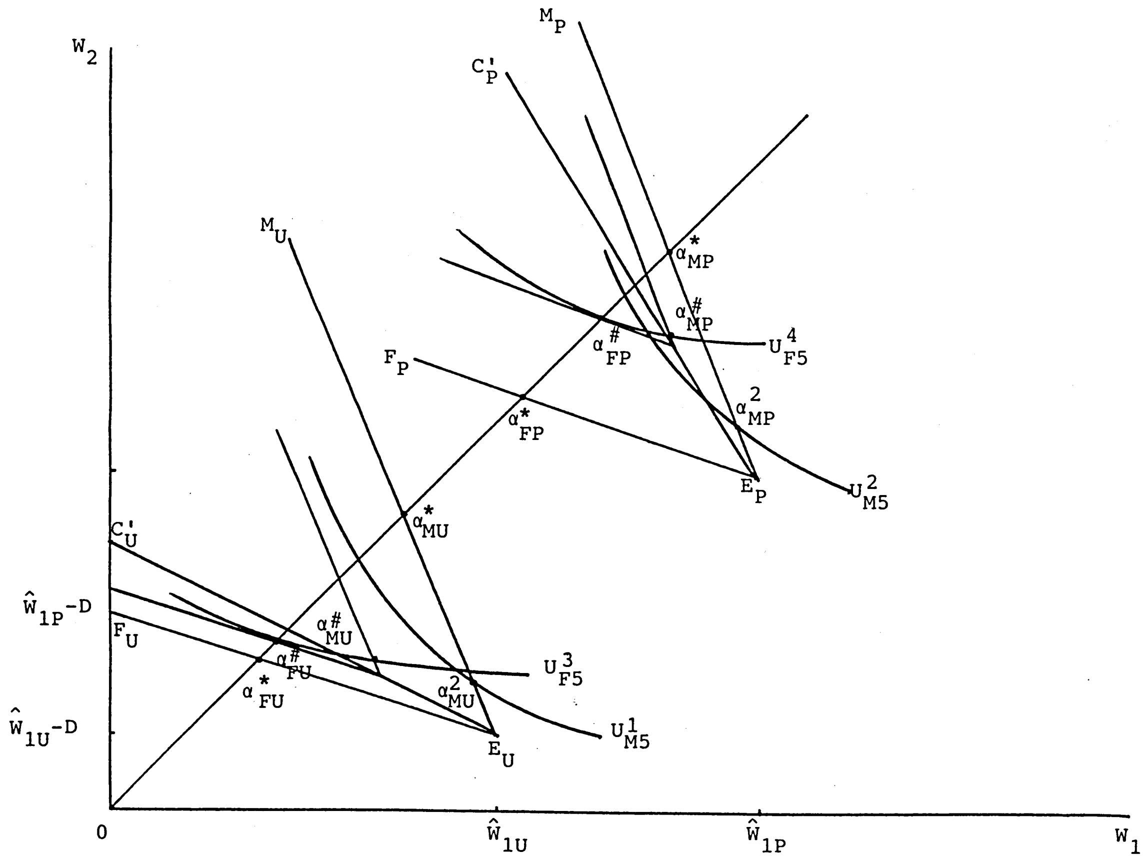


FIGURE 6: Regime 4 Insurance Market Equilibria for $\lambda_M^P > \lambda_M^U$



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