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Do Unprejudiced Societies Need Equal Opportunity Legislation?

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Abstract

To what extent should banks, insurance companies and employers be allowed to use personal information about the people whom they lend to, insure or employ in setting the terms of the contract? Even when different treatment is motivated by profit not prejudice, banning discrimination (when combined with mandatory protection against failure) may well be the best way of effecting redistribution of income. Unlike income taxation this policy achieves its goals without much adverse effect on incentives. Public provision of low-powered incentive contracts issued on generous terms is also a potent instrument of efficient redistribution. This is true even if the government cannot observe type but the private sector can.

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1) Introduction

Justice is blind. Not so credit, insurance and labour markets. For example, women tend to have less costly motoring accidents than do men. Thanks to competition between insurance companies, this difference is reflected in premiums. Should such gender discrimination be legal? If so, does it follow that the disabled should pay higher premiums than the rest of the population? What if accident rates differ by race? There is evidence that a poor credit record is correlated with accident propensity. In the US missing a credit card payment puts up the cost of motoring insurance. Eight states are legislating to prevent this. Are they right to do so? Should insurance contracts be independent of all personal characteristics? This paper addresses such questions.

Companies of all sorts are increasingly using sophisticated methods to predict how individuals will perform.[1] For example, banks use statistical analysis to distil an array of personal information it into a single "credit score". This is used to determine whether to grant a loan, how large it should be and the interest rate to charge. Whether it is actually legal to collect and utilise information involving personal characteristics varies. In most jurisdictions motoring and life insurance premiums can differ with gender but not race, whereas employment and credit contracts can vary with neither.[2] The distinction may be related to whether market differentials are most plausibly motivated by profit or prejudice.[3] For example, under the British Disability Discrimination Act 1995, insurers are required to justify any different treatment on the basis of actuarial data, medical research information or medical reports about an individual.

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[1] Chiappori and Salanie (2000) argue that in motoring insurance there is no evidence of asymmetric information.

[2] Montana is the only US state to have passed legislation to prohibit gender-based classification in all personal insurance policies (auto, health, disability, annuities and life).

[3] The distinction is related to the "taste for discrimination" model of Becker (1957) and the "statistical discrimination" approach of Arrow (1972) and Phelps (1972). In the former, if race or gender is a significant explanation of the terms of trade (after controlling for human capital and other observable economic variables) it is attributed to some parties disliking to interact with the disadvantaged group. In the latter the interpretation is that the characteristic is correlated with economic performance. For example, if in a loan market blacks are charged higher interest rates (as found by Blanchflower, Levine and Zimmerman (1998) the implication of Becker's approach is that in equilibrium blacks are less likely to default than whites whereas in Arrow and Phelps the opposite would be true. There is some evidence that blacks are more likely to default (Berkovec et al, (1998)) though under ECOA this would not be a defence. In standard models neither kind of discrimination leads to Pareto inefficiency though the taste for discrimination seems more troubling. Akerlof and Kranton (2000) provide a persuasive account of how group identity can lead to self-fulfilling expectations of discrimination implying welfare losses.

Nevertheless, legislation often goes beyond requiring that differentials are evidence based. The US Equal Credit Opportunities Act is explicit; it allows the use of

"…..any empirically derived credit system which considers age if such system is demonstrably and statistically sound in accordance with regulations of the Board, except that in the operation of such system the age of an elderly applicant may not be assigned a negative factor or value."

There is a tendency that differentials, even if performance based, are disallowed if they appear to harm disadvantaged groups. This paper argues that there is merit in such policies. In essence, prohibiting contractual terms from depending on individuals' innate characteristics redistributes income towards the less able whilst preserving financial incentives to perform well. Progressive income taxation is not so efficient in helping the disadvantaged because it decreases the return to effort.

Consider insurance contracts. To keep premiums low, contracts generally do not offer complete coverage. Deductibles give buyers of insurance an incentive to take care to avoid losses. They also discourage small claims for which the administrative cost is a high proportion of the loss.

The role of the premium is different. It is payable whether or not a loss occurs, so it has little effect on the incentive to take precautions. The premium is there to raise the revenue to pay the claims. In a way it is like a tax. The question is how should the tax burden be distributed? Remember, this is a tax with the distinctive property that it has negligible disincentive effect. It can therefore be set to equalise consumption with no negative effects. So, for example, if diabetic motorists are higher-risk than non-diabetics, there is no good reason for reducing their consumption by charging them the higher premium occurring in an unregulated market.[4] In fact, high-risk types should pay lower premiums. Since they are more likely to suffer a loss and have low income, a premium cut is more likely to be really useful for the high-risk types.

What though of diabetics becoming motorists because of the cross-subsidy? Surely they must be imposing costs on other motorists through higher premiums, so it would be better were they not to become

[4] There is limited evidence on whether diabetics are worse motoring risks. Following the DDA act of 1995 British insurers to stopped charging higher premiums, but this may be because it is cheaper to avoid litigation even though diabetics are higher risk drivers. The British Government does not allow type 1 diabetics to drive heavy goods vehicles.

motorists. Not necessarily. Think about a diabetic just willing to pay the market premium: the net social benefit from their decision to become a motorist is then zero. But as we have noted, there is an overall social gain if the premium burden is distributed more equally. Since there is a social gain if the diabetic's policy is 'subsidised' by non-diabetics, it becomes strictly socially desirable for the diabetic to be a motorist.

This is not to deny that an equal treatment policy may go too far. Those with very low driving ability obviously should not be motorists. A cut-off is appropriate, with all those above paying the same premium, but the threshold should be below the market level. Even without such a limit, the no discrimination solution may create more benefits than does the unregulated equilibrium.

Notice that there is only a benefit from redistributing towards diabetics who choose to become motorists. For those who do not, there is no reason to think that their marginal utility of income is different to that of the rest of the population. Thus a transfer of income to diabetics irrespective of whether they are or will become a motorist (ability-based redistribution) is not especially beneficial.

Subsidising diabetic insurance is probably feasible, but in other cases implementing subsidies is difficult. The subsidies should go to the less able but this may run into trouble. It may be impossible to claim a falsely high ability, but it is easy to under achieve. Think of performance in a vision test. Or ability may be observable but not verifiable. Firms may be able to recognise the good managers and compete for them with the offer of lavish stock options, yet it is not feasible for the government to specify verifiable criteria to determine transfers on the basis of intrinsic managerial ability. Equal opportunity legislation may then be a compromise. Consider a "least-favoured-person" law that mandates that offers should be made to all irrespective of disability, race or gender even when *laissez-faire* differentials are not the result of prejudice. Such equal opportunity legislation may make matters worse; principals may respond with contracts that induce costly self-selection. For example, insurance companies would then have incentives to find indirect ways to target low risks. They may respond with policies with very high deductibles that only appeal to good drivers who are unlikely to claim. Relative to allowing discrimination on the basis of observable indices of driving ability, the good drivers are worse-off because of the lower coverage, while the less able drivers still end up paying the same high premiums. This reaction could be avoided by a statutory minimum deductible. Then insurance companies could not attempt to 'cherry-pick' the good risks by offering cheap low-coverage options.

Designing and enforcing such regulations may be difficult though. An alternative is direct government provision of subsidised insurance. Loan contracts and employment contracts involving performance pay involve the same structure, so the arguments apply in these settings also. An unregulated market tends to offer the less able low payoffs for both success and failure. The government can uplift both payments but in preserving relatively low financial rewards for good performance it self-selects those treated worst in the unregulated market without harming incentives. To implement this scheme, the government requires no direct knowledge of ability. Its aim is redistribution, but appropriate incentives to perform well are preserved.

When insurance companies have some information as to a client's type but the information is incomplete, there are further considerations. Competition sets a high premium for applicants in a group known to comprise a high proportion of accident-prone people. Even if you know yourself to be fairly safe, you may choose not to become a motorist because the insurance premium is so high. Were the same person a member of a group known to have below average risk they will secure a lower premium and so may choose to become a motorist. Thus, the marginal buyer in a high-risk category is likely to be safer than the marginal buyer in a group known to be safe on average.

Now imagine that discrimination is banned, so the premium settles somewhere between the levels previously charged to the two groups. Then, there would be a tendency for the worst drivers in the good group to drop out to be replaced by better drivers from the high-risk group. This enhances efficiency and helps keep the premium low.

Three literatures are related to the analysis here. It has long been argued that information concerning an individual's type can make everyone worse off *ex ante* by eliminating opportunities to trade risk. This line of argument can be seen in Dreze (1960), Hirshliefer (1971) Marshall (1974), Arrow (1978) and Milgrom and Stokey (1982). So, for example, the public availability of genetic information hampers the provision of medical insurance and in the extreme, if outcomes are fully predictable, it may cause it to vanish. If people buy insurance in the absence of genetic information, revealing it makes them worse off in expected terms. This is a case where equal treatment of unequals is justified. By adding moral hazard, this paper shows that the best solution may not be equal treatment but to offer better terms to the least able. How to implement this outcome is not self-evident. Whether or not moral hazard is present, prohibiting insurers from using information that is available to clients may be counter productive since it creates adverse selection, as Doherty and Thistle (1996) and Hoy and Polborn (2000) demonstrate. The answer is to constrain allowable contracts or to have recourse to public provision.

Akerlof's (1978) study of the economics of tagging also bears on the analysis. The setting is the classic utilitarian dilemma, as formalised by Mirrlees (1971). The government cannot observe workers' ability or effort but there are no information problems within the private sector (perhaps because everyone is self employed) so no need for incentive contracts. Diminishing marginal utility of income makes it desirable to take from the rich and give to the poor, yet doing so weakens the incentive to earn. Consider the relative merits of two instruments of redistribution. A negative income tax provides a subsidy to all of those on low incomes irrespective of the group to which they belong whereas tagging selects a "needy" segment of the population to receive an extra transfer. Per dollar of tax revenue spent, tagging concentrates the benefits on the poor for whom the marginal utility of income is high. Due to the efficiency cost of raising tax revenue, the selective scheme may be preferable. Given that the aim is to redistribute income it seems odd that the magnitude of the transfer received by a poor person depends on personal characteristics that appear irrelevant for welfare. The resolution of the puzzle is that without this feature redistribution schemes involve too much of a scattergun approach to benefits. So rather than institute negative income taxes, it may be efficient for tax allowances to vary with disability, region, gender or race or to subsidise inferior goods.

The set up of this paper differs from the usual optimum tax framework in that in the base case ability is observable (though it may not be verifiable) whereas even within the private sector, effort is not. Making contracts depend inversely on ability is of course a form of ability taxation. When ability is observable by the private sector, two cases are straightforward. If output is observable and deterministic, everyone receives the same piecework contract. The private sector has no need to observe ability and, as everyone receives the same contract, requiring equality of treatment is inconsequential. The government would wish to levy an ability tax, but would have to estimate ability itself with no market benchmark. This is almost certainly not feasible. All that is left is income taxation, with the usual equity/efficiency trade off.

When output is not observable performance pay is ruled out, but suppose that inputs as well as ability can be contracted on. More able types (their input generates higher output) would then have superior contracts in market equilibrium. Assuming, as here, that the utility function is additively separable, a utilitarian would equalise incomes and the more able be required to supply more effort (e.g. Salanie (1997 p. 44). The reversal of market outcomes resembles that in the base case here but is for the plausible case of noncontractible inputs. Indeed it is common to observe market equilibria in which contracts varying across individuals but some form of performance pay is involved so the assumptions studied here cover an important class of cases. One implication of the analysis of this paper is that whether or not individuals are in receipt of incentive contracts, when income is stochastic but abilities differ it is optimal to present individuals with a menu of income tax rates from which they must choose prior to the realisation of uncertainty.

Most directly linked to this paper is Whinston (1983) which applies a Mirrlees approach to the design of a socially optimal disability insurance scheme. Individuals differ in their *ex ante* probabilities of being able to work and there is *ex post* moral hazard as the able can choose to declare themselves unfit and claim the disability pay. The main findings are that if disability probabilities are public information those at greatest risk should pay the lowest premiums and receive the highest disability compensation. When disability probabilities are private information, everyone should receive the same payment. The first of these features also emerges here. One added ingredient of the present analysis is that there is an *ex ante* choice of activity. At first sight this creates the potential for efficiency loss through misallocation between activities, especially when type is private information. Too many bad drivers will be on the road. In fact with pooling it is advantageous that more drivers are on the road in a pooling equilibrium. A further difference is the treatment of moral hazard. Here it is of the *ex ante* variety. This is not of much significance in itself. What matters more is that in Whinston only one of the two *ex post* groups is subject to moral hazard (the disabled cannot work). This feature is responsible for the optimality of pooling under adverse selection. In the main set up here, all agents are subject to "smooth" *ex ante* moral hazard. Even when type is hidden, pooling is no longer optimal. The analysis here does not assume hidden types but that a scheme that rewards lower ability is often not incentive compatible. Firms know ability but the less able are treated worse and cannot misrepresent higher ability. The government may want to reverse the situation but cannot as the able can feign incompetence. Because of moral hazard considerations this does not mean everyone should be treated alike. It does though provide the basis a good case for allowing equal access to policies. Doing so forces companies to offer alternatives that efficiently redistribute to the less able. Thus the focus here is on regulation; whether prohibiting the use of personal information in a market system is beneficial, rather than the design of an optimal state scheme when private insurance is for some reason precluded. Although a first step is to look at a first-best scheme, this is only a starting point in appraising the regulatory reform.

The Whinston model is developed by Anderberg and Anderrson (2000). In their model all individuals have the same intrinsic accident probabilities but there is a verifiable choice between two occupations that differ in risk. The cost of entering the safer activity varies across the population and is private information. The question is how the insurance contract should differ between occupations. The desirability of offering better terms to those in the risky sector is offset to the extent there is mobility between sectors.[5] In this paper the issue is the extent to which policies should vary according to personal characteristics rather than how policies should vary with the type of car or job. The Anderberg and Anderrson analysis, which assumes that accident probabilities are the same for all, is not therefore applicable.

Vercammen (2002) is also related to this paper. A credit market is studied in which a fixed number of risk-neutral entrepreneurs are able to increase the probability of project success by applying unverifiable effort. Finance is through a debt contract. Given risk neutrality, incentives are maximised by minimising the advance. The borrower's return in the fail state is then zero. A higher interest rate lowers effort, and deadweight cost as a ratio of revenue raised is increasing in the interest rate. When type is hidden, a pooling interest rate emerges and aggregate welfare tends to rise relative to the outcome when type is visible. In this setting the non-negativity constraint on fail-state payoff binds, so all that varies across types is the reward for success. To cover the lender's costs, the less able are therefore under-incentivised relative to the more able. If type were hidden the overall distribution of incentives is improved and welfare may be higher than if type is hidden. Risk neutrality is important here. With risk aversion maximum self-finance does not arise under full information and to compensate for the disincentive effect of higher interest rates, the less able will have smaller advances. So pooling has no particular incentive

[5] Black and de Meza (1999) also provide a case for subsidising risky occupations even when private insurance is possible.

benefit. Moreover, hiding type leads to separation not pooling and this is welfare reducing. Though suggestive, even ignoring entry issues, the model is an incomplete foundation for equal opportunity legislation. The story of this paper is that equal treatment yields distributional gains without entailing efficiency costs rather than it serves to enhance overall incentives.

The next Section of the paper provides an analytical introduction to some of the issues emphasising the beneficial effects of cross-subsidy induced entry. Section 3 develops the main analysis by putting moral hazard into the model along with verifiable types. Section 4 considers partially hidden and unverifiable types, then Section 5 looks at the merits of equal opportunity legislation and public provision as methods of moving towards a full optimum. Section 6 introduces noisy signals and shows that the case for equal treatment is strengthened. The same is true when it is costly to acquire information, as in Section 7. Finally, conclusions are drawn.

2. A First Look

To introduce some of the issues, consider a simple case with neither moral hazard nor adverse selection. Chiappori and Salanie (2000) and Abbring Chiappori, Heckman, and Pinquet (2002) suggest these assumptions hold empirically for the insurance market for young French motorists. This is a world where people are unresponsive to incentives so distributional considerations govern policy. This is true even when the number of motorists depends on the cost of insurance.

a) **Assumptions A1**

- The economy comprises a collection of risk-averse individuals with identical utility of income function but differ in their accident probabilities.
- An individual's accident probability is public information.
- No moral hazard
- Accidents involve both a financial and non-pecuniary cost (but liability law internalises externalities).
- Not being a motorist is safe and yields the same utility for all.

b) **Market equlilibrium**

If individual i becomes a motorist their expected utility is

$$E_i = p_i U(G-\Pi_i) + (1-p_i)[U(B-\Pi_i + C) - L]$$

where $(1-p_i)$ is the accident probability, $G > B$ is gross income in the two states, Π_i the insurance premium, C is the contracted compensation in the event of loss and L is the direct utility cost of an accident. Under these assumptions it is trivial that the **market equilibrium involves full insurance on actuarially fair terms**. Expected utility on becoming a motorist is

$$E_i = U(p_i G + (1-p_i)B) - (1-p_i)L$$

It is worth becoming a motorist if $E_i > Z$, the utility of a non motorist. So **there is some threshold value of p above which it is worth becoming a motorist.**

c) **Socially-optimal contracts**

Consider first the trivial problem of contract design when the number of motorists is fixed at $\bar{n}$ but cross-subsidies are allowed. Full coverage clearly remains optimal so the utilitarian's planning problem is to maximise

$$W = \int_0^{\bar{n}} [U(G-\Pi(n)) - (1-p(n)L]dn \quad s.t. \int_0^{\bar{n}} [(1-p(n))(G-B) - \Pi(n)]dn = 0$$

where the $n'th$ best driver has accident probability $1-p(n)$ and their premium is chosen as $\Pi(n)$. For simplicity n is treated as continuous.

The F.O.Cs require

$$U'(G-\Pi(n)) = \lambda$$

So the premium should be independent of accident probability.

Turn now to the choice of $\bar{n}$ given a population of N potential motorists. Letting $\overline{\Pi}(n)$ be the breakeven (pooling) premium when the best n drivers become motorists. For simplicity n will now be treated as a continuous variable. The problem is to maximise

$$W = \bar{n}U(G-\overline{\Pi}(\bar{n})) - (\bar{n}L - L\int p(n)dn) + (N-\bar{n})Z$$

$$s.t. \ \bar{n}\overline{\Pi}(\bar{n}) - (G-B)\int (1-p(n))dn$$

$$\frac{dW}{d\bar{n}} = U(G - \bar{\Pi}(\bar{n})) - L(1 - p(\bar{n})) - Z - \bar{n}U'(G - \bar{\Pi}(\bar{n}))\frac{d\bar{\Pi}(\bar{n})}{d\bar{n}}$$

$$\frac{d\bar{\Pi}(\bar{n})}{d\bar{n}} = \frac{(G-B)(1-p(\bar{n})) - \bar{\Pi}(\bar{n})}{\bar{n}}$$

Write the breakeven (market) premium as $\Pi(n)$. If $\bar{n}$ is the *laissez faire* number of motorists

$$U(G - \bar{\Pi}(\bar{n})) - L(1 - p(\bar{n})) - Z = 0$$

so

$$\frac{dW}{d\bar{n}} = [U(G - \bar{\Pi}(\bar{n})) - U(G - \Pi(\bar{n})] - U'(G - \bar{\Pi}(\bar{n}))[\Pi(\bar{n}) - \bar{\Pi}(\bar{n})] > 0$$

with the signing following from concavity of the utility function.

Unregulated entry on pooling terms is though excessive. The marginal entrant is no worse off if refused insurance, but all the intra marginal types enjoy a lower premium.

d) **Regulation**

The implications of the foregoing results are immediate.

> **Policy Summary** *A statutory requirement that all motorists are fully insured on terms that are independent of their personal characteristics (except that applicants below a competence threshold strictly less than the free market level may be refused insurance) raises a utilitarian social welfare function.*

In the case of a uniform distribution of probabilities with support [0,1], $G = 26, L = 1.2, Z = 0, U = Y^{0.5}$ the market solution has 88% of the population as drivers. Equal opportunity with no entry restriction results in everyone becoming a motorist and aggregate welfare increases 5%.

e) **Qualifications**

Notice that the formulation here assumes that transfers between the motoring sector and other goods are not possible. In fact, other things equal, motorists will spend less on other goods so have higher marginal utility of income. This implies that there will be aggregate gains from subsidising motoring insurance, raising the revenue through taxes on other goods.

The model is structured so that pooling attracts some new drivers but no one ceases to participate. Although it is plausible that this tendency prevails there may of course be some safe types with low benefits from driving. Pooling will cause them to exit and this is a welfare loss. In principle pooling could now generate a loss. Suppose there are two types of potential driver. Some are risky but attach a high value to driving whilst the rest are perfectly safe so under *laissez faire* are in no need of insurance. Under full pooling the premium is too high to justify the safe types becoming motorists. So the effect of the regulation is to lower the welfare of the safe drivers without benefiting the rest. This is clearly an extreme case. It seems implausible that pooling would drive many good risks out. There may be some groups that have low claim propensity and low benefits; perhaps low mileage drivers. The problem of inefficient exit under equal opportunities only arises if these types are identifiable. In that case the characteristic can be excluded from the equal treatment requirement.

The formulation here assumes that equal opportunity legislation has no effect on the alternative activity. This is natural for a number of settings (such as motoring) but not for all. Suppose for example that there are two occupations each with the same gross monetary return for success. An individual has two characteristics, their probability of success in occupation A and in B. There is a (possibly small) non-pecuniary benefit associated with success, the same in both jobs. Under full information workers select the job in which his or her probability of success is the highest and receives a fixed wage equal to their expected gross revenue. Now suppose that equal opportunity legislation is applied along with a minimum wage. If prior to this policy the average success probability were equal in the two jobs then the legislation would have no effect on the allocation of workers. Both occupations would offer the same pay and so individual choice still be decided by success probability, consistently with unchanged composition. Equal opportunities then have the distributional benefits just analysed. The situation is different if prior to legislation the average success probability in one job, say A, was higher than in the other. Perhaps the generally competent people tend to have a comparative advantage in A. Equal opportunity legislation will now draw people into A. This is a mixed blessing. Those in B who move tend to be low earners in both occupations so the effect is redistributative. On the other hand not everyone is working in the job in which their probability of success is highest, which is plainly inefficient. The best policy here is obvious; there should be pooling not only between people in the same occupation but across occupations. Everyone should be paid the same irrespective of where they work and their own productivity. This could be achieved by an income tax/subsidy scheme that takes 100% of income in excess of the average level and fully subsidises anything below. This seems far too extreme to be sensible, but what is missing from the model? First, there may be non-pecuniary aspects of jobs that differ between people. Now progressive income tax comes at an efficiency cost. Second, some jobs may require prior investment in human capital but there is no incentive to undertake this if jobs pay the same *ex post.* Finally, when performance depends on unverifiable effort, it is efficient for firms to create incentives by establishing performance pay. Income taxes interfere with these incentives. The main theme of this paper, explored more thoroughly in the next two sections, is that equal opportunity legislation avoids the last of these problems. To the extent that investment in human capital is observable the first problem does not apply since people making different investments do not have to be treated equally. As for the second issue, as we have noted, reallocation between activities could be an advantage or a disadvantage. Effects are though unlike income taxes. In the basic model of this section equal opportunity legislation drew less able types into the risky sector. A progressive income tax would discourage entry.

3 Verifiable Types, Hidden Action

In this section the model is modified to incorporate moral hazard. The chosen setting is once again insurance, but this is analytically identical to other incentive contracts, such as loan contracts or performance pay.

Assumptions A2

- The economy comprises a large number, n, of risk-averse accident-prone individuals. An accident causes an individual's income to fall from S to F and involves a direct utility cost of L. Whether an accident occurs is verifiable.
- The accident probability is $(1-p)$ and can be diminished by exerting precautionary effort with utility cost $C(p,a_i)$, where a_i is an observable and verifiable "ability" parameter and $C_p > 0, C_{pp} > 0, C_a < 0, C_{pa} < 0$. The choice of p is not verifiable.
- Clients are risk averse with utility function $U(y)-C(p)-x$ where $x=L$ if an accident occurs and $x=0$ otherwise.
- Accidents are independently distributed so the Law of Large Numbers allows insurance to be offered on actuarially fair terms.

Analysis

First consider the market equilibrium with competitive insurance companies. Let a company commit to a contract that results in individual i obtaining net income W_i if there is an accident and B_i when there is no accident. So $(S-B_i)$ is the insurance premium and $-(F-W_i)$ the net of premium payout in the event of loss. The client maximises

$$E_i = pU(B_i) + (1-p)(U(W_i) - L) - C(p,a_i) \qquad (1)$$

so the choice of success probability satisfies

$$U(B_i) - U(W_i) - L = C_p(p,a_i) \qquad (2)$$

From (2)

$$\frac{dp}{dB_i} = \frac{U'(B_i)}{C_{pp}(p,a_i)} > 0, \quad \frac{dp}{dW_i} = \frac{U'(W_i)}{C_{pp}(p,a_i)} < 0, \quad \frac{dp}{da_i} = \frac{C_{pa}(p,a_i)}{C_{pp}(p,a_i)} > 0 \qquad (3)$$

In competitive equilibrium, B_i and W_i are chosen to maximise expected utility subject to the incentive constraint (2) and to the insurance company breaking even, which requires

$$R_i \equiv p(S-B_i) + (1-p)(F-W_i) + s_i = 0 \qquad (4)$$

where s_i is a subsidy for issuing a contract to individual i. The required conditions for an interior solution follow from the Lagrangian

$$L = E_i(B_i,W_i) + \lambda_i R_i(B_i,W_i)$$

where from (2), $p = p(B_i,W_i,a_i)$. Making use of (2) and (3)

$$\frac{dR_i}{dB_i} = -p + ((S-B_i)-(F-W_i))\frac{U'(B_i)}{C_{pp}(p,a_i)} = -p\left(1-((S-B_i)-(F-W_i))\frac{U'(B_i)C_p(p,a_i)}{C_{pp}(p,a_i)pC_p(p,a_i)}\right) =$$
$$-p\left(1-((S-B_i)-(F-W_i))\frac{U'(B_i)}{\eta(U(B_i)-U(W_i)-L)}\right)$$

where $\eta = C_{pp}(p,a_i)p/C_p(p,a_i)$ is the elasticity of marginal precautionary cost.

Since by the first-order condition $\frac{dE_i}{dp} = 0$,

$$\frac{dE_i}{dB_i} = pU'(B_i)$$

Following a similar procedure for variations in W_i, it follows from the Lagrangian that an interior solution satisfies (4) and

$$\lambda_i\left(1-[(S-B_i)-(F-W_i)]\frac{U'(B_i)}{\eta[(U(B_i)-U(W_i)-L]}\right)-U'(B_i)=0 \quad (5)$$

$$\lambda_i\left(1+[(S-B_i)-(F-W_i)]\frac{pU'(W_i)}{(1-p)\eta[(U(B_i)-U(W_i)-L]}\right)-U'(W_i)=0 \quad (6)$$

At an optimum, the extra utility per dollar of foregone revenue to the insurance company should be the same whether it is W_i or B_i that is increased. Of course the revenue effects of the two variations are not symmetric. A decrease in the premium holding constant net payout in the event of loss is partly offset by a decrease in the probability of loss whereas greater coverage raises the probability of loss.[6]

One property of the market solution is of relevance for subsequent analysis. If $d\lambda_i/ds_i > 0$ the incentive scheme just analysed is not optimal. Such increasing marginal utility of transfers implies that the insurance company can then increase the attractiveness of its offer by contracting with the client that two policies will be prepared, one that is optimal for $s_i = s*$ and the other for $s_i = -s*$. The client chooses between two unmarked envelopes each containing one of these policies. Such randomisation schemes are not observed so it will be assumed that the conditions for $d\lambda_i/ds_i > 0$ do not hold.[7] To see what is required to exclude randomisation, it is convenient to define $\theta \equiv 1-((S-B_i)-(F-W_i))\frac{U'(B_i)}{\eta(U(B_i)-U(W_i)-L)} > 0$ and $\phi = 1+((S-B_i)-(F-W_i))\frac{pU'(W_i)}{(1-p)\eta(U(B_i)-U(W_i)-L)}$. From (4), (5) and (6)

$$\frac{d\lambda_i}{ds_i} = \frac{\Delta}{H}$$

where $H > 0$ is the bordered Hessian signed from the second order conditions and $\Delta \equiv (\lambda\theta_B - U''(B))(\lambda\phi_W - U''(W)) - \lambda^2\theta_W\phi_B$.

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[6] In an interior solution the revenue effects of reducing the premium can never be fully offset, as inspection of (5) and (6) reveal.

[7] The same result can be achieved if the client takes a fair gamble prior to buying insurance. This makes it seem that the client is a risk lover but this is not really so. There is diminishing marginal utility of consumption but not necessarily of income. The reason for the latter is that when income is high their may be more self insurance so avoiding the deadweight cost of moral hazard. The celebrated Friedman and Savage (1948) reconciliation of simultaneous purchase of insurance and lottery tickets is a different story; here the potential implication is sequential purchase.

Remark The optimal incentive scheme is non random iff $\Delta < 0$

Turn now to the social problem. A utilitarian social planner seeks to maximise

$$L_s = \sum_{i=1}^{n} E_i + \lambda \sum_{i=1}^{n} R_i$$

In contrast to the market solution, the social planner can cross subsidise within the insurance sector. The implication is that (5) and (6) must hold for λ common to all n clients. Along with the overall breakeven constraint the socially optimal solution must satisfy

$$\frac{1-[(S-B_i)-(F-W_i)]\dfrac{U'(B_i)}{\eta[(U(B_i)-U(W_i)-L]}}{U'(B_i)} = -\frac{\dfrac{dR_i}{dB_i}}{\dfrac{dE_i}{dB_i}} = \text{constant } \forall_i \qquad (7)$$

Suppose that the cost function is $C = f(a_i)(\alpha + \beta p^{\gamma})$ with $f'(a) < 0$ so $\eta = \gamma - 1$ and is independent of ability. It then follows that in the social solution W_i is higher for the less able and so is B_i.

<u>**Proposition 1**</u> If random incentives are not optimal and $C = f(a_i)(\alpha + \beta p^{\gamma})$, then it is socially optimal that both B_i and W_i are decreasing in ability.

Proof

To find how incentives should vary with ability the procedure is to perform comparative statics on (5) and (6) for a given *i* holding λ fixed. This is eased by the fact that with η constant the FOC w.r.t. to B_i is independent of *a*.

$$\frac{dB_i}{da_i} = -\frac{\lambda^2 \theta_W \phi_a}{\Delta} < 0, \; \frac{dW_i}{da_i} = \frac{(\lambda\theta_B - U''(B))\lambda\phi_a}{\Delta} < 0.$$

The signings follow since it is readily checked that $\theta_B > 0, \phi_W < 0, \theta_a = 0, \phi_a > 0$ (the latter two terms are signed as η is independent of a but from (2), $p(B_i, W_i, a)$ rises in a whilst $\Delta > 0$ follows from the non-randomness of incentives.

To illustrate Proposition 1, suppose $C = p^3/3a$ so $\eta = 2$, $S = 10, F = 0$ and the utility function is CARA with risk aversion parameter $r = 0.5$. Calculation reveals that λ is decreasing in the relevant range. Allowing for endogenous p, the market equilibrium for $a=1$ is plotted in Figure 1 with the indifference curve and breakeven revenue constraint having the expected shapes.

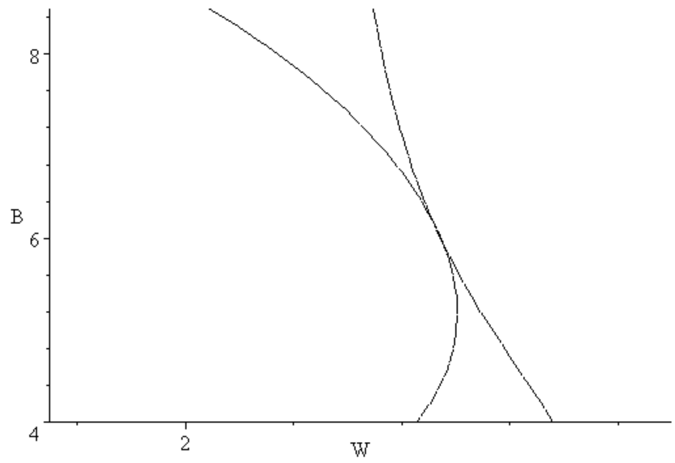

Figure 1

The optimal payments for $a=1$ and for the higher ability level $a=1.2$ are shown below.

	$a=1$	$a=1.2$
Competitive W	2.9	3.2
Optimal W	3.5	2.7
Competitive B	6.1	6.5
Optimal B	6.5	6.1

In this case the socially-optimal solution raises the return of the lower-ability individual so much that, despite their lower success probability, they are better off than the more able.

Of course Proposition 1 reports sufficient but not necessary conditions for the more able to receive strictly worse terms. Making the necessary and sufficient terms easily interpretable has proved elusive. One further result is that if $C=C(p-a_i)$ then $p/(1-p)\eta$ is certainly increasing in ability and applying the same methodology as above, it is socially optimal that B falls with ability.

A possible objection to Proposition 1 is the assumption that the whole population is engages in some activity, say driving, giving rise to the same income contingencies. A relevant alternative for the less able is not to drive at all. Then the social planner must decide how many drivers there should be. To model this, becoming a motorist is represented as a discrete choice creating utility M but at some monetary cost and exposing the motorist to income loss (and possibly utility loss) should an accident occur.

Assumptions A3
Rejecting the activity which gives rise to income risk yields utility $w = U(\overline{Y}) - M$.

There is now the issue of how many policies to sell. In particular, should more policies should be issued than under *laissez faire.* Suppose that n policies are sold, with the rest of the population, $N - n$, choosing the safe activity and enjoying utility w. Given that w is independent of type, it is of course best that it is the most able types that engage in the risky activity. The planning problem is now to select B_i, W_i and n to

$$\max \sum_{i=1}^{n} (E_i + M) + (N-n)U(w) \quad s.t. \sum_{i=1}^{n} R_i = 0 \; and \; U(B_i) - U(W_i) = C'(p)$$ [8]

First, n should certainly not be smaller than under competition. Everyone choosing the risky activity (rather than taking the w option) in a free market does so on terms that enable the insurance company to breakeven. So there can be no social loss in the social planner insuring them on breakeven terms rather than excluding them. Yet it has been demonstrated that with the same set of clients as under competition, it is best to offer terms that differ from the competitive equilibrium. Consider the most able individual rejecting the risky option in the competitive equilibrium. Were this individual offered insurance on terms making motoring at least as attractive as the w option but as close to breakeven as possible, the expected financial loss to the company would be negligible. Offered instead the distinctly more attractive contract that is one of the set that maximises aggregate welfare, the previously marginal buyer will certainly accept it and by definition, overall benefits are greater. With such contracts it must therefore be strictly advantageous for social welfare for this client to participate and the same must apply to potential clients of slightly lower ability. Consider though whether it would be worth selling to every applicant who applies on the terms that are socially optimal were they to accept. Then the marginal buyer obtains zero

[8] This formulation supposes that cross subsidies are between those engaging in the risky activity. Allowing transfers between activities yields similar results and if, as is possible, the marginal utility of income is the same in the two activities there will be no transfers between them.

expected surplus, but being the highest risk of all and given overall breakeven, this client must involve an expected financial loss.[9] Hence, surplus would be greater were this individual not offered insurance.

Proposition 2 To maximise welfare under A2 and A3, more policies should be sold than under *laissez faire*. Policies should though be rationed in that there is a cut off ability level below which policies are not available even though these clients are willing to accept finitely worse contracts than offered to those only infinitesimally more able.

A natural extension is to suppose that M varies across individuals and is private information. A general treatment is messy, but for illustrative purposes suppose that M is either zero or high. The individuals with $M = 0$ never become motorists and Propositions 1 and 2 apply to those with the positive M. The economic point of these remarks is to further illustrate the difference between ability based redistribution and regulation of contracts. The strategy developed here involves redistribution to low-ability motorists. Subsidising low ability non-motorists at the expense of the high ability lowers aggregate utility. So even if ability is observable, ability taxation by itself is not optimal.

4 Unverifiable Types, Hidden Action

Although ability has been assumed to be observable by the competitive firms it may not be verifiable, in which case it is not a feasible tax base. This is especially true if, as seems likely, it is easy to feign incompetence. Consider vision. If, as in the competitive equilibrium, those able to score above a threshold qualify for better insurance terms this is implementable, but a scheme rewarding those doing badly in the test is useless.

In addition to taking this hidden-types constraint into account, the issue of implementation in a competitive insurance market is addressed. Competition is specified in standard game theoretic fashion; two or more firms make simultaneous offers of contracts then clients choose the one they prefer.

[9] There may be no marginal buyer for the whole population may wish to purchase when offered the socially optimal terms given that they are buyers. A version of the argument above implies that it may be better if not everyone buys. An extra high risk buyer does impose externalities on existing clients.

The analysis requires identification of how the slope of indifference curves and the slope of the revenue function vary with ability. Round an indifference curve

$$\frac{dB_i}{dW_i} = -\frac{1-p}{p}$$

Given the incentive contract, p increases in ability and so therefore does the slope of the indifference curve. Turn now to the slope of the iso-revenue curve

$$\frac{dB_i}{dW_i} = -\left(\frac{1-p}{p}\right)\left(\frac{1-((S-B_i)-(F-W_i))\dfrac{U'(B_i)}{\eta(U(B_i)-U(W_i)-L)}}{1+[(S-B_i)-(F-W_i)]\dfrac{pU'(W_i)}{\eta(1-p)[(U(B_i)-U(W_i)-L]}}\right)$$

Under the assumptions of Proposition 1, this slope increases in ability by less than does the indifference curve. In Figure 2 the convex functions are indifference curves, the concave are iso-revenue curves (not necessarily breakeven level) and the bold curves are for higher ability types. The slope properties noted above imply that at a tangency between iso revenue curve and indifference curve for a high-ability type the indifference curve of a low ability type is steeper and tangency with its own iso revenue curve lies at a higher W. From now, for simplicity, only two ability levels are considered.

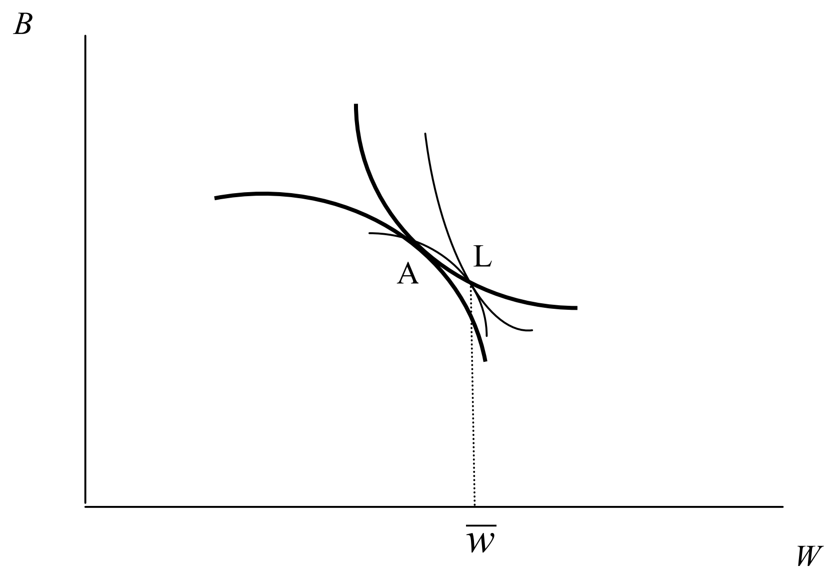

Figure 2

So far it has been assumed that type is observable, but whether or not this is the case, if firms are not allowed to contract on their information, the setting is equivalent to hidden types. With sufficient risk aversion a separating equilibrium emerges. Firms offer a menu of contracts that results inducing the high-ability types take on just enough risk to dissuade those of low-ability following suit. The lowest ability types are no better off than in the absence of equal opportunity legislation and the rest are worse off. [10] Think of a requirement that annuities must be available on terms independently of gender. As women live longer on average, pooling terms would be unattractive to men. Women will buy annuities and men purchase shorter duration financial instruments. This is no gain.

Consider first public provision by a government unable to observe abilities. Relative to the full-information market equilibrium, redistribution with no efficiency cost is now possible.

Proposition 3 Under the assumptions of Proposition 1 aggregate welfare is increased from the full-information market level by appropriate government provision of contracts even if type is not observable to the government. Much redistribution can be achieved at no efficiency cost. This solution can be decentralised by a scheme which taxes low premiums and subsidises high premiums.

Proof. Suppose that contracts A and L are offered. High-ability types select contract A on a revenue function delivering positive expected income whilst the low-ability opt for contract L on a loss-making offer curve. These two contracts are breakeven overall. The allocation is Pareto efficient (as a result of the tangency properties). Contract L is the best that can be offered which preserves Pareto efficient separation and leads to overall breakeven. By Proposition 1, to maximise social welfare the low-ability type should have higher state-contingent payments than the more able. As the configuration in the diagram involves a subsidy to the less able, but stops short of the optimal redistribution it must represent a welfare improvement relative to the market outcome.

Finally note that premium is payable irrespective of the state so subsidising the high premium and taxing the low is efficient redistribution. ‖

Note that the solution in Proposition 3 involves the maximum redistribution consistent with Pareto efficiency. Further redistribution can

[10] This is shown explicitly in Doherty and Thistle (1996) and Hoy and Polborn (2000).

be accomplished by widening the gap between *B* and *W* for the two contracts. As the efficiency cost of doing this is initially vanishingly small but the distributive gains finite, some Pareto inefficiency should certainly be introduced. The way this is best done is by ensuring that the more able type gets an efficient contract (tangent between indifference curve and iso-revenue frontier) but giving the less able a contract with an inefficiently high ratio of *W* to *B*. The reason for this is to achieve incentive compatibility at higher levels of redistribution. To prevent the more able type taking the contract intended for the less able the revenue raised from the more able should be extracted at minimum utility cost and then the contract for the less able made just as unattractive as required. Having the least rather than most able type with the distorted contract is of course the opposite configuration from that arising in a separating market equilibrium when type is private information.

Two reinterpretations of Proposition 2 are of practical relevance;

a) The analysis can be applied to the design of socially optimal business loans. The only change is that the contract must yield positive revenue to cover the cost of the capital. Relative to the market equilibrium, it is socially optimal to subsidise high interest rate advances and tax those made at low interest rates. Note that these interventions involve transfers that are independent of outcomes. An income tax/subsidy raising the same revenue as the interest rate scheme would cause the banks to modify their contract so as to lower good state payment and raise bad state income, thereby sacrificing social efficiency.

b) Consider a Mirrlees (1971) style optimal income tax problem. Ability is private information as is effort. Unlike the Mirrlees formulation, productivity conditional on effort is stochastic but the distribution for the more able first-order dominates that for the less able and, given ability, the distribution of outcomes for greater effort dominates that for the less. No private insurance is available for life chances. Proposition 3 now implies that workers should be offered a choice of income tax schedules. The able types will select the rate that taxes high incomes at a lower rate than is selected by the less able.

Tax/subsidy schemes have their problems. They may be bureaucratically costly. High premiums or interest rates should be subsidised when they are the result of low ability but not as a result of occupational choice or high risk activities. This may not be easy to implement. Moreover, paying a subsidy when the gross premium is high is an invitation to corruption. An alternative is public provision. This too may have hidden costs. To keep competition alive there is a case for partial government provision. The objective is to attract the less able, offering lower-powered incentives but on terms that the private sector could never match financed through taxes on private contracts. In principle, this would replicate the full scheme, but ossification may still creep in.

Potentially attractive since direct intervention is avoided is regulation that prohibits discrimination according to observable characteristics and requires a minimum of protection against failure (a maximum deductible in the insurance case, exempting some of bankrupt debtors' assets in the credit context, or setting a minimum basic wage in the case of an employment contract) If there are good properties in principle, the need for government bureaucracy is reduced and controlling for different activities and occupations is eliminated.

To see the mechanics, in Figure 2, let $\overline{W}$ be the minimum allowable payment in the fail state. Change the parameters so that when both types take the contract at L there is overall breakeven. There will now be a pooling solution at this payment. The able type now taking a Pareto inefficient contract but the benefits of redistribution may be sufficient that there is an overall gain relative to the market solution.[11]

Consider again the case of $C = p^3/3a$ so $\eta = 2$, $S = 10, F = 0$ and the utility function is CARA with risk aversion parameter $r = 0.5$. There are two types. In the market solution for a =1.2 the payments are B=6.3, W=3.1 with the endogenous success probability 0.45. For a =0.6 the payments are B=5.5, W=2.5 with the endogenous success probability 0.36. The agents are very incompletely insured under these contracts so moral hazard is very significant. With pooling at a minimum W involving an efficient contract for the a=0.6 type, the incentive payments are intermediate at B=5.8, W=2.8. The financial loss on the contract bought by the low ability type is 0.487 . There is inefficiency in that were the a=1.2 to face a lump-sum tax of 0.5 their welfare would be the same as in the equal opportunities solution. The deadweight cost of effecting the transfer by equal opportunity is thus some 2.6% of the transfer. Nevertheless there is a gain. The equal opportunity policy creates

[11] Setting the minimum W lower at the efficient level for the able types may allow for a separating equilibrium in which the lowest ability types are peeled off so replicating the tax/subsidy solution. This equilibrium does not generalise to the case of many types though so here we look at the pooling case which is anyway nearly as good in welfare terms.

aggregate welfare equivalent to giving the less able types a lump-sum subsidy of 0.14 in the market equilibrium.

The equal opportunity solution is very close to what is achieved by a government able to set optimal cross subsidies subject to type being hidden. This solution has B=6.019*,* W=2.79*,* for the able and B=5.7*,* W=2.86 with the financial transfer 0.5. Relative to the equal opportunity solution the low ability type is slightly worse off and the high ability better off but the difference is negligible. Optimal fiscal redistribution slightly distorts the contract received by the less able types and equal opportunity policy the contracts received by the able but in both cases the able are just as well off if they take the deal offered to the less able. The fiscal redistribution ends up only slightly superior.

An alternative fiscal approach is to tax the high realization (in the case of the loan interpretation this would be an income tax) returning the revenue as a an equal lump-sum to everyone in the population or as a subsidy to the low realization. This is redistributory since the more able have a greater chance of obtaining the high realization, but the power is low since it is the difference in success probabilities that determines the extent of redistribution. Moreover, every contract is now distorted away from the optimal incentive mix. In our example the optimal policy of this sort is hardly better than *lasissez faire* and certainly much worse than interest or premium cross subsidies or equal opportunity policy.

To summarise the policy implications;

<u>Proposition 4</u> Whether or not type is hidden, under the other assumptions of Proposition 1, aggregate welfare may be increased from the market level by a statutory minimum W and a requirement that all contracts must be available irrespective of ability. Examples show the welfare achieved may be close to what is achieved by the optimal explicit cross subsidies.[12]

5. Noisy Signals

Principals typically do not have precise information concerning an individual's economic attributes. Rather, noisy but informative signals are observed. To be specific, suppose that there are two observable, disjoint groups of agents with the distribution of abilities in one group differs from that in the other.

The first issue is that in standard signalling models, group membership does not influence offers. Either a separating equilibrium exists within each group (so group membership is uninformative) or else no pure-strategy equilibrium exists.[13] In this world there is no point in screening (whether in credit or any other kind of market). For group membership to influence the terms of trade, pooling equilibria must exist but these are notoriously difficult to generate. One possibility is to invoke a Wilson (1977) "anticipatory" equilibrium. An alternative is to retain the Rothschild and Stiglitz structure but allow preferences to depend on a variety of characteristics (not just ability) as developed in de Meza (2002).

Easier is to let cost be independent of ability and the state contingent gross payoffs be $S - z(a_i), F - z(a_i))$ with $z(a_i),\ z'(a_i) < 0$. It is immediate that (5) and (6) still apply and so therefore does Proposition 1. Now the

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[12] It seems appropriate to compare this policy with the rather different conclusions of de Meza and Webb (1987). There the economy comprises a collection of risk-neutral agents differing in ability though effort is not a choice variable. Under hidden types there is a pooling equilibrium in which the implication is that the information-impacted sector expands relative to the full-information level. As there is universal risk neutrality, a utilitarian would not care about distribution. Consequently, if types were initially observable, imposing equal opportunity legislation would certainly lower welfare. As Proposition 4 is for Assumptions A1 there is no alternative activity, the possibility of misallocation is closed off. Now the asymmetric-information solution (augmented by a prohibition on contractual form) is fully efficient and better on distributional grounds than the full-information solution. With an alternative safe activity introduced (Assumption A2), extending equal opportunity policy to all ability levels could lead even a utilitarian to prefer the laissez-faire solution. Along the lines of Proposition 2, there will though be an ability level such that if equal opportunity policy only applies to those above this threshold the solution improves on laissez faire. Moreover, this threshold involves more agents in the risky sector than in the free-market solution.

[13] This is the famous Rothschild and Stiglitz (1976) result.

slope of indifference curves is independent of ability so only pooling equilibria exist. Here an even more basic set of assumptions is made.

Assumptions A4

- m members of a collection of risk-averse motorists have costlessly observable characteristic M whilst the remaining w individuals have characteristic W.
- Everyone has the same utility of income function but an individual's accident probability is private information with the distribution in group M differing from that in group W
- No moral hazard
- Compulsory third-party coverage due to "shallow pockets", enforceability issues or to preclude inefficient separation. This requirement gives rise to a pooling equilibrium with self-damage uninsured (a given risk class can only be attracted with offers that also appeal to all worse risks).
- Competitive insurance providers with no administrative costs (the equilibrium involves statistical discrimination)
- For now, not being a motorist is not an option

Analysis

The expected utility of individual i belonging to group j is

$$E_i^j = p_i^j U(G - \Pi^j) + (1 - p_i^j)U(B - \Pi^j)$$

where $(1 - p_i^j)$ is the accident probability, Π^j the insurance premium and $G - B$ is self damage. The utilitarian's social problem is to maximise

$$\sum E_i^M + \sum E_i^W \quad s.t.\ [m\Pi^M - \sum(1 - p_i^M)L] + [w\Pi^W - \sum(1 - p_i^W)L] = 0$$

where L is third-party damage.

The F.O.Cs require

$$\bar{p}^M[U'(B-\Pi^M)-U'(G-\Pi^M)]-U'(B-\Pi^M)=\bar{p}^W[U'(B-\Pi^W)-U'(G-\Pi^W)]-U'(B-\Pi^W)$$

where $\bar{p}^j$ is group *js'* is the average safety rate for group *j*.

The result with fixed composition is by now familiar. To maximise aggregate welfare the group with the highest accident rate should have the lowest premium Prohibiting unprejudiced discrimination raises welfare relative to *laissez faire*

Selection Effects

Now suppose

- Everyone has the option of not driving in which case their utility is independent of their *p*

The decision function is to drive if $F(\Pi_i^j, p_i^j) > 0$ $\frac{\partial F}{\partial \Pi_i^j} < 0,$ $\frac{\partial F}{\partial p_i^j} > 0$

Under *laissez faire* suppose the pooling premiums are $\Pi^M > \Pi^W$ so for the marginal drivers $\tilde{p}^M < \tilde{p}^W$ **.**Under *laissez faire* some non-drivers have lower *ps* than some drivers. Banning discrimination ensures only the safest drivers are on the road.

Proposition 5 Under A4 and A5 a sufficient condition for banning unprejudiced discrimination to raise social welfare is that the number of those insured does not rise.

Proof

When the number of buyers in each group is held fixed, welfare rises when discrimination is banned.

Keeping the premium at the pooling level were their no change in composition, the decisions to change status directly add to welfare.

Moreover, the pooling premium may fall. Those with lower accident probabilities replace those with higher. Thus if the number of buyers falls, the average accident rate falls and so the competitive premium declines.

Numbers do decline if, for example, above some accident threshold the groups are identical but below it one group has more representatives than the other.

6. Costly Information Acquisition

Given that information on type is free, it has been demonstrated that aggregate utility is higher if its use is prohibited. There is a further reason for disallowing discrimination. When information on types is expensive firms will still acquire it but the resources expended are ultimately at the expense of the agents. This conclusion is not dependent on the agents having private information as to their ability, as will now be demonstrated.

Consider a labour market in which two risk-neutral firms are engaged in an English auction for a manager of unknown quality. Moral hazard is not an issue. The manager is either worth *H* or *L* with expected value *M.* At the outset workers do not know their type but each firm can find out the manager's type at cost *I.* There is then a mixed strategy equilibrium in which firms randomise over whether to evaluate. First consider the equilibrium bidding strategy;

An informed firm drops out at the worker's true value
An uninformed firm drops out at M[14].

The strategy of the informed firm is obvious. As for the uninformed firm, if the bidding reaches *M* the uninformed firm knows its rival is either informed and has discovered the manager is worth *H* or else the rival is uninformed. In the former case the uninformed firm knows that to win the wage must rise to *H* and there will be no profit, and in the second case expected profit is negative if the worker is hired for more than *M.*

Given the optimal bidding strategy an informed employer earns *H-M* when facing an uninformed bidder and zero otherwise. So if each firm is informed with probability π and the prior probability the manager is of high ability is Π, then in a mixed-strategy equilibrium

$$(1-\pi)\Pi(H-M)=I$$

so

$$\pi = 1-\frac{I}{\Pi(H-M)}$$

[14] There are also asymmetric equilibria in which one of the uninformed bidders drops out below *M.* The dissipation of resources is then all the greater.

As the expected profit of the firms is zero, the expected wage of the workers would be higher by $2I\left(1-\frac{I}{\Pi(H-M)}\right)$ if evaluation is banned.

Proposition 6 When there is symmetric imperfect information but firms can become informed at a cost, prohibiting them from doing so raises the managers' expected utility.

7. Conclusion

This paper has shown that the market distribution of incentives is not generally welfare maximising. Competition rewards the more able with superior contracts, but social efficiency often requires the opposite. Granted that moral hazard leads to agents being incompletely insured, were everyone to have the same incentive contract the expected marginal utility of increasing income in all states is greater for the less able since they are more likely to have the low income associated with the fail state. This is the underlying reason the less able should have better contracts, so much so as sometimes to have greater expected utility. Such positive discrimination is not feasible if it is possible to hide high ability, or if ability is observable but not verifiable. When better deals cannot directly be given to the less able any offered contract should be available irrespective of ability with regulation ensuring a minimum of protection in unfavourable states. So prohibiting "discrimination" on grounds of gender, race or disability may be efficient even if competitive market differentials are prejudice free. One implication is a case against allowing banks to adopt credit-scoring techniques.

A further benefit of disallowing the use of informative but noisy signals is that, rather paradoxically, more accurate social selection then ensues. When everyone faces the same price it is the most able fraction of the population that opt for contracts but when price differs according to group membership type1 and type 2 errors occur. In addition there may be cost savings in information acquisition, a pure social gain.

Preventing firms from offering terms that subvert the regulations will be difficult though. Then the analysis provides the basis of a case for state provision of insurance, loans and employment on terms that appeal to those the market treats worst. One feature of optimal public provision is that it should involve weaker performance incentives than offered by profit maximising firms.

An analytically trivial but practically important extension in the labour market case is if disability entails a direct cost on the employer, say in modifying machinery. Write this cost $z(a_i), z'(a_i) < 0$ (effects are identical if the state-contingent gross payoffs are reduced by disability to $S - z(a_i), F - z(a_i)$). It is immediate that (5) and (6) still apply and so therefore does Proposition 1. Lower state-contingent productivity or the cost of catering to a disability does not upset the conclusion that the disabled should receive unambiguously superior contracts. Moreover, let the safe alternative to employment be unemployment. Proposition 2 then applies. The ability threshold below which agents are unemployed should be lower than the free market level even with a positive z. Prohibiting employers from making offers on terms that depend on the level of disability and setting a minimum ability threshold above which offers must be made is welfare enhancing.

The most compelling objection to policies that require employers to be blind to "ability" is that competence is often the result of prior investment rather than innate talent. If ability is endogenous there will be moral hazard effects if those not investing can still secure attractive terms, say in government employment. There are two responses to this. First, the moral hazard is inescapable but redistributing through constraining the form of incentive contracts is superior to the use of income taxes. Income taxes distort *ex post* incentives whereas equal opportunity policy preserve them. Second, it may sometimes be possible to draw a distinction between productivity effects that an individual can control and those that they cannot. Only the former involve moral hazard, so discrimination involving the latter can often be outlawed with no efficiency cost. Indeed, the analysis here suggests that positive discrimination may well be justified. For example, if race is correlated with barriers to human capital acquisition then positive discrimination on this characteristic is potentially beneficial. It is commonly held to be unjust to penalise people for what they cannot help. Such a view will frequently coincide with efficiency considerations.

Economists' instinctive advice that disadvantaged groups are best helped through income redistribution rather than by directly regulating contractual relationships is not generally valid. By such means redistribution can be accomplished without any inefficiency loss at all. In the standard optimum tax framework every dollar received by the poor lowers the income of the rich by more than a dollar. As Okun (1975) put it, redistribution can only be implemented by means of a leaky bucket. Equal opportunity policy is a watertight bucket. Prohibiting contracts from utilising personal characteristics that would further disadvantage a disadvantaged group is a potentially efficient strategy.

Of course public policy in these areas is ultimately fuelled by factors beyond those dreamt of in utilitarian philosophy, most notably by conceptions of procedural justice. Even so, it is worth knowing that there is no real conflict with distributional efficiency.

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