Genetic Testing and Insurance: The Complexity of Adverse Selection

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Maureen Durnin
Guelph, Ontario, Canada

Michael Hoy
Department of Economics and Finance
University of Guelph
Guelph, Ontario, Canada

Michael Ruse
Lucyle T. Werkmeister Professor
Department of Philosophy
Florida State University
Tallahassee, Florida, USA

Abstract

The debate on whether insurance companies should be allowed to use results of individuals' genetic tests for underwriting purposes has been both lively and increasingly relevant over the past two decades. Yet there appears to be no widely agreed upon resolution regarding appropriate and effective regulation. There exists today a gamut of recommendations and actual practices addressing this phenomenon ranging from *laissez faire* to voluntary industry moratoria to strict legal prohibition. One obvious reason for such a variance in views and approaches is that there are competing norms for evaluating the outcomes of restricting insurers' use of such information. For example, an outright ban on the use of genetic test results may seem the best method for protecting against unfair discrimination while allowing their use may seem to be the best way to foster efficiency in the market for insurance. However, there is also a lack of understanding about how restricting the use of genetic information would play out in the market through the so-called phenomenon of adverse selection. Using economic analysis, we discuss how the type of adverse selection that occurs in insurance markets affects various arguments both in favour and against an outright ban on insurers' use of genetic tests for pricing insurance. We review arguments based on moral principles (i.e., a concern with unfair discrimination as well as welfarist analysis related to distributive justice). The practical concerns from the insurance industry based on actuarial principles and economic efficiency are also compared. Each perspective is shown to lead to a range of conflicting recommendations about how genetic information should be regulated and these conclusions depend critically on whether one conducts the analysis from the ex ante temporal perspective (i.e., before individuals know their risk type), from the interim temporal perspective (i.e., after individuals know their risk type but before they purchase their insurance policies), or from the ex post temporal perspective (i.e., after all uncertainty is resolved including the claims status of each policyholder).

Keywords: insurance; genetic discrimination; regulation

Genetic Testing and Insurance: The Complexity of Adverse Selection

1. Introduction

From the beginning of the Human Genome Project in 1990, and perhaps even prior to that time, there has been much discussion and disagreement about how to use the emerging information provided by the increasingly detailed mapping and identification of specific genetic markers in human DNA. This progress in genetic testing, while fascinating and productive for the scientific community, produces potentially chaotic effects on insurance markets. Global response to genetic testing has resulted in the adoption of many different regulatory frameworks which vary significantly between countries and sometimes within countries. The question arises: Why hasn't the issue been resolved with some consistency across countries?

The academic literature addressing the problem offers many conflicting viewpoints. The difficulty arises from the complexity of the multiple reactions at play in the consideration of the ultimate use of genetic testing. There exist different moral principles and perspectives. The business/actuarial based argument addresses the market functionality for various types of insurance. Ethical arguments are concerned with issues of potential discrimination and loss of privacy rights. The welfare economics approach to the argument includes consideration of efficiency and equity over resources. An important factor which may complicate the moral principles/perspectives arguments is the variety of possible market outcomes (Economists refer to this as adverse selection.) which could result from bans which prohibit insurance companies from using genetic testing for pricing purposes. This will become evident later in the discussion of pooling versus separating equilibria.

There exist, as well, differing temporal perspectives. Should a moral principle or other criterion be applied from the ex ante perspective (i.e., taken as the point in time before people know their genetic types) or from what we will call an interim perspective (i.e., taken as the point in time after people know their genetic types and make their insurance purchasing decision). One can also assess the appropriateness of a regulatory ban from the ex post perspective (i.e., once all uncertainty has been resolved and insurance claims have been processed). Thus, there are three very different sets of considerations which interact in a complex manner when assessing the efficacy of a ban on use of genetic test results by insurers. In this paper we highlight these complexities by considering a comparison between a laissez faire approach (i.e., allowing insurers to use whatever information their clients have obtained from genetic tests) to a regulation that bans insurers from using any such information. Such a stark difference in policy options brings out clearly the complexities involved in the academic and public debates and the practical difficulties in resolving this issue.

2. World View

Worldwide, the reaction to the use of genetic testing for life, private health, and long term disability insurance purposes varies from legislation or total moratoria banning any use of genetic test results by insurers to a status quo approach letting the industry regulate itself. In most of Western Europe the ban is almost total, falling in line with the UNESCO Declaration on Human Genetic Data 2003. In Belgium, insurers are prohibited from even accepting favourable genetic test results provided voluntarily by consumers. In the United Kingdom and the Netherlands, companies can ask for genetic test results only for large policies (those exceeding £500,000 in Britain and the equivalent of $150,000 U.S. (approx.) in the Netherlands. The latter is adjusted every three years to the cost of living.) In Britain, the types of genetic tests that insurers can request for policies exceeding the cap are restricted to tests deemed relevant by an independent committee. In Asia and the Middle East, with the exception of South Korea and Israel, who both ban genetic testing for insurance purposes, no specific stances have been taken on genetic testing use for insurance purposes. In South America and Africa, only Brazil and South Africa have begun to address the issue. Brazil requires the insureds' consent and South Africa retains a status quo approach. Australia, New Zealand and Canada are also among those who allow the status quo to remain, relying on existing privacy laws and the insurance industry's self-regulation. The United States is a particular case in that the discussion there, in the absence of socialized medical insurance, involves both the health and the life insurance industries. As well, the regulations vary from state to state. Federally, the Genetic Information Nondiscrimination Act (GINA) passed in May of 2008 addresses the use of genetic testing in health insurance though only 14 states have introduced some laws to govern the use of genetic testing in life insurance and these laws make restrictions rather than outright bans.[1]

3. Competing Moral Principles and Other Perspectives

So why are so many countries opting for strict regulations, and often restrictions, on the use of genetic tests to evaluate risk levels and prices in the insurance industry? Legislative bodies are responding to public opinion and public opinion is strongly against insurance companies requiring genetic test results in order to place people in risk categories.[2] These reactions can, in part, be attributed to the moral principles governing privacy. The genetic code is perceived as the very essence of the self. Revealing it strips away any possibility of retaining sole ownership of the most basic aspect of one's being. Moreover, it is often considered unfairly discriminatory that some people be punished in the market place for reasons over

[1] See Joly, Braker, Le Huynh (2010) for details.
[2] A Canadian poll conducted in 2003 by Pollara-Earnscliffe (2003) found that 91 percent of respondents believe insurance companies should not have the right to ask about an individual's genetic information.

which they have no control. This is a commonly noted concern (e.g., see Alper and Natowicz, 1993 and Kitcher, 1996) and the term "genetic discrimination" has become widespread. The moral discrimination perspective is supported by the rationale of egalitarianism or fairness due to the distinction between so-called brute luck and option luck (e.g., see Dworkin, 2000). Since individuals do not choose their genes and so have no responsibility over them, it follows that differential treatment in the insurance market based on genes is deemed unfair.

The desire for privacy extends to the uncertainty created by not knowing the outcome of genetic tests. There is fear that the results of genetic testing will cause emotional and/or financial stress. What if the results mean bad news for the individual or her loved ones? What if the outcome is that the boss learns of unfavourable test results and denies promotion or even terminates employment (and in the case of the United States before the so-called Genetic Information and Nondiscrimination Act signed into law in 2008 access to comprehensive health care)? What if the results mean insurance rates go sky high or, worse yet, insurance is denied altogether? This is the argument put forward by many support associations, such as the Huntington Society, which were formed to raise the public awareness of specific diseases in the hopes of raising funds for research into cures and offering sufferers and their families counselling, aid and general moral support. What if individuals can use genetic information about predisposition genes to alter their lifestyle or medical choices? Any decision about regulating the use of genetic test results by insurers can have important spillover effects in these other facets of genetic information through their incentive effects for individuals to obtain genetic information about themselves.

Under the umbrella of moral principles, there is also the question of genetic discrimination. It is considered by many to be morally wrong to discriminate against people for reasons over which they have no control. Just as the individual has no control over being born a certain gender or into a certain racial group, he has no control over his DNA. How then can it be appropriate to charge increased fees or possibly even deny insurance based on the results of genetic tests? (In the US, the Americans with Disabilities Act 1991 already prohibits all non-job related medical screening though it doesn't specifically mention genetic screening.)

Underlying these reactions are the questions of need and right. Do people need health and life insurance? Do people have a human right to health and life insurance? In surveys performed by Rothstein and Hornung (2004), consumers were asked to respond to just such statements about right and need. To the statement "Everyone needs health insurance.", the response was 91.2% in agreement. When the statement was "Everyone has a right to health insurance.", the response was 90.6% in agreement. When the statements concerned life insurance, the responses were 69.2% of respondents were of the opinion that life insurance is a need (A figure which corresponds to the percentage of people who actually purchase life insurance policies.**)** and 82.6% responding that access to life insurance is a right. If genetic test results

lead to interference with the public's perception of what constitutes needs and rights, then it is important to create regulations which will afford the appropriate protection.

A major opponent to restrictions on the use of genetic testing is often, of course, the insurance industry. A concept specific to the insurance industry is that price should reflect as closely as possible expected cost for each policy holder – a view commonly described as actuarial fairness. One of their biggest fears is that the consumer will have access to genetic tests that are not made available to the companies. The result would be that those consumers who discover unfavourable results from genetic tests could then buy huge quantities of insurance in the full knowledge that their health or mortality risk will allow them (or their heirs) to realize enormous benefits. In a letter dated February 16, 2007 to then Speaker of the House, Nancy Pelosi, the American Academy of Actuaries, a group that advises federal policymakers on issues related to insurance, writes: "Risk classification, which is the process by which applicants for insurance coverage are placed into groups of roughly equivalent levels of risk to ensure their premium cost is commensurate with their risk level, is key to the soundness of the voluntary individual medical expense insurance market. Voluntary markets operate most efficiently when there is equality of information among buyers and sellers. .... barring insurers from obtaining test results already known to the applicant could result in an imbalance of information that would leave insurers at a disadvantage. Such asymmetric information between the insurer and the applicant could result in adverse selection that would have a direct impact on premium rates, ultimately raising the cost of insurance to everyone."

In most circumstances, economic reasoning also supports the business/actuarial view. This is the idea that one party in a contract or transaction should not be allowed to hide relevant information. The classic paper of Akerlof (1970) explains how the presence of hidden information may spoil the market for everyone. His example of used cars offers a simple understanding of the inherent logic. Suppose some sellers of used cars hold a poor quality product, a so-called lemon, while others hold a product of good quality. Buyers are willing to pay a higher price for a higher quality product and sellers of good quality cars typically require a higher price to part with their vehicles. Further suppose potential buyers cannot discern between good or poor quality cars but they are aware that sellers of both types are in the market. The result is that the price buyers are willing to pay for used cars will be based on their willingness to pay for a car of "average quality" and this price will be below the value to both buyer and seller of the high quality cars. At least some sellers of good quality cars can be expected to withdraw their cars from the market as they would not be willing to sell their vehicles at the required discount. This will shift the balance of used cars left in the market towards poor quality cars and thus lead to an even lower price. Faced with an even higher discount in order to sell a good quality car, even more good quality cars will be withdrawn from the market. Although an equilibrium may be reached with some cars of both quality being sold, there will likely be many good quality cars that sellers would like to sell and potential buyers

would like to buy but which nevertheless go unsold. Thus, the market does not operate as efficiently as it would if the information about product quality was not hidden. One could even end up in an equilibrium where no good quality used cars are being sold – a so-called adverse selection death cycle. This efficiency consideration is explained more fully in the following section in the context of an insurance market when individuals are able to keep their genetic test results private.

4. Market Implications of Regulatory Bans of Genetic Information

A ban on insurers' using genetic test results for pricing insurance contracts creates a situation of hidden information. The buyer of the product has information relevant to the payoff (cost) of the seller. This scenario has been referred to as regulatory adverse selection.[3] One strategy that may be adopted by insurers in such a scenario we will called simple pooling. An insurer that cannot identify who are the good and who are the bad risks may simply pool the consumers together and charge a price high enough to cover the costs. At any given price the higher risk types value the product more since they are more likely to make a claim. Thus, one can expect higher risk types to purchase more insurance than do lower risk types.[4] Thus, the price that is required to cover the pooled actuarial cost of the insurance sold will be higher than the simple population weighted average cost. Such a price is referred to as the *average clientele risk price*.[5] This price can still be referred to as actuarially fair but it is a pooled actuarially fair price rather than a risk type specific actuarially fair price. Also, the price will typically be between the price that would be charged for high and low risk types and so the suggestion sometimes made that allowing consumers to keep such information private will lead to an increase in the price of insurance for *everyone* is not credible.[6] It is, however, most likely that a ban would lead to a price of insurance that is higher than the average (population weighted) price that would be charged absent such a ban and certainly higher than what the low risk types would pay. This is the reason low risk type purchase less insurance under such a ban, reflecting the same type of market inefficiency associated with the example in which the *average* price for low and high quality cars is such that sellers of high quality cars are less likely to sell their cars due to the discount generated by privately held information. Adverse selection restricts market transactions that would be welfare improving. This is the primary concern about such a ban from

[3] For details of how such a ban can affect the markets for health, life and other forms of insurance, see Hoy and Ruse (2005). The classic papers on how asymmetric information affects insurance markets are Rothschild and Stiglitz (1976) and Wilson (1977). The market implications when information is imperfect was first addressed in Hoy (1982) and Crocker and Snow (1986).

[4] Pauly, et al. (2003) estimate the risk elasticity of demand for life insurance to be between 16 and 29 per cent. This implies, for example, that a person with a 50% higher risk of death would purchase between 8 and 14.5 per cent more life insurance.

[5] See Hoy and Polborn (2000) for details on how such pricing for a pooling equilibrium would arise.

[6] Recall such a claim quoted earlier from the letter of the American Academy of Actuaries.

an economic efficiency perspective. The social importance of life insurance is reflected in the study by Bernheim, et al. (p. 361, 2003) who estimate that "35.7 percent of poverty among surviving women … resulted from a failure to ensure an undiminished living standard through insurance." One must, nonetheless, balance the concern of under-insurance of low risk types due to a ban on insurers using genetic information with the issue of the price and availability of insurance for the bad (high) genetic risks. We address this in the following section.

A second strategy that insurers may follow rather than simple pooling is to design different contracts that appeal to a greater or lesser extent to different risk types. For example, since higher risk individuals place a higher value on more comprehensive coverage, it follows that insurers can offer one policy with a high level of coverage at a relatively high unit price and another contract with a lower level of coverage at a lower unit price. The bad or high risk is more willing to pay the higher unit price for the higher coverage policy and so such a strategy can lead to a so-called self selection equilibrium with high risk types purchasing the more costly policy with more comprehensive coverage while low risk types purchase the less costly policy with a lower level of coverage. This is called a separating contracts outcome. Rothschild and Stiglitz (1976) and Wilson (1977) showed that if the fraction of high risk types in the population is sufficiently high, then such an outcome can be expected and that the high risk types are no better off than if the insurer were allowed to use the privately held information (i.e., the genetic test results). The low risk types, however, end up with an inefficiently low level of coverage and so the overall result of the ban is to harm good (low) risks without any advantage given to bad (high) risks. This is a compelling efficiency argument against banning insurers from using genetic test results. However, this market outcome is a credible scenario only if the proportion of high risk types in the population is high enough that low risk types prefer *their* contract (from the separating pair of contracts), which has limited coverage, to a pooling contract with higher coverage but also is offered at a higher price.[7] For a separating contacts outcome to be effective, it is also necessary that the insurers offer exclusive contracts; that is, each consumer can purchase insurance from only one of the possible sellers. Without this restriction, the high risk types can purchase from several insurers the contract with the low coverage and low price level, which is offered with the expectation of attracting only low risk types. The result is that each insurer will discover that the contract designed for the low risk types will attract many high risk customers and so the low price will not be sustainable. Although some insurance products are sold through exclusive contracts

[7] Determining what this critical proportion of high risk types would be depends on many factors, including individuals' degree of risk aversion. An application that provides some insight into this aspect is Hoy et al. (2003).

(e.g., automobile, health, long term care), life insurance typically is not.[8] So the separating contracts scenario does not apply to all types of insurance.

5. Welfarist Perspective

Besides providing an understanding of the possible market implications of banning the use of genetic test results, economic analysis can also offer an assessment based on standard welfare criteria of efficiency and equity. The efficiency implications of a ban have already been described in the previous section, although only from an interim temporal perspective. From this perspective (i.e., after one knows one's genetic type and has made his insurance purchase but before one knows his claim status) insurance is treated as an individualistic risk management tool. In the context of a pooling equilibrium some people – the low risk types – end up with too little insurance while others – the high risk types – end up with too much insurance. If the quantitative relevance of the genetic information held privately by consumers is sufficiently great, then one can expect the extent of under-insurance (of good risks) to be significant enough that the ban should be judged to be undesirable.[9] This is true a fortiori if the result in the market is one of separating contracts (i.e., a high coverage policy at a high price for the bad risks and a low coverage policy at a low price for the good risks) since high risk types are no better off as a result of the regulatory ban while low risk types are made worse off.

If the market reaction to a ban is a simple pooling contract then, compared to no ban, high risk types face a lower price and low risk type face a higher price; that is, there is cross-subsidization from the lucky (low risks) to the unlucky (high risks). Comparing incomes of the two types net of the cost of buying insurance, the ban (implicitly) creates a progressive transfer from better off to less well off. If one adopts a general welfarist framework, which spans a range of distributive ethics from utilitarian to Rawlsian (lexicographic maximin), then one may indeed find support for a ban if the extent of adverse selection is small enough that underinsurance of low risk types is sufficiently unimportant in comparison to the implicit (favourable) redistribution from good risks to bad risks. Hoy (2006) has shown that for any welfare function reflecting at least some modest aversion to inequality, then for any amount of information below some critical level, welfare is enhanced by the presence of a ban. Although many parameters play a role in leading to this outcome, such as the extent to which people are risk averse,

[8] Of course, if the sellers of life insurance discover over time that there is a sufficient amount of hidden information arising from privately held genetic test results, then they may find that exclusive contracts are worthwhile.

[9] If a simple pooling contract prevails in the market then low risks end up with less insurance and high risks end up with more insurance compared to no ban. Thomas (2008) points out, however, that the overall result can have more people who face a loss ending up being compensated through the claim process since the high risks are more likely to incur a loss. Although the interim efficiency of the insurance market is still compromised by a ban, one can argue that ex post (i.e., after all uncertainty is resolved) the fact that more losses are covered is desirable.

ceteris paribus the critical level is characterized by the fraction of individuals in the population who are of high risk.

Therefore, adopting a welfare perspective allows one to form a coherent perspective on whether a regulatory ban on the use of genetic test results is desirable. The difficulty with applying such an approach, however, is that at one point in time (e.g., presently) the fraction of people who know they are of high risk may be small enough that a welfare criterion supports a ban while at another period of time (e.g., 20 years from now) the state of information may be such that the recommended policy conclusion will be reversed. This doesn't imply an inconsistency in the assessment principle per se but does mean the application may lead to different recommendations depending on circumstances. Certainly one would not suggest an irrevocable ban on insurers using genetic test results for pricing purposes as a result of a standard economic welfare assessment.

6. The Moral Discrimination Perspective

Whether one believes a regulatory ban is justified by a concern with unfair discrimination may well depend on the type of equilibrium, pooling or separating, as well as the temporal perspective one deems most relevant. Furthermore, one must decide whether one is concerned with price discrimination, quantity discrimination or some other norm such as "well-being" discrimination.

Consider first the distinction between price and quantity discrimination. In the event that a regulatory ban results in a pooling equilibrium, both risk types face the same price and so price discrimination is absent (at least from a morality based view of discrimination). One could argue that from both ex ante and ex post temporal perspectives no price discrimination occurs. Low risk types, however, choose to purchase less insurance and so could be argued to face discrimination along this dimension. Such a stance is perhaps not without controversy, however, since the level of coverage is a choice freely engaged in. In the context of life insurance, however, the affected party or group of relevance is the survivor family and this is a different entity than the individual or unit that made the decision about how much insurance to purchase in the first place. It is clear that survivor families of low risk types are, ceteris paribus, worse off in a strictly economic sense than are survivor families of high risk types as the latter will hold larger quantities of life insurance. Thus, from an ex post perspective, the "quantity discrimination" experienced by low risk types is a relevant concern. This experience can also be identified as a sort of (ex post) "well-being" discrimination against survivor families of low risk types.[10]

[10] We ignore all other sources of income inequality and so consider only effects from insurance purchases on the survivor families' economic well-being. If high risk types experience lower incomes during their lifetime due to their high-risk status (and possible ill health) then this must also be weighed into the analysis.

In the case of a regulatory ban leading to a separating equilibrium the low risk types again end up with a lower level of insurance coverage and so face quantity discrimination and the survivor families face well-being discrimination. An added complication arises due to the fact that the insureds face a pair of contracts – one with a higher price but higher quantity that attracts high risk types and the other with a lower price but lower quantity that attracts low risk types. From an interim temporal perspective (i.e., at the point in time when a decision about which insurance contract to choose is to be taken) both types are free to purchase either policy and so one might argue that there is no discrimination. However, the high risk types purchase the high price, high quantity contract while the low risk types purchase the low price, low quantity contract. So, leaving the relevance of free choice aside, the high risk types are discriminated against in price while the low risk types are discriminated in the quantity dimension. It is not clear which type of discrimination is more relevant in the context of the interim temporal perspective. From an ex post perspective, however, it is clear that the survivor families of low risk types again end up worse off as a result of a regulatory ban and so can be said to face "well-being" discrimination.

7. The Business/Actuarial Perspective

As noted earlier in the paper, the insurance industry argues that insurance companies should be allowed to use actuarially relevant genetic test results held by insureds. On the face of it at least, this is a reasonable position. Contracts in private sector relations typically are expected to be entered into in good faith; that is, any relevant information that either party holds should not be kept hidden. Moreover, since the main cost of providing insurance is generated from satisfying claims and the expected cost of doing so for high risk types is indeed higher, it is reasonable to argue that in a pragmatic sense the insurer is not engaged in unfair discrimination when high risk types are assessed a higher unit price for insurance coverage. After all, a product that costs more to supply is typically sold at a higher price. This seems a reasonable way for a supplier to behave. On the other hand, however, private sector interactions are often subject to regulations that are deemed to be in the public interest. It can be reasonably argued that private incentives should be allowed to play out in the market place only if the public interest is served. Moreover, it is generally the case that insurers do not have perfect information about each individual and so all individuals are placed into groups in which some differences in risk levels are present. Introducing additional information such as the result of a genetic test is also likely to be an imperfect indication of an individual's overall *true* risk type and so use of genetic tests enhances information but does not lead to perfect risk-type specific categorization. Hoy and Lambert (2000) have shown that information that improves the average accuracy of risk determination may actually create an additional impact of discrimination of the statistical (rather than moral) sort if one allows for the realization that the cost of

discrimination may indeed be nonlinear in the amount.[11] As long as all insurers face the same regulation then prices can be expected to adjust in such a way as to preserve the financial viability of insurance companies even if some relevant information about individual risk levels is not used. Thus, the claim that insurers *should* or *must* use all available information to classify individuals is neither true descriptively nor justifiable on normative grounds. Of course, if a sufficiently large amount of information about risk type can be held privately by insureds then it is quite possible that the market will not function very well as a means of risk management for insureds and so it may not be sensible to adopt a regulation that suppresses such information in all circumstances.

8. Further Considerations

We have discussed many complexities – both philosophical and practical – that arise when addressing the implications and desirability of a regulatory ban on insurers' use of genetic test results for pricing insurance contracts. In this section we explore a couple of additional considerations that the future may hold and that will add further challenges to the development of a coherent framework for deciding on the efficacy of a ban.

Although early discoveries in the way genes are linked to diseases tended mostly to be for Mendelian (monogenic) diseases, current and future research is more likely to lead to the discovery of more multifactorial disease genes that involve more than one gene in combination with environmental factors (see Antonarakis and Bechmann, 2006). In many cases these environmental factors can be at least partially controlled through individuals' behaviour. Such genes are sometimes referred to as predisposition genes since their presence leads to an increased likelihood of a person contracting a specific disease (e.g., lung cancer). Individual behaviours can influence this risk (e.g., by avoiding smoking) with differential impact on the risk of onset of disease depending on which genes are present. Thus, whether or not a regulatory ban is in place may influence a person's decisions as well as insurers' pricing strategies. Consider, for example, that a regulatory ban is not in place and so insurers can charge a higher price to anyone known to have a higher mortality risk due to their having some predisposition gene. Since individuals have some control over their risk level it is less clear how one should view price differentials based on individuals possessing such a gene. To some extent risk differences are the result of individaul choices which could come under the option luck category. Whether or not the insurer can observe or determine the individual behaviours and use this information in determining individual specific prices comes into play when assessing whether unfair discrimination is being practiced. One

[11] That is, nonlinearity (convexity) follows if a person feels more than twice as aggrieved by being charged 10% more than is reflected by his true risk level than he would by being over-charged by 5%.

might argue that, to the extent that risk levels differ because of differences in behaviour (i.e., option luck), insuers should be allowed to assign different prices. However, separating that part of differences in risk levels associated with option luck (behaviour differences) and that part which is due to brute luck (genetic differences) is not a trivial exercise. Therefore, it is a difficult challenge to determine whether differential prices are justifiable or what proportion of differences in risk levels it would be justifiable to reflect in prices. Welfare analysis is also more complex when differences are due to multifactorial genes (see Hoy, 1989 who models the implications of alternative informational environments when individuals can influence their risk level).

The entire debate about appropriate regulation may shift as the costs of genetic tests fall over time and the market for direct to consumer genetic testing (DTC-GT) develops. Already over the counter tests have raised grave concerns about genetic information being offered to a public which is not sufficiently educated to interpret it or always aware of the importance of protecting the information. Although the companies (such as www.23andme.com and www.navigenics.com) include a statement about security and privacy, nothing sent over the internet can give 100% assurance of protection of personal information. The companies invite clients to participate in research including completing questionnaires gathering personal data beyond the genetic test itself, expanding the scope for loss of personal privacy. If genetic tests become sufficiently cheap and insurers become concerned that many potential customers will have substantial genetic information as a result of obtaining them in the DTC-GT market then insurers may well want to screen all applicants by insisting that they take a battery of genetic tests in order to qualify for insurance. However, outside the need to qualify for insurance, many people don't want to be tested in this manner.[12] Not having a regulation banning insurers from insisting on genetic testing means another right will be placed at risk; namely, the right not to know about one's genetic status (see Lemmens, Luther, and Hoy, 2008 for a discussion on this topic).

Throughout this paper the quantity of relevant genetic information that is held by the insurance buying public is the most crucial feature of the contracting environment and it can tip the balance on just how adverse selection will be realized in the market place. This in turn affects, in a fundamental way, how any of the philosophical or normative positions considered in this paper performs as a useful framework for deciding on the merits of a regulatory ban. In a review of the current actuarial (academic) literature MacDonald (2009, p. 4) concludes that "little, if any strong empirical evidence has been found for the presence of adverse selection (although it is admittedly hard to study)." Simulation exercises based on population genetics and epidemiological data Hoy, et al. (2003) and Hoy and Witt (2007) also find, for the most part, little impact is likely to occur from a ban on insurers using genetic test results for health

[12] See Meiser and Dunn (2000), Babul et al. (1993), and Quaid and Morris (1993) who document that free and anonymous genetic tests for Huntington disease are often refused by members of at-risk families.

and life insurance markets, respectively. Oster, et al. (2010), however, report strong evidence of adverse selection in the long-term care insurance market due to individuals holding private information about HD (Huntington disease) carrier status. It seems safe to say that the future holds uncertainty in this regard and continued empirical research will be necessary in order to help resolve the debate about the use of genetic information in insurance markets.

9. Conclusion

In this paper we have addressed the fact that globally the issue of whether to regulate or how to regulate genetic information within the insurance industry has not been resolved in a consistent manner. Even within the OECD countries, the response to the concern of genetic privacy and genetic discrimination has varied from no regulation whatsoever to rigid and complete bans on the use of genetic information by insurers. We argue that this is not surprising given that the academic literature has not provided a unified or coherent assessment of the debate. This, we argue, is due to several different sets of issues that make such an exercise extremely challenging. The various elements that form any such analysis interact in a complex manner. First, whether the contracting environment involves exclusivity or non-exclusivity of provision determines whether pooling or separating contracts will persist under a ban. This in turn affects the implications of each of the normative assessments of a ban that we have considered. Second, the *reasonable* normative criteria or perspectives we have reviewed that can be used to develop guidelines or principles for regulation often lead to starkly different conclusions across the various contracting environments.

Third, the conclusions about regulation that would be recommended using any of the normative principles presented in this paper and reflected in the literature depend critically on the temporal perspective one adopts. Should one perform an evaluation of a ban from the perspective of individuals before they know their risk type? Presently, most people have limited or no information about their genetic risk profile but they may do so easily in the future. Thus, this temporal perspective (i.e., the ex ante position) seems a perfectly reasonable one to adopt in the context of genetic discrimination. However, once people do know their risk type, their private incentives and that of insurance providers change. It is this stage (i.e., the interim stage) in which customers and insurance firms engage in contracting. It also seems quite a reasonable point from which to assess the merits of regulating these market transactions. Finally, since the point of insurance is protection of individuals in the event of a financial loss, then an ex post perspective, wherein all uncertainly about the relevant states of the world has been resolved, may seem most appropriate. This is particularly relevant in the context of life insurance since it is the financial

protection of survivor families that is the goal of insurance and the survivor family is a different entity from the decision making unit in the interim or ex ante stages.

We find that even within the same normative framework one can arrive at different conclusions regarding the evaluation of the merits of a ban. This is especially so for the approach we have associated with a moral definition of discrimination. One reason that this normative perspective faces such complexities is that it is not clear what element should be the main focus of concern. Should it be price discrimination, quantity discrimination, or end state discrimination in well-being? It is possible that from an ex ante perspective one would conclude that no discrimination occurs in the presence of a ban but from an interim or ex post scenario there is one form of discrimination faced by one risk type (e.g. price discrimination against high risk types) and another form of discrimination faced by the other risk type (e.g. quantity discrimination or well-being discrimination against low risk types). That such complexities in reasoning arise for a normative viewpoint which at face value quite is straightforward, is reflected in the lack of coherence in policy in a global context.

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