Genetic Testing and Genetic Discrimination: 
Public Policy When Insurance Becomes “Too Expensive”

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ABSTRACT
We examine public policy toward the use of genetic tests by insurers when a positive test makes insurance too expensive for consumers.

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1. Introduction

The Human Genome Project and the subsequent development of predictive genetic tests created widespread concerns about the possibility of genetic discrimination. Genetic discrimination is defined as “… discrimination against an individual or against members of that individual's family solely because of real or perceived differences from the "normal" genome of that individual.” (Billings, et al. 1992, p. 447). In particular, genetic discrimination refers to the treatment of asymptomatic individuals and can arise either as the result of genetic tests or family history. A positive genetic test or other adverse genetic information may result in higher premiums, possibly making insurance unaffordable. A positive test for a genetic disorder implies a greater health risk and a greater financial risk arising from health care costs and other consequences of the disease. If insurance coverage becomes unaffordable, the individual and their family are left to bear all of these substantial costs themselves. The affordability of insurance is an important issue among those concerned with genetic discrimination.

There is evidence of genetic discrimination, including genetic discrimination in insurance. Billings provides case studies of individuals who reported experiencing genetic discrimination. Low, King and Wilke (1998), in survey of British genetic disorder support groups, found that 33% reported problems applying for life insurance, versus 5% for a control group of the general population. In a survey of 233 individuals at risk for Huntington’s disease (HD), Bombard et. al, (2009, 2010, 2012) find that overall 75% reported fear of genetic discrimination, 40% reported some form of genetic discrimination, including 30% reporting
discrimination in insurance.\textsuperscript{1} In their meta-analysis of studies of genetic discrimination in life insurance, Joly, Feze, and Simard (2013) point out serious methodological limitations of the existing studies.\textsuperscript{2} They note that, of 33 studies conducted in Australia, Canada, Europe, and the U.S., 14 studies report that genetic discrimination exists and is a concern while 19 studies find that either it does not exist or exists but is rare. In their survey of the literature, Otlowski, Taylor and Bombard (2012) report that fear of genetic discrimination is more widespread than reported genetic discrimination. Nonetheless, they conclude (p. 437) that genetic discrimination “… is now an established, incontrovertible ethical, legal, and psychosocial phenomenon.”

What advocates view as genetic discrimination, insurers view as actuarially sound risk classification intended to ensure individuals pay a premium commensurate with their risk. The inability to classify based on risk-relevant information can lead to adverse selection. There is evidence of risk–based selection in U.S. employer provided health insurance (Handel, 2013; Bajari et al., 2014), including small-, medium- and large-group markets (Bundorf, Herring and Pauly, 2010). Finkelstein (2004) and Lo Sasso and Laurie (2009) find evidence of adverse selection in the U.S. Medigap and non-group health insurance market. Ollivella and Vera-Hernandez (2013) find evidence of adverse selection in the U.K. private health insurance market.\textsuperscript{3} Genetic information appears to be a contributor to risk-based selection. Zick et al. (2005) and Taylor (2010) find substantial increases in the ownership of long-term care insurance by

\textsuperscript{1} See Armstrong, et. al, (2003), Christiaans, et. al, (2010), Erwin, et. al., (2010, Lapham, Kozma and Weiss (1996) Taylor, et. al. 2007, 2008) and Williams, et. al. (2010), among others. The majority of studies of genetic discrimination in insurance focus on life insurance. The structure of national health insurance systems and of employer provided group health insurance may provide fewer opportunities for genetic discrimination. Life insurance and long term disability insurance are typically privately provided and underwritten on an individual basis and may be more susceptible to possible genetic discrimination.

\textsuperscript{2} They argue that (1) the methodology of many studies is not sufficiently robust to establish discrimination, (2) a small number of genetic conditions are examined, (3) the heterogeneity and small scope of existing studies prevents statistical analysis and (4) the small number of reported cases of discrimination in some studies could be due to chance.

\textsuperscript{3} The evidence on risk based selection in insurance markets in general is mixed. There is evidence of selection on other dimensions in addition to risk-based selection. Cohen and Siegelman (2010) and Chiappori and Salanié (2013) survey the empirical research on adverse selection in insurance markets.
individuals who had positive predictive tests for Alzheimer’s disease. Oster et al. (2010) report asymptomatic individuals who have tested positive for Huntington’s disease are five times more likely to own long-term care insurance than otherwise comparable individuals, which they interpret as "strong evidence of adverse selection" (p. 1048).

The purpose of this paper is to examine public policy toward the use of genetic information by insurers when a positive genetic test may make the insurance too expensive for consumers. There are a number of papers that examine public policy toward insurer’s use of genetic information. Crocker and Snow (1992) show that, if consumers do not have prior information, then the private value of information is negative if insurers can observe whether or not individuals are informed. Doherty and Thistle (1996) show that if insurers are unable to observe the consumers’ informational status or if individuals are able to conceal their information status then the private value of information is non-negative. That is, whether the individual’s tested/untested status is known to insurers determines the value of the test. These two papers assume the risk is exogenously fixed. Doherty and Posey (1998) and Bardey and DeDonder (2013) examine models in which revealed high risks can engage in primary prevention. Barigozzi and Henriet (2011) and Crainich (2013) study observable secondary prevention. Peter, Richter and Thistle (2016) allow for observable and unobservable primary prevention and examine a range of public policy alternatives. These papers examine public policy in a range of economic environments. The policy conclusion that emerges from this literature is that the mandatory disclosure or duty to disclose regime is not dominated by other policies and that the information ban never dominates other policies.

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4 Our paper also contributes to the broader literature on risk classification and the social and private value of information in insurance markets. See Crocker and Snow (2013) for a recent survey of this literature.
5 Erlich and Becker (1972) introduced self-protection (primary prevention) and self-insurance (secondary prevention).
All of these papers assume utility is state-independent. State-dependent utility, introduced by Eisner and Stotz (1961), is now well established as a method of dealing with the fact that poor health status affects the marginal utility of consumption. Viscusi and Evans (1991) estimate that ill health reduces marginal utility by about 25 percent. Finkelstein, Luttmer and Notowidigo (2013) estimate that chronic disease decreases the marginal utility of consumption by 10-25 percent. Second, all of these papers assume that individuals who have a positive genetic test will purchase insurance. In contrast, we assume state-dependent utility and assume that there is genetic discrimination in the sense that at least some individuals who have positive genetic tests will decide that insurance is too expensive and will not purchase insurance.

The paper most closely related to ours is Stohmenger and Wambach (SW, 2000). They assume state-dependent utility, and show that the cost of treatment can be less than the individual’s income yet exceed the individual’s willingness to pay for insurance. In particular, they show that if the high risks’ loss probability exceeds a critical level then the high risk individuals do not purchase insurance. They consider the duty to disclose, where individuals are required to reveal whether they have been tested and the test result to the insurer, and the information ban, where insurers are prohibited from using any genetic information in pricing coverage, as the public policy alternatives. They examine the different ways that market equilibria may break down when treatment costs exceed individuals’ willingness to pay.

We extend the existing literature in a number of dimensions. We assume state-dependent utility. We use a different formulation from SW by including a “pain tolerance” parameter that allows for comparative statics analysis of the effect of the difference in utility between the good and bad states. We show that the critical probability at which individuals decline insurance

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6 See also Arrow (1963, 1974) on state dependent utility and De Meza (1983) on state-dependent utility in health insurance.
depends on their pain tolerance and the magnitude of treatment costs. With full information, individuals with low pain tolerance always insure, while individuals with high pain tolerance may not. Whether high risk individuals buy insurance or not has implications for the performance of the insurance market. We show that if the high risks drop out of a market with asymmetric information, then the low risks may not buy insurance and there is no trade in the insurance market. Since it is the high risks that drop out of the market this is different from the “adverse selection death spiral.”

The population incidence of many genetic conditions is very small. The proportion of high risks may not be large enough to support a Rothschild-Stiglitz (1976, RS) equilibrium. Our asymmetric information model with two risk types builds on that of Netzer and Scheuer (2014), providing a multistage game whose subgame perfect Nash equilibrium has the Wilson (1977)-Miyazaki (1977)-Spence (1978, WMS) cross-subsidizing contracts, or the null contracts as its potential outcomes, depending on parameter conditions. When some individual may drop out of the market, the individual rationality constraints play an important role in determining the equilibrium outcome. To our knowledge, this is the first paper to analyze a model where menus of contracts can be offered when individual rationality constraints may be binding. We examine the value of information and social welfare. We first examine a model in which everyone that has a positive test result views treatment to be too costly without insurance and high risks will never buy insurance at actuarially fair rates. But individuals vary in their willingness to pay for insurance. Some individuals who have positive test results will buy insurance despite the high premium. We extend the model to consider insurance markets in which some individuals buy insurance and some do not. Finally, we consider a wider range of public policy options than previous research.

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7 Posey and Thistle (2016) show that a similar problem arises if utility is state independent but losses exceed wealth.
Whether there is genetic discrimination or adverse selection depends on the information that insurance companies can use to underwrite policies, which in turn is determined by public policy. There is a wide range of policies in place, depending on the jurisdiction and the type of insurance. The Health Insurance Portability and Accountability Act (HIPAA) of 1996 and the Genetic Information and Nondiscrimination Act (GINA) of 2008 together effectively prohibit the use of genetic information (including family health history) in underwriting in both group and individual health insurance for asymptomatic individuals. However, these laws do not apply to life, disability, or long-term care insurance or to annuities. These markets are unregulated, so that insurers could in principle require genetic tests. Most European countries ban the use of genetic information through the Oviedo Convention and through national legislation. In the U.K., insurers have agreed not to use genetic tests (except for life insurance policies over £500,000), however, individuals are allowed to provide favorable genetic test results and South African insurers have agreed to a Code of Conduct under which previous tests, but not their results, must be disclosed to the insurer, and the insurer may not require additional tests. While Canadian insurers do not require genetic tests, they may request the results of any tests that have been taken; the situation is similar in New Zealand and Australia. Most African and Asian countries have not passed legislation governing the use of genetic information.

We analyze five different public policies toward the use of genetic testing to cover the wide range of policies currently in use. First, we analyze a mandatory testing regime, where insurers require test results as a condition of insurance. We then examine a mandatory disclosure or duty to disclose regime, where insurers may not require testing, but must be provided the results of any tests that are taken. We discuss the code of conduct, under which insurers must be

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8 See Jol, Braker and Le Huyhn (2010) and Otlowski, Taylor and Bombard (2012) for surveys of regulatory regimes regarding the use of genetic information.
informed that a test has been taken, but not provided with the test results. We analyze a voluntary disclosure or consent law policy, under which individuals may choose whether or not to disclose test results to the insurer. Finally, we examine an information ban regime, under which insurers are not allowed to use any genetic information. Our objective is to rank the policy regimes.

The next section develops the model. Sections 3 and 4 compare the policy regimes under the assumption that there is genetic discrimination in the sense that all (Section 3) or some (Section 4) of the high risk individuals decide that insurance is unaffordable at actuarially fair premiums. Section 5 provides a summary and concluding remarks.

2. The Model

2.1 The Basic Model. Individuals face the risk of developing a disease that has a genetic component. We assume that for an individual there are two states of the world, the good state and bad state, $G$ and $B$, respectively. Individuals may be at high or low risk for developing the disease (i.e., entering the bad state), with probability $p_H$ and $p_L$, respectively, where $0 < p_L < p_H < 1$. All individuals have initial wealth $w$. The disease does not cause death but results in a reduction in the quality of life. Utility in the good state is $u(w)$. We assume $u$ is strictly increasing and concave. There is a treatment for the disease which results in a complete cure and costs $l$. If the individual is untreated then utility in the bad state is $\tau u(w)$, where $\tau \in (0, 1]$ can be interpreted as a “pain tolerance” parameter, and if the individual is treated utility in the bad state is $u(w - l)$. We allow for the possibility that the treatment costs more than the individual’s wealth, $l > w$. An insurance policy consists of a premium, $\alpha_i$, and a net indemnity, $\beta_i$. If an

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9 This formulation is restrictive, for example, it implies risk aversion is the same in both good and bad health.
insurance policy is purchased, wealth in the good state is $w_{IG} = w - \alpha_i$ and wealth in the bad state is $w_{IB} = w - l + \beta$. An insurance contract can be viewed as an allocation of wealth in the good and bad states, $c_i = (w_{IG}, w_{IB})$.

2.2 Who Will Buy Actuarially Fair Full Insurance? We now consider an individual’s decisions to buy or forgo insurance. Individuals are willing to pay at most $\Delta$ for treatment where $\Delta(w, \tau)$ is defined by

$$u(w - \Delta) = \tau u(w);$$  \hfill (2.1)

$\Delta$ is the wealth equivalent of the utility lost due to bad health and is not an actual expenditure.\(^{10}\) The willingness to pay for treatment is less than wealth and is an increasing function of wealth with $0 < \partial \Delta/\partial w < 1$, and is a decreasing, concave function of $\tau$, with $\Delta(w, 1) = 0$. If $l < \Delta$, the individual would be willing to pay for their own treatment and will always buy full coverage if insurance is fairly priced. If $l > \Delta$, the individual would refuse to pay for their own treatment and may not be willing to buy insurance. In particular, there is a $\bar{p}$ such that the individual will fully insure if $p \leq \bar{p}$ but will not insure if $p > \bar{p}$.

Observe that if $u(w - l) > \tau u(w)$, then in the disease state without insurance, utility is greater with treatment than without treatment, and vise versa if $u(w - l) < \tau u(w)$. Defining

$$\tau = \frac{u(w - l)}{u(w)},$$  \hfill (2.2)

then an uninsured individual who falls ill will obtain treatment if $\tau < \tau_*$ and will not obtain treatment if $\tau > \tau_*$. 

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\(^{10}\) Cook and Graham (1977) refer to $\Delta$ as the “ransom.”
With actuarially fair pricing, when insurance is desirable full insurance is preferred to partial insurance and the optimal contract is \( \alpha = pl \) and \( \beta = (1-p)l \). The net benefit of full insurance is

\[
N(p) = u(w - pl) - (1-p)u(w) - p\text{Max}[u(w - l), \tau u(w)]
\]

(2.3)

If \( \tau < \bar{\tau} \), then \( N(p) = u(w - pl) - (1-p)u(w) - pu(w - l) > 0 \) and full insurance is preferred to no insurance. If \( \tau > \bar{\tau} \), then \( N(p) = u(w - pl) - (1-p)u(w) - p\tau u(w) \) since no treatment will be obtained in the disease state without insurance.

**Proposition 1**: Take \( l, w \) and \( \tau \) as given. Then there is a unique cutoff probability \( \bar{p} \) such that the individual will fully insure at the actuarially fair price if \( p \leq \bar{p} \) and will not insure if \( p > \bar{p} \).

Proof: For \( \tau < \bar{\tau} \), \( N(p) \) is never negative and \( \bar{p} = 1 \). For \( \tau > \bar{\tau} \), \( N(p) \) has the following properties: \( N(0) = 0 \) and \( N(1) < 0 \),

\[
N'(p) = -u'(w - pl)l + u(w) - \tau u(w)
\]

(2.4)

and

\[
N''(p) = u''(w - pl)l^2 < 0.
\]

(2.5)

If \( N'(0) < 0 \), then \( N(p) \) is never positive. If \( N'(0) > 0 \), then \( N(p) > 0 \), at least in some neighborhood of zero. Then \( N(p) \) crosses the axis once from above and there exists a unique \( \bar{p} \in (0,1) \) such that \( N(p) > 0 \) for \( p < \bar{p} \) and \( N(p) < 0 \) for \( p > \bar{p} \). That is, individuals will fully insure if \( p \leq \bar{p} \) and will not insure if \( p > \bar{p} \). Letting \( \bar{\tau} \) be the value of \( \tau \) where \( N'(0) = -u'(w)l + u(w) - \tau u(w) = 0 \), we have

\[
\bar{\tau} = 1 - \frac{u'(w)l}{u(w)}.
\]

(2.6)

For \( \tau > \bar{\tau} \), \( N'(0) < 0 \) so \( N(p) \) is never positive and \( \bar{p} = 0 \). For \( \tau \) between \( \tau \) and \( \bar{\tau} \), \( \bar{p} \) is implicitly defined by \( N(p) = u(w - pl) - (1-p)u(w) - p\tau u(w) \equiv 0 \).
Observe that $\bar{p}$ depends on pain tolerance, $\tau$, as well as on wealth, $w$, and the cost of treatment, $l$. The critical probability is decreasing in pain tolerance, 

$$\frac{dp}{d\tau} = \frac{pu(w)}{-u(w-pl)l + (1-\tau)u(w)} < 0,$$

since the denominator is $N'(p)$ which is negative at $\bar{p}$. This implies that if an individual with pain tolerance, say, $\tau'$ will not insure, then neither will any individual with greater pain tolerance. The cutoff probability is increasing in wealth,

$$\frac{dp}{dw} = \frac{-u(w-pl)+(1-p+\tau)u(w)}{-u(w-pl)l + (1-\tau)u(w)} > 0,$$

so that low income individuals forgo insurance at a lower risk of disease than high income individuals. The cutoff probability is decreasing in the cost of treatment,

$$\frac{dp}{dl} = \frac{u(w-pl)p}{-u(w-pl)l + (1-\tau)u(w)} < 0,$$

implying fewer people will buy insurance as the cost of treatment rises.

Holding the wealth and loss severity constant across individuals, the threshold probability can be written as $\bar{p}(\tau)$. We begin by assuming all individuals have pain tolerance $\tau_0$ and the corresponding $\Delta(w, \tau_0)$ is denoted $\Delta_0$. We further assume that $p_L < \bar{p}(\tau_0) < p_H$, so that low risks with pain tolerance $\tau_0$ prefer actuarially fair full insurance to no insurance and high risks with pain tolerance $\tau_0$ prefer not to insure. This situation is illustrated in Figure 1. The traditional fair odds lines for high and low risks, $P_H$ and $P_L$, and the pooled fair odds line $P_P$, emanate from the point $E_1 = (w, w-l)$ since insurers must receive premium revenue on all coverage provided. If individuals are uninsured, they have expected utility equal to that at the point $E_0 = (w, w-\Delta_0)$. The corresponding indifference curves for low and high risks are denoted $U_L^0(0)$ and $U_H^0(0)$, respectively. It is assumed that when individuals are indifferent between insurance policies, they will choose the one with more coverage, but when they are indifferent between buying and not buying insurance, they will choose to go uninsured. The low risks would prefer to buy any policy along $P_L$ above point $B$ to remaining uninsured, and would prefer to remain uninsured rather than buy a policy along $P_L$ at or below $B$. Since $p_H > \bar{p}(\tau_0)$, the high risk fair odds line lies
completely below the indifference curve $U^0_H(0)$, so the high risks are not willing to buy either partial or full insurance at an actuarially fair premium. Since $U^0_H(0)$ is flatter than $U^0_L(0)$, it must intersect the fair odds line $P_L$ below $B$, for example, at point $A$, where the low risks prefer to remain uninsured. If there is full information, then in equilibrium the low risks will obtain their full insurance actuarially fair contract, $c^*_L$, and high risks obtain the null contract where $\alpha_H = \beta_H = 0$.

2.3 The Possibility of No Trade. We now turn to the characterization of equilibrium in markets with asymmetric information. We assume that $\lambda$ is the proportion of the population that is high risk and $1 - \lambda$ is the proportion that is low risk. Individuals have private information about their risk type. We follow the approach of Netzer and Scheuer (2014) and assume an extensive form game where firms simultaneously offer menus of contracts and after those contracts have been observed, firms simultaneously decide whether to remain in the market or withdraw and incur a small withdrawal costs. Then individuals decide which, if any, contract they will buy. When $l < \Delta_0$, the subgame perfect Nash equilibrium for this game is characterized by the Wilson-Myazaki-Spence equilibrium outcome. The contracts maximize the expected utility of low risks while satisfying incentive compatibility constraints for both low and high risks and a resource constraint that allows for cross-subsidization. High risks obtain full insurance and their incentive compatibility constraint is binding, while low risks obtain partial insurance.

For the present analysis where $l > \Delta_0$, the possibility that some individuals may choose not to buy insurance is important. Thus, it is necessary to include individual rationality constraints for both risk types. Consequently, the subgame perfect Nash equilibrium (SPNE) for individuals with $\tau = \tau_0$ solves:
Max \( U^0_L(c_L) \)

Subject to

\[
U^0_H(c_H) \geq U^0_H(c_L) \quad (SSh)
\]

\[
U^0_L(c_L) \geq U^0_L(c_H) \quad (SSL)
\]

\[
\lambda[w - (1 - p_H)w_{HG} + p_Hw_{HB} + p_Hl]T_H + (1 - \lambda)[w - (1 - p_L)w_{LG} + p_Lw_{LB} + p_Ll]T_L \geq 0 \quad (RC)
\]

\[
U^0_H(c_H) \geq U^0_H(0) \quad (IRH)
\]

\[
U^0_L(c_L) \geq U^0_L(0) \quad (IRL)
\]

where \( U^0_i(c_i) = (1 - p_i)u(w_{ig}) + p_iu(w_{ib}) \) if the individual buys insurance, \( c_i = 0 \) represents the case where no insurance is purchased and no treatment is obtained in the event of illness so that \( U^0_i(0) = (1 - p_i)u(w) + p_iu(w - \Delta_0) \) is expected utility if the individual does not buy insurance. The first two constraints are the self-selection constraints for the high and low risks, the third constraint is the resource constraint. The last two constraints are the individual rationality constraints for the high and low risks. The resource constraint is affected by whether or not high risks, low risks or both decide to buy insurance. The \( T_i \) are indicators equal to 0 if \( c_i = 0 \) and 0 otherwise. Figure 2 will be helpful in determining the equilibrium contracts. In the figure, the contracts H and L are the traditional Rothschild-Stiglitz equilibrium contracts and are not individually rational for either of the risk types. The dotted line represents the set of low risk contracts that satisfy the resource constraint, RC, and constraint \( SSh \) for each potential high risk full insurance contract between H and the pooling contract F. This \( FL^* \) locus is the traditional MWS locus of low risk contracts. The equilibrium outcome when \( l > \Delta \) depends critically whether the low risk indifference curve through \( E_0, \overline{U^0_L}(0) \), crosses the \( FL^* \) locus.

**Proposition 2:** The solution to SPNE satisfies the following conditions:
A. (i) The resource constraint is binding.
(ii) If the high risks insure, they fully insure.
(iii) The solution is unique.

B. (i) If $\overline{U}_L^0(0)$ crosses the FL$^*$ locus, then $IR_H$ and $IR_L$ are slack, $SS_H$ is binding,
\[
\frac{(1-p_L)u'(w_{LG})}{p_Lu'(w_{BG})} = \frac{\lambda(1-p_H)u'(w_{LG})+(1-\lambda)(1-p_L)u'(w_H)}{\lambda p_H u'(w_{LB})+(1-\lambda)p_Lu'(w_H)},
\]
and the equilibrium outcome is the MWS outcome.
(ii) If $\overline{U}_L^0(0)$ does not cross the FL$^*$ locus, then $IR_H$ and $IR_L$ are binding, $SS_H$ and $SS_L$ are binding, and both types obtain the null contract.

Proof: If $\overline{U}_L^0(0)$ crosses the FL$^*$ locus, it may cross once or twice, from below if once and from above and below as in Figure 3 if twice. Let Z represent the point at which $\overline{U}_L^0(0)$ crosses FL from below. All points along FL$^*$ to the northeast of $\overline{U}_L^0(0)$, represented by the dashed portion in Figure 3, are feasible low risk contracts from the perspective of the individual rationality constraints $IR_L$ and $IR_H$. Letting Y denote the northwestern most point along FL$^*$ that satisfies $IR_L$, if $\overline{U}_L^0(0)$ crosses the 45 degree line to the southwest of F, then Y = F. In either case, the contract on the FL$^*$ locus that maximizes low risk utility, $\bar{c}_L$, is to the left of point Z, occurring along the dashed YZ portion where $IR_L$ is slack, and the high risk indifference curve through that point of tangency is to the northeast of $\overline{U}_H^0(0)$ so that $IR_H$ is slack. So when $\overline{U}_L^0(0)$ crosses the FL$^*$ locus, the results in parts A (i)-(iii) and part B (i) are equivalent to those proven in Netzer and Scheuer (2014) where the constraints $IR_L$ and $IR_H$ are absent. The equilibrium contracts are denoted $\bar{c}_L$ and $\bar{c}_H$ and are the MWS equilibrium low risk and high risk contracts, respectively.

When $\overline{U}_L^0(0)$ does not cross the FL$^*$ locus, as seen in Figure 2, low risks prefer to forgo insurance than to purchase any cross-subsidizing contract along FL$^*$ or any actuarially fair contract below point B. In this case, no cross-subsidizing contracts can be offered since low risks will not participate in them. No actuarially fair high risk contracts can be sold because $\overline{U}_H^0(0)$ is northeast of the high risk fair odds line. No actuarially fair low risk contracts can be profitably sold since those below B are unattractive to low risks and those above B will be purchased by both high and
low risks, losing money. Therefore, the equilibrium is characterized by both low and high risks obtaining the null contract. ||

This result has two important implications. First, the equilibrium where there is no trade is second best efficient. Second, if there is an active insurance market, then the low risks subsidize the high risks.

The Value of Information. We assume that individuals who have not taken the genetic test have no information about their genetic risk. All individuals are assumed to start out uninformed about their risk type. These uninformed individuals view their probability of becoming ill as being equal to the population average risk, \( p_U = \lambda p_H + (1 - \lambda) p_L \). We assume throughout that \( p_U < \bar{p}(\tau_0) \) so that the uniformed will purchase full insurance at their actuarially fair rate if it is offered. Expected utility for the uniformed is denoted \( U_U^0 \). It is useful to note that for any fixed contract \( c \), we have \( U_U^0(c) = \lambda U_H^0(c) + (1 - \lambda) U_L^0(c) \).

It is assumed that firms simultaneously choose contracts and then have an opportunity to withdraw from the market as before. In the next stage individuals decide whether or not to take the genetic test and in the final stage they choose their contracts from those offered. The value of information is the \( \text{ex ante} \) change in expected utility from taking the test, which we assume perfectly reveals the individual’s type.\(^{11}\) Suppose informed high and low risks obtain the contracts \( c_H \) and \( c_L \) and the uniformed obtain the contract \( c_U \) (these may be null contracts). Then the value of information for individuals with \( \tau = \tau_0 \) is

\(^{11}\) The assumption that the test is perfect is unrealistic, since tests have both false positives and false negatives. This simplifying assumption can be relaxed. All that is required is that insurers and individuals agree on the post-test values of \( p_H \) and \( p_L \). As Ligon and Thistle (1996) point out, individuals can infer the loss probabilities from the contracts offered by insurers.
We let \( z \) denote the individual’s information status, where \( z = 1 \) if the individual is informed and \( z = 0 \) if the individual is uninformed. We assume individuals become informed if the value of information in non-negative, so \( z = 1 \) if, and only if, \( I \geq 0 \). \(^{12}\)

Under the mandatory testing, duty to disclose and code of conduct regimes, \( z \) is verifiable by insurers. Insurers can then condition the contracts offered on individuals’ information status. Under the consent law and information ban regimes, \( z \) is not observed by insurers and contracts cannot be conditioned on information status. Insurers must form beliefs, \( b(z) \), about whether individuals will become informed and these beliefs must be confirmed in equilibrium.

3. Policy Alternatives When There is Complete Genetic Discrimination

In this section we analyze the policy alternatives under the assumption that informed high risk individuals regard insurance as too expensive at their actuarially fair premium. Genetic discrimination is complete in the sense that all informed high risks consider such insurance too expensive.

3.1 Mandatory Testing. Under a mandatory testing regime, insurers are allowed to require a genetic test as a condition of insurance and to deny coverage to untested individuals. In this case, the insurer knows the individual’s information status and the risk type of tested individuals. Since \( p_H > \bar{p}(\tau_0) \), informed high risk will not buy insurance while informed low risks obtain their first best policy. Then the value of information is

\[
I^0 = \lambda U^0_H(c_H) + (1 - \lambda) U^0_L(c_L) - U^0_U(c_U)
\]

\(^{12}\) If insurers believe consumers will remain uninformed, they offer \( \tilde{c}_U \) to everyone. Then the value of information is

\[
\lambda U_H(\tilde{c}_H) + (1 - \lambda) U_L(\tilde{c}_L) - U_U(\tilde{c}_U) = 0.
\]

But, the tie-breaker rule implying that consumers become informed when the value of information is zero applies only when the value of information is nonnegative if insurers assume that individuals will become informed.
\[ I_0^0 = \lambda U_H^0(0) + (1 - \lambda) U_L^0(\hat{c}_L) - U_U^0(0) \]
\[ = (1 - \lambda)[U_L^0(\hat{c}_L) - U_U^0(0)] > 0. \]  

(3.1)

Those who test positive remain uninsured while those who test negative gain from access to insurance.

3.2 Duty to Disclose. Under the duty to disclose insurers may not require a test as a condition of insurance. However, individuals who are tested are required to disclose their test result to the insurer. Again, \( p_H > \bar{p}(\tau_0) \) implies informed high risk will not buy insurance while informed low risks the uninformed obtain their first best policies. Since informed and uninformed consumers can be distinguished, the insurer offers the full insurance, zero-profit contract \( \hat{c}_U \) to the uninformed. The value of information is

\[ I_1^0 = \lambda U_H^0(0) + (1 - \lambda) U_L^0(\hat{c}_L) - U_U^0(\hat{c}_U) \]
\[ = I_0^0 + \lambda [U_H^0(0) - U_U^0(\hat{c}_U)] \geq 0. \]  

(3.2)

\( U_H^0(0) < U_H^0(\hat{c}_U) \), so the sign of \( I_1^0 \) is ambiguous. If \( I_1^0 > 0 \), then the high risks receive the null contract and the low risks receive their first best contract. If \( I_1^0 < 0 \), then all consumers buy \( \hat{c}_U \).

The uninformed are better off under the duty to disclose than under mandatory testing, which reduces the value of information, \( I_1^0 < I_0^0 \).

3.3 Code of Conduct. The code of conduct requires individuals to reveal whether they have taken the genetic test but not the results of the test. Insurers can distinguish between the informed and the uninformed, but cannot distinguish the risk type of the informed. The uninformed obtain the contract \( \hat{c}_U \). If individuals become informed, then by Proposition 2, the equilibrium outcome is either the no trade outcome or MWS outcome. If \( \bar{U}_L^0(0) \) does not cross the FL^* locus, then the equilibrium is the no trade equilibrium and the value of information is
\[ I^0_2 = \lambda U^0_H(0) + (1 - \lambda) U^0_L(0) - U^0_U(\hat{\epsilon}_U) \]
\[ = U^0_U(0) - U^0_U(\hat{\epsilon}_U) < 0. \]  (3.3)

If \( U^0_U(0) \) crosses the FL* locus, then the equilibrium is the cross-subsidized WMS contracts, \((\hat{\epsilon}_H, \hat{\epsilon}_L)\) and the value of information is
\[ \hat{I}^0_2 = \lambda U^0_H(\hat{\epsilon}_H) + (1 - \lambda) U^0_L(\hat{\epsilon}_L) - U^0_U(\hat{\epsilon}_U) < 0 \]  (3.4)

The result in (3.4) can be shown as follows. Along the FL* locus, \( w_{LB} \) can be implicitly defined as a function of \( w_{LG} \). In addition, the full insurance high risk contract associated with each \( w_{LG}, w_{LB} \) pair on FL*, i.e., where SSIH is binding, can also be implicitly defined as a function \( w_H(w_{LG}, w_{LB}(w_{LG})) \) with \( \frac{\partial w_H}{\partial w_{LG}} = -\left(\frac{1 - \lambda}{\lambda}\right) \left[(1 - p_L) + p_L \left(\frac{\partial w_{LB}}{\partial w_{LG}}\right)\right] < 0 \) and \( \frac{\partial w_{LB}}{\partial w_{LG}} < 0 \). (see Dionne and Fombaron, 1996). For any given \( w_H, w_{LG}, w_{LB} \) combination, define
\[ E_U(w_H, w_{LG}, w_{LB}) = \lambda u(w_H) + (1 - \lambda)[(1 - p_L)u(w_{LG}) + p_L u(w_{LB})]. \]
Note that \( \lambda U^0_H(\hat{\epsilon}_H) + (1 - \lambda) U^0_L(\hat{\epsilon}_L) = E_U(\bar{w}_H, \bar{w}_{LG}, \bar{w}_{LB}) \) and \( U^0_U(\hat{\epsilon}_U) = E_U(w - p_l l, w - p_l l, w - p_l l) \). Since \( \bar{w}_{LG} > w - p_l l \), (3.4) follows from the fact that
\[ \frac{\partial E_U}{\partial w_{LG}} = \lambda u'(w_H) \frac{d w_H}{w_{LG}} + (1 - \lambda) \left[(1 - p_L) u'(w_{LG}) + p_L u'(w_{LB}) \left(\frac{d w_{LB}}{w_{LG}}\right)\right] \]
\[ = \lambda u'(w_H) \left\{-\left(\frac{1 - \lambda}{\lambda}\right) \left[(1 - p_L) + p_L \left(\frac{\partial w_{LB}}{\partial w_{LG}}\right)\right]\right\} \]
\[ +(1 - \lambda) \left[(1 - p_L) u'(w_{LG}) + p_L u'(w_{LB}) \left(\frac{d w_{LB}}{w_{LG}}\right)\right] \]
\[ = (1 - \lambda) p_L \left(\frac{d w_{LB}}{w_{LG}}\right) [u'(w_{LB}) - u'(w_H)] \]
\[ -(1 - \lambda)(1 - p_L)[u'(w_{LG}) - u'(w_H)] < 0 \]  (3.5)

Therefore, under Code of Conduct, individuals do not become informed and they receive the pooling contract \( \hat{\epsilon}_U \).
3.4 Consent Law. The consent law allows, but does not require, individuals to reveal whether they have been tested and the test results. Since insurers do not observe consumers’ information status, they must decide which contracts to offer based on their beliefs about what consumers will choose to do. If insurers believe that individuals will become informed, they will offer $\hat{c}_L$ to individuals who offer verification of a negative test result. Individuals who test negative have an incentive to reveal their results. Insurers infer that anyone who does not reveal their test result has tested positive and would only be willing to offer $\hat{c}_H$ to everyone else. Then the low risks receive $\hat{c}_L$, while both informed high risks and the uninformed choose the null contract and the value of information is

$$I_0^\theta = I_0^\theta = \lambda U_H^0(0) + (1 - \lambda)U_L^0(\hat{c}_L) - U_H^0(0) > 0. \quad (3.6)$$

Insurers’ belief that consumers will become informed in equilibrium is confirmed. When high risk individuals drop out of the market, the consent law leads to the same value of information and the same market outcome as mandatory testing.

3.5 Information Ban. Under an information ban, insurers are forbidden from using the fact that an individual has been tested or the test results in underwriting. Suppose insurers expect consumers to become informed. If $\overline{U}_L^0(0)$ does not cross the $FL^*$ locus, then the equilibrium is the no trade equilibrium, the uninformed do not have a contract offering a positive amount of coverage to choose and the value of information is

$$I_0^k = \lambda U_H^0(0) + (1 - \lambda)U_L^0(0) - U_H^0(0) = 0 \quad (3.7)$$

The tie-breaker rule implies individuals will choose to be tested.\(^\text{14}\)

\(^{13}\) If insurers believe consumers will not become informed, they offer $\hat{c}_U$ to everyone. Then the value of information is $\lambda U_H(\hat{c}_U) + (1 - \lambda)U_L(\hat{c}_U) - U_H(\hat{c}_U) = 0$. The tie-breaker rule implies that consumers become informed and insurers’ beliefs are not confirmed.

\(^{14}\) If insurers believe consumers will not become informed, they offer $\hat{c}_U$ to everyone, the value of information is zero, and, as under the consent law, their beliefs are not confirmed.
If $\overline{U_L^0}(0)$ does cross the FL* locus, the equilibrium is the cross-subsidized WMS contracts, ($\tilde{c}_H, \tilde{c}_L$). The uninformed would choose $\tilde{c}_L$ and the value of information is

$$I_4^0 = \lambda U_H^0(\tilde{c}_H) + (1 - \lambda)U_L^0(\tilde{c}_L) - U_L^0(\tilde{c}_L) = 0$$  \hspace{1cm} (3.8)$$

since $SS_H$ is binding. Again, the tie-breaker rule implies individuals choose to be tested.

Summarizing these results:

**Proposition 4:** If $\tau = \tau_0$ and $p_L < \overline{p}(\tau_0) < p_L$, the value of information is equal and positive for mandatory testing and the consent law, $I_0^0 = I_3^0 > 0$. The value of information may be positive or negative for the duty to disclose $I_1^0 \geq 0$, and is zero under an information ban, $I_4^0 = I_4^0 = 0$. The value of information is negative for the code of conduct, $I_2^0 < 0$ and $I_2^0 < 0$. The value of information can be ranked $I_0^0 = I_3^0 > I_1^0$ and $I_0^0 = I_3^0 > 0 = I_4^0 = I_4^0 > I_2^0, I_2^0$.

The value of information and the equilibrium outcomes under the various policy alternatives are summarized in Table 1.

<table>
<thead>
<tr>
<th>Policy</th>
<th>Value of Information</th>
<th>Equilibrium Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandatory Testing</td>
<td>$I_0^0 &gt; 0$</td>
<td>$(0, \tilde{c}_L)$</td>
</tr>
<tr>
<td>Duty to Disclose</td>
<td>$I_1^0 &gt; 0$</td>
<td>$(0, \tilde{c}_L)$</td>
</tr>
<tr>
<td></td>
<td>$I_1^0 &lt; 0$</td>
<td>$(\tilde{c}_U, \tilde{c}_U)$</td>
</tr>
<tr>
<td>Code of Conduct I</td>
<td>$I_2^0 &lt; 0$</td>
<td>$(\tilde{c}_U, \tilde{c}_U)$</td>
</tr>
<tr>
<td>Code of Conduct II</td>
<td>$I_2^0 &lt; 0$</td>
<td>$(\tilde{c}_U, \tilde{c}_U)$</td>
</tr>
<tr>
<td>Consent Law</td>
<td>$I_3^0 &gt; 0$</td>
<td>$(0, \tilde{c}_L)$</td>
</tr>
</tbody>
</table>
Information Ban I
Information Ban II

\[
\begin{array}{c|c|c}
\text{Information Ban I} & I_4^0 = 0 & (0,0) \\
\text{Information Ban II} & I_4^0 = 0 & (\bar{c}_H, \bar{c}_L) \\
\end{array}
\]

Code of Conduct I and Information Ban I refer to the case where \( U_L^0(0) \) does not cross the FL\(^*\) locus and Code of Conduct II and Information Ban II refer to the case where \( U_L^0(0) \) does cross the FL\(^*\) locus. The contract options that go into the calculation of the value of information for all other regimes do not depend on the relationship between \( U_L^0(0) \) and FL\(^*\). The mandatory testing and consent law regimes create an incentive for individuals to be tested. The duty to disclose may or may not create an incentive for individuals to undertake genetic testing while a code of conduct does not create an incentive to be tested. Whether or not \( U_L^0(0) \) crosses the FL\(^*\) locus does not affect sign of the value of information under any policy and does not affect the equilibrium outcome under any policy other than an information ban. The decision of the high risks to drop out of the market impacts the value of information. Consider the standard assumptions of \( p_H < \bar{p} \), so that both high risks and low risk buy insurance.\(^{15}\) Then we would have \( I_1 < 0 \). We would still have \( I_0, I_3 > 0 \), but would no longer have \( I_0 = I_3 \).

3.6. Welfare Analysis. We now examine the public policy implications of genetic discrimination. We compare the market outcomes under the policy alternatives to determine if they can be ranked. The rankings are ex ante, that is, from the perspective of an uniformed individual.

Consider the comparison of the mandatory testing regime with the duty to disclose. Under mandatory testing, the value of information is positive, \( I_1^0 > 0 \), the informed high risks obtain the null contract and informed low risks obtain their first best contract, \( \bar{c}_L \). Under the duty to disclose, the value of information may be positive or negative, \( I_1^0 \geq 0 \). If \( I_1^0 > 0 \), then the

\(^{15}\) See Crocker and Snow (1992) and Doherty and Thistle (1996).
market outcome is the same as under the mandatory testing regime and both policies yield the same welfare. If \( I_1^0 < 0 \), then individuals remain uninformed and obtain \( \hat{c}_U \). Comparing the outcomes under the two regimes, we have

\[
\lambda U_L^0(0) + (1 - \lambda) U_L^0(\hat{c}_L) - U_U^0(\hat{c}_U) = I_1^0 < 0.
\]  (3.9)

The duty to disclose is Pareto superior to the mandatory testing regime.

Carrying out the complete set of pairwise comparisons yields the following welfare ranking:

**Proposition 5:**

A. Assume \( U_L^0(0) \) does not cross the FL*, Then (i) The duty to disclose is never Pareto dominated. It is Pareto superior to the information ban regime and to mandatory testing and a consent law, and is non-comparable with or equivalent to the code of conduct regime. (ii) The information ban regime is Pareto inferior to all of the other policy regimes. (iii) The mandatory testing regime and consent law regime are equivalent. The mandatory testing regime is Pareto superior to the information ban, Pareto inferior to the duty to disclose and non-comparable with the code of conduct. (iv) The code of conduct regime is non-comparable with the mandatory testing, duty to disclose regimes and consent law regimes and Pareto superior to the information ban.

B. Assume \( U_L^0(0) \) crosses the FL*. Then the information ban is non-comparable with the mandatory testing and consent law regimes and may be non-comparable with duty to disclose depending on parameter conditions. All other welfare comparisons are the same as when \( U_L^0(0) \) does not cross the FL*.

The proof is given in Appendix A. A summary of the results is in Table A.4.

Many jurisdictions have no legislation regarding genetic testing, so that insurers could require a test as a condition of insurance. An important argument against the mandatory testing regime is its coercive nature. In contrast, the consent law does not appear to be coercive – individuals may choose whether or not to be tested, choose whether or not to reveal the test results and untested individuals are not denied coverage. But if individuals who test positive view insurance at too expensive, these two policy regimes yield identical outcomes. A consent law might be a more politically palatable way of achieving the same outcome as mandatory testing.
The information ban is the most widely explicitly adopted policy. The best case that can be made for the information ban is that it is Pareto non-comparable to the mandatory testing, duty to disclose and consent law regimes. This implies that there are conditions under which the information ban is preferred to these policies. This would need to be determined on a condition by condition basis.

The main conclusion that emerges from the welfare analysis is that it is not possible to make a broad policy recommendation. Perhaps the strongest case is for the duty to disclose, since it is not Pareto dominated by any other policy alternative. The duty to disclose is Pareto superior to the mandatory testing and consent law regimes but superior to the information ban regime only if $I^0_1 > 0$. However, it is Pareto non-comparable to the code of conduct. Then there are conditions under which, say, the information ban would be the preferred policy and conditions under which the duty to disclose would be the preferred policy. This would have to be determined on a condition by condition basis.

4. Policy Alternatives When There is Partial Genetic Discrimination

Individuals differ in their ability to tolerate disease or more broadly, in their willingness to pay for treatment. In this section, we extend the model to allow for this difference. We assume that there are two levels of pain tolerance, $\tau_0$ and $\tau_1$, where $\tau_1 < \bar{\tau} < \tau_0 < \bar{\tau}$. Individuals know their own pain tolerance, which is private information. $\theta$ is the proportion with type $\tau_0$ and $(1- \theta)$ is the proportion with type $\tau_1$. Within each pain tolerance group, the proportion of high risks is $\lambda$ and the proportion of low risks is $(1- \lambda)$. Individuals with pain tolerance $\tau_1$ (type 1 individuals) have a willingness to pay that is greater than the cost of treatment. Whether they are high risk or
low risk, type 1 individuals prefer insurance to no insurance at actuarially fair premiums. We retain the assumption $p_H > p(\tau_0) > p_L$, that is, informed high risk type 0 individuals choose not to buy insurance at actuarially fair prices. There are four types altogether – type 1 high risks (type H1), type 1 low risks (type L1), type 0 high risks (type H0) and type 0 low risks (type L0). Although individuals with pain tolerance $\tau_0$ (type 0 individuals) have been analyzed above, the existence of type 1 individuals may alter their market outcomes.

Since $\tau_1 < \tau < \tau_0 < \bar{\tau}$, we have $\Delta_0 < \mu \leq \Delta_1$ so the decision to buy insurance depends on pain tolerance. For an individual with pain tolerance $j = 0, 1$ and risk type $i = L, H$, expected utility at the contract $c = (w_G, w_B)$ is

$$U^j_i(c) = (1 - p_i)u(w_G) + p_i(w_B)$$  \hspace{1cm} (4.1)

if insurance is purchased and

$$U^j_i(0) = (1 - p_i)u(w) + p_i(w - \Delta_j)$$  \hspace{1cm} (4.2)

if insurance is not purchased. Given risk type, the indifference curves over insurance contracts are the same for type 1 and type 0 individuals, although expected utility differs if insurance is not purchased. Type 1 individuals always prefer actuarially fair insurance to no insurance.

Since type 0 and type 1 individuals make different decisions about whether or not to buy insurance, we need to determine the mix of risk types purchasing coverage under asymmetric information. Consider the case where all consumers know their risk type and pain tolerance, but insurers do not. All market participants know $\lambda$ and $\theta$. If $\bar{U}^0_L(0)$ crosses the FL* locus as in Figure 3, then the subgame perfect Nash equilibrium is the MWS outcome $(\bar{c}_H, \bar{c}_L)$ with all low risks obtaining $\bar{c}_L$ and all high risks obtaining $\bar{c}_H$ as in Netzer and Scheuer (2014). In that case, the proportion of high risks purchasing insurance is $\lambda$ and the proportion of low risks purchasing insurance is $(1 - \lambda)$ as is the case in traditional models.
When $U_L^O(0)$ does not cross the FL$^*$ locus, as in Figure 2, the L0s prefer to forgo insurance than to obtain a policy on the FL$^*$ locus of cross-subsidizing contracts. Therefore, the mix of risk types in the market will depend on whether or not the H0 types purchase insurance. To determine which cross-subsidizing contracts are feasible for low risks, it is necessary to consider the FL$^*$ locus which satisfies the resource constraint for the case where types L1 and H1 obtain insurance so that the percentage of high risks is $\lambda$, as well as the locus for the case where types L1, H1, and H0 obtain insurance and the percentage of high risks is $\lambda + (1-\lambda)(1-\theta)$. Let $p_3 = \left(\frac{\lambda}{\lambda+(1-\lambda)(1-\theta)}\right)P_H + \left(\frac{1-\lambda}{\lambda+(1-\lambda)(1-\theta)}\right)P_L$ be the pooling probability of a loss when the three risk types L1, H1, and H0 obtain insurance. The pooled price line for probability $p_3$ is included in Figure 4 along with the original pooled price line for probability $p_P$. In this figure, there is an additional locus of low risk contracts specifying for each high risk contract along the 45 degree line between $\hat{c}_H$ and K a contract that satisfies the high risk self selection constraint and the resource constraint with the percentage of high risks equal to $\lambda$. This second locus of contracts has an endpoint at L*, but is to the southwest of the rest of FL$^*$ because a larger subsidy is needed from the low risks given the higher percentage of high risks in the market. The portions of the FL$^*$ and KL$^*$ loci that are dashed represent the segments that are feasible given which high risks will be willing to participate. Below point M on the FL$^*$ locus, the H0 types prefer to forgo insurance, so the percentage of high risks is $\lambda$, but above M, the H0 types will enter the market and make low risk contracts along FL$^*$ unprofitable when paired with incentive compatible full insurance contracts for high risks. Therefore, the FL$^*$ locus is dotted along that portion, but the KL$^*$ locus above indifference curve $U_H^0(0)$ is feasible and is depicted with dashes.
The key to the nature of the equilibrium when $U_L^0(0)$ does not cross the FL* locus is the low risk indifference curve going through point M, i.e., $U_L^j(M)$. Note $U_L^j(M)$ is identical for $j = 0,1$. If $U_L^j(M)$ crosses KL* as in Figure 5 (this will be referred to as Case MX), then the equilibrium L1 equilibrium contract, $c_L$, is the point along KM where there is a tangency between KM and a low risk indifference curve as depicted in Figure 6. In this case, the H0 types join the H1 and L1 types in purchasing $c_H$ and the proportion of high risks is $\lambda \frac{\lambda}{\lambda + (1-\lambda)(1-\theta)}$. The L1’s must subsidize a percentage of high risks larger than $\lambda$ since the L0’s have dropped out of the market, obtaining the null contract, but the H0’s participate in the market. If $U_L^j(M)$ does not cross KM, then the equilibrium L1 contract is on segment ML* of the FL* locus and only the L1 and H1 types obtain insurance. Both the L0 and H0 types will obtain the null contract. If $U_L^j(M)$ is flatter or has the same slope as KL* at point M, then both L0 and H0 types will obtain null contracts in equilibrium. The L1 equilibrium contract will be M and the H1 contract will be the corresponding full insurance contract and denoted $c_H^M$ (this will be referred to as Case M1). The final case occurs if there is a point of tangency between a low risk indifference curve and a point along ML* to the southeast of M, then that point will be the L1 equilibrium contract and there will be a MWS equilibrium with only type 1’s with contracts $c_H$ and $c_L$ (this will be referred to as Case MWS1). If the highest level of utility available to L1 types is at point L*, then that will be the MWS equilibrium contract for L1 types and coupled with the full insurance, actuarially fair high risk contract for H1s, the MWS1 equilibrium contracts for type 1 consumers.

The Value of Information with Four Types when $U_L^0(0)$ crosses the FL* locus:
**Mandatory Testing.** Under a mandatory testing regime, the value of information for the type 0s, \( I^0_0 > 0 \), is given by (3.1). The value of information for the type 1s is
\[
I^1_1 = \lambda U^1_H(\hat{c}_H) + (1 - \lambda) U^1_L(\hat{c}_L) - U^1_U(0) > 0. \tag{4.2}
\]
The high and low risk type 0s choose the contracts \((0, \hat{c}_L)\), while the high and low risk type 1s choose the contracts \((\hat{c}_H, \hat{c}_L)\).

**Duty to Disclose.** Under the duty to disclose the value of information for the type 0s, \( I^0_1 \geq 0 \), is given by (3.2). The value of information for the type 1s is
\[
I^1_1 = \lambda U^1_H(\hat{c}_H) + (1 - \lambda) U^1_L(\hat{c}_L) - U^1_U(\hat{c}_U) < 0. \tag{4.3}
\]
The type 0s choose the contracts \((0, \hat{c}_L)\) if \( I^0_1 > 0 \) and choose the contract \( \hat{c}_U \) if \( I^0_1 < 0 \). Since their value of information is negative, the types 1s choose the contract \( \hat{c}_U \).

**Code of Conduct.** Under the code of conduct the value of information for both type 0s and type 1’s, \( I^0_2 < 0 \) and \( I^1_2 < 0 \), is given by (3.4). Since their value of information is negative, the both types choose the contract \( \hat{c}_U \) and remain uninformed.

**Consent Law.** Under the consent law, the value of information for the type 0s, \( I^0_3 > 0 \), is given by (3.6). The value of information for the type 1s is given by
\[
I^1_3 = \lambda U^1_H(\hat{c}_H) + (1 - \lambda) U^1_L(\hat{c}_L) - U^1_U(\hat{c}_H) > 0. \tag{4.5}
\]
The type 0s choose the contracts \((0, \hat{c}_L)\) and the type 1s choose the contracts \((\hat{c}_H, \hat{c}_L)\). The consent law yields the same outcome as mandatory testing.

**Information Ban.** Under the information ban, the value of information for type 0s and type 1s, \( I^0_4 = 0 \) and \( I^1_4 = 0 \), is given by (3.8). The tie-breaker rule implies that both types of individuals will choose to be tested and will obtain \((\hat{c}_H, \hat{c}_L)\).
The Value of Information with Four Types when $U^0_L(0)$ does not crosses the FL* locus:

Equilibrium results and the value of information for mandatory testing, duty to disclose, and the consent law are the same when $U^0_L(0)$ does not crosses the FL* locus as when it does for both the type 0 and type 1 individuals. The code of conduct and information ban must be considered under three conditions when $U^0_L(0)$ doesn’t crosses the FL* locus (i) Case MX ($U^1_L(M)$ crosses KL*), (ii) Case M1 ($U^1_L(M)$ does not cross KL* and the point of tangency between $U^1_L(M)$ and FL* occurs at or to the northwest of M), (iii) Case MWS1 (the MWS equilibrium if the market had only type 1 individuals occurs to the southeast of M along the FL* locus).

Code of Conduct. Case MX. Suppose insurers expect both type 0s and type 1s to become informed. If they do become informed, the outcome is that depicted in Figure 6, where L0s obtain the null contract, L1s obtain contract $c^L$ and both H0s and H1s obtain $c^H$. The value of information for type 0s is

$$I^0_2 = \lambda U^0_H(\bar{c}^H) + (1 - \lambda)U^0_L(0) - U^0_U(\hat{c}_U)$$

$$< \lambda U^0_H(0) + (1 - \lambda)U^0_L(0) - U^0_U(\hat{c}_U)$$

$$= U^0_L(0) - U^0_U(\hat{c}_U) < 0$$  \hspace{1cm} (4.6)$$

and insurer’s beliefs are not confirmed. Suppose insurers expect type 0s to remain uninformd and type 1s to become informed. Then type 0s obtain $\hat{c}_U$ but type 1s obtain the standard MWS contracts $\bar{c}_H$ and $\bar{c}_L$. The value of information for type 1s is given by (3.4) and is negative and insurers beliefs are not confirmed. Finally, suppose insurers expect type 0s to become informed but type 1s to remain uninformd. Then the type 0s the null contract and type 1s obtain $\hat{c}_U$. The value of information for type 0s is given by (3.3) and insurers beliefs are not confirmed. Therefore, in equilibrium both type 0s and type 1s remain uninformd and obtain contract $\hat{c}_U$. 
Cases M1 and MWS1. Suppose insurers expect type 0s to become informed. If they do become informed, types L0 and H0 obtain the null contract. The value of information for type 0s is given by (3.3) and insurers beliefs are not confirmed. Suppose insurers expect type 0s to remain uninformed and type 1s to become informed. Then type 1s obtain \( c_H \) and \( c_L \), the value of information for type 1s is given by (3.4) and insurers beliefs are not confirmed. Therefore, in equilibrium both type 0s and type 1s remain uniformed and obtain contract \( c_U \).

Information Ban. Case MX. Suppose insurers expect both type 0s and type 1s to become informed. If they become informed, the value of information for type 0s is
\[
I_0^2 = \lambda U_H^0(\bar{c}_H) + (1 - \lambda)U_L^0(0) - U_U^0(0) = 0. \tag{4.7}
\]
or
\[
I_0^2 = \lambda U_H^0(\bar{c}_H) + (1 - \lambda)U_L^0(0) - U_U^0(\bar{c}_L) = 0 \tag{4.8}\]
The value of information for type 1s is
\[
\lambda U_H^1(\bar{c}_H) + (1 - \lambda)U_L^1(\bar{c}_L) - U_U^1(\bar{c}_L) = 0. \tag{4.9}
\]
Therefore, both type 0s and type 1s become informed and the equilibrium contracts are \( \bar{c}_H \) for H0s and H1s, \( \bar{c}_L \) for L1s and the null contract for L0s.

Case M1. Suppose insurers assume both types will become informed. Then the value of information for type 0s is given by (3.7) and is zero. The value of information for type 1s is
\[
\lambda U_H^1(M) + (1 - \lambda)U_L^1(M) - U_U^1(M) = 0. \tag{4.10}
\]
Therefore, insurer’s beliefs are confirmed and the equilibrium contracts are the null contract for type 0s, and \((\bar{c}_H^M, M)\) for type 1s.
Case MWS1. If insurers expect both types to become informed then the value of information for type 0s is given by (3.7) and is zero, and the value of information for type 1s is given by (3.8) and is also zero. Therefore, insurers beliefs are confirmed and the equilibrium contracts are the null contract for type 0s, and \((\hat{c}_H, \hat{c}_L)\) for type 1s.

Collecting the results on the value of information for the types 1 yields

**Proposition 6.** (i) Assume \(\overline{U}_L^0(0)\) crosses the \(FL^*\) locus. For the type 0s, the value of information is given in Proposition 4. For the type 1s, the value of information is positive under mandatory testing and the consent law, \(I_0^1 > I_3^1 > 0\). The value of information is negative under the duty to disclose and code of conduct, \(I_2^1 < I_1^1 < 0\) and equal to zero for the information ban, \(I_4^1 = 0\). (ii) Assume \(\overline{U}_L^0(0)\) does not cross the \(FL^*\) locus. The value of information is the same as when \(\overline{U}_L^0(0)\) crosses the \(FL^*\) locus under mandatory testing, duty to disclose, and the consent law. The value of information is negative under the code of conduct, \(I_2^0 < 0, I_2^1 < 0\). Under Case MX of the information ban, the value of information is \(I_4^0 > 0\) and \(I_4^1 = 0\). Under Cases M1 and MWS1 of the information ban, the value of information is zero, \(I_4^0 = 0\) and \(I_4^1 = 0\).

The value of information and market outcomes are listed in Table 2. The contracts are listed in the order H0, L0, H1, L1.

<table>
<thead>
<tr>
<th>Policy</th>
<th>Value of Information</th>
<th>Equilibrium Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandatory Testing</td>
<td>(I_0^0 &gt; 0, I_3^0 &gt; 0)</td>
<td>((0, \hat{c}_L, \hat{c}_H, \hat{c}_L))</td>
</tr>
<tr>
<td>Duty to Disclose</td>
<td>(I_1^0 &gt; 0, I_3^1 &lt; 0)</td>
<td>((0, \hat{c}_L, \hat{c}_U, \hat{c}_U))</td>
</tr>
<tr>
<td></td>
<td>(I_1^0 &lt; 0, I_3^1 &lt; 0)</td>
<td>((\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U))</td>
</tr>
<tr>
<td>Code of Conduct I</td>
<td>(I_2^0 &lt; 0, I_3^2 &lt; 0)</td>
<td>((\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U))</td>
</tr>
<tr>
<td>Code of Conduct II</td>
<td>(I_2^0 &lt; 0, I_3^2 &lt; 0)</td>
<td>((\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U))</td>
</tr>
<tr>
<td>Consent Law</td>
<td>(I_3^0 &gt; 0, I_3^3 &gt; 0)</td>
<td>((0, \hat{c}_L, \hat{c}_H, \hat{c}_L))</td>
</tr>
<tr>
<td>Information Ban I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case MX</td>
<td>(I_4^0 &gt; 0, I_3^4 = 0)</td>
<td>((\bar{c}_H, 0, \bar{c}_H, \bar{c}_L))</td>
</tr>
<tr>
<td>Case M1</td>
<td>(I_4^0 = 0, I_4^4 = 0)</td>
<td>((0, 0, \bar{c}_H^M, M))</td>
</tr>
<tr>
<td>Case MWS1</td>
<td>(I_4^0 = 0, I_4^4 = 0)</td>
<td>((0, 0, \bar{c}_H, \bar{c}_L))</td>
</tr>
</tbody>
</table>
Welfare Analysis. We now analyze the welfare implications of the various public policy alternatives.

Consider the comparison of the mandatory testing and duty to disclose regimes. Under mandatory testing, the value of information is positive, $I_0^0 > 0$, $I_0^1 > 0$. The H0s obtain the null contract and the L0s obtain $\hat{c}_L$, while the types 1s obtain $\hat{c}_H$ and $\hat{c}_L$. Under the duty to disclose, the value of information is ambiguous for the type 0s, $I_1^0 \leq 0$, and negative for the type 1s, $I_1^1 < 0$. If $I_1^0 > 0$, the H0s obtain the null contract and the L0s obtain $\hat{c}_L$. The type 1s choose $\hat{c}_U$. If $I_1^0 < 0$, all of the consumers choose $\hat{c}_U$.

<table>
<thead>
<tr>
<th>Case</th>
<th>Mandatory Testing</th>
<th>Duty to Disclose</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$I_0^0 &gt; 0$, $I_0^1 &gt; 0$, $I_1^0 &gt; 0$, $I_1^1 &lt; 0$</td>
<td>$(0, \hat{c}_L, \hat{c}_H, \hat{c}_L)$</td>
<td>$(0, \hat{c}_L, \hat{c}_U, \hat{c}_U)$</td>
</tr>
<tr>
<td>B</td>
<td>$I_0^0 &gt; 0$, $I_0^1 &gt; 0$, $I_1^0 &lt; 0$, $I_1^1 &lt; 0$</td>
<td>$(0, \hat{c}_L, \hat{c}_H, \hat{c}_L)$</td>
<td>$(\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U)$</td>
</tr>
</tbody>
</table>

For Case A. the type 0 obtain the same outcome under both policies. For the type 1s, the welfare comparison is given by

$$\lambda U_H^1(\hat{c}_H) + (1 - \lambda) U_L^1(\hat{c}_L) - U_U^1(\hat{c}_U) = I_1^1 < 0. \quad (4.11)$$

which implies the duty to disclose is preferred. For case B, the welfare comparison for the type 0s is given by

$$\lambda U_H^0(0) + (1 - \lambda) U_L^0(\hat{c}_L) - U_U^0(\hat{c}_U) = I_1^0 < 0. \quad (4.12)$$
The welfare comparison for the type 1s is again given by (4.11). These results imply the duty to disclose is preferred. The duty to disclose regime is Pareto superior to the mandatory testing regime.

Carrying out the pairwise comparisons of the different policy alternatives yields the following result.

Proposition 7: (i) The duty to disclose is never Pareto dominated. It is Pareto superior to the mandatory testing and consent law regimes, and either Pareto superior or equivalent to the code of conduct and either Pareto superior to or non-comparable with information ban depending on parameter conditions (ii) The information ban regime is either Pareto inferior or non-comparable to all of the other policy regimes. (iii) The mandatory testing regime and consent law regime are equivalent. The mandatory testing regime is either Pareto superior or non-comparable to the information ban, Pareto inferior to the duty to disclose and non-comparable with the code of conduct. (iv) The code of conduct regime is non-comparable with the mandatory testing and consent law regimes, either Pareto inferior or equivalent to the duty to disclose, and Pareto superior or non-comparable to the information ban.

The proof is given in Appendix B.

5. Summary and Conclusions

The development and increasing availability of genetic tests has lead to concerns about genetic discrimination, that is, the differential treatment of asymptomatic individuals based on perceived differences from a “normal” genome. An important concern is that genetic discrimination may lead to insurance becoming unaffordable. The purpose of this paper is to analyze public policy toward insurers' use of genetic information when a positive genetic test may make insurance unaffordable.

We assume state-dependent utility. Individuals with low pain tolerance always buy insurance. Individuals with high pain tolerance may not buy insurance even at actuarially fair rates. These individuals may have a willingness to pay that is less than the cost of treatment, and
will not buy insurance if their probability of loss exceeds a critical cutoff value. Whether these individuals buy insurance or not has important implications for the characteristics of market equilibrium. We define genetic discrimination as the situation where an individual who tests positive for a genetic condition has a probability of loss that exceeds the critical value and does not buy actuarially fairly priced insurance. These individuals regard insurance as unaffordable. We analyze the case where there is complete genetic discrimination in the sense that all individuals who test positive decline insurance and partial genetic discrimination in the sense that some, but not all, individuals who test positive decline insurance.

We use Netzer and Scheuer’s (2014) three stage extensive game to analyze equilibria in the insurance market. They show that a unique subgame perfect Nash equilibrium always exists and is second best efficient, and the equilibrium outcome is at the Wilson-Miyazaki-Spence contracts. Under Netzer and Scheuer’s assumptions, all individuals buy insurance. We extend their model to allow for state-dependent utility and, more importantly, to take account of the possibility that some individuals may not buy insurance. The population incidence of many genetic conditions is small, and may be too small to support a Rothschild-Stiglitz equilibrium. The theoretical framework we use allows us to analyze markets with small proportions of high risk individuals.

We begin by analyzing insurance markets with asymmetric information when all individuals know their risk type. We show that, when there is complete genetic discrimination, there may be no trade in insurance markets with asymmetric information. Individuals who test positive face a risk that exceeds the critical value and drop out of the market. The need to separate the high and low risks restricts the coverage offered the low risks to a level they are unwilling to accept, and the result is that no one buys insurance. If there is active trade in
insurance, then the low risks must subsidize the high risks. When there is partial genetic
discrimination, there is a group of individuals with low pain tolerance who always buy insurance.
Individuals with high pain tolerance may or may not buy insurance. There is an equilibrium
where no high pain tolerance individuals buy insurance. There are also equilibria where the high
risk, high pain tolerance and both high risk and low risk, high pain tolerance individuals buy
insurance; at these equilibria the low risks subsidize the high risks.

We then turn to the analysis of public policy. We assume that individuals are initially not
informed about whether or not they have a genetic condition. Individuals take a genetic test if the
value of information is non-negative. Public policy determines the information the insurers can
use to underwrite policies, which in turn determines the value of information and the equilibrium
policies. We analyze the mandatory testing, duty to disclose, code of conduct, consent law and
information ban – each of these policies is in place in some jurisdiction. We show that, under
both complete and partial genetic discrimination, the mandatory testing and consent law regimes
are identical. Both policies have the same (positive) value of information and yield the same
equilibrium outcome. The consent law may be a more politically palatable way of implementing
mandatory testing. However, the mandatory testing/consent law is not the best public policy.

The information ban is the most widely adopted explicit policy on the use of genetic
information by insurers. The best case that can be made for an information ban is that, under
certain parameter conditions, it is Pareto non-comparable to each of the other policy regimes,
although it is also Pareto inferior to each under alternative parameter conditions. The duty to
disclose is never Pareto dominated. It is Pareto superior or equivalent to the mandatory testing
and consent law policies. Under complete genetic discrimination, the duty to disclose and code
of conduct are either equivalent or Pareto non-comparable, and under partial genetic
discrimination either the two policies are equivalent or the duty to disclose is Pareto superior. Neither policy requires individuals take a genetic test, but both require the fact that a test has been taken to be revealed. Under the duty to disclose, the test result can be used to underwrite the insurance policy, while under the code of conduct it cannot. The welfare comparisons between these policies imply that different policies may be appropriate for different genetic conditions.
References


FIGURE 1
Two Types Where No Treatment is Preferred In the Absence of Insurance, High (Low) Risks Prefer No (Full) Insurance at Their Actuarially Fair Premium
FIGURE 2
Two Type Asymmetric Information Equilibrium with No Trade
FIGURE 3
Two Type Equilibrium with MWS Cross-Subsidizing Outcome
Figure 4
Cross-Subsidizing Loci with Four Types
Figure 5

Four Types: $\overline{U}_L^0(0)$ Does Not Cross the FL* Locus and $\overline{U}_L^0(M)$ crosses KL*
Figure 6
Cross-Subsidizing Equilibrium with Four Types – H1, L1, H0 Buy Insurance

$w_B$

$P_P$

$P_L$

$P_H$

$P_3$

$U_H^0(0)$

$U_L^0(0)$

$U_L^1(\tilde{c}_L)$

$\tilde{c}_L$

$\tilde{c}_H$

$w - \Delta_0$

$w - l$

$w_G$

$w$

$E_0$

$E_1$

$L^*$

$M$

$K$

$F$

$\bar{c}_H$

$\bar{c}_L$
Appendix A: Proof of Proposition 5.

The comparison of the mandatory testing and duty to disclose regimes is carried out in the text.

**Mandatory Testing vs. Code of Conduct.** Under the mandatory testing policy the value of information is positive, \( I_0 > 0 \). The high risks choose the null contract and the low risks choose the first best contract, \( \hat{c}_L \). Under the code of conduct policy the value of information is negative so all consumers remain uninformed and choose \( \hat{c}_U \). Comparing ex ante welfare under the two policies, we have

\[
\lambda U_H^0(0) + (1 - \lambda) U_L^0(\hat{c}_L) - U_L^0(\hat{c}_U) = I_1^0 \geq 0.
\] (A.1)

The two policies are Pareto non-comparable.

**Mandatory Testing vs. Consent Law.** From the text, \( I_0 = I_3 > 0 \), so both policies lead to the same market outcome, \((0, \hat{c}_L)\) and are equivalent.

**Mandatory Testing vs. Information Ban.** The value of information is zero under the information ban. If \( \bar{U}_L^0(0) \) does not cross the FL* locus, the market outcome under the information ban is at the null contracts, \((0, 0)\). The mandatory testing regime yields the outcome \((0, \hat{c}_L)\). The mandatory testing policy is Pareto superior to the information ban. If \( \bar{U}_L^0(0) \) does cross the FL* locus, the market outcome under the information ban is the WMS equilibrium at \((\hat{c}_H, \hat{c}_L)\). The difference in ex ante welfare is

\[
\lambda [U_H^0(0) - U_H^0(\hat{c}_H)] + (1 - \lambda) [U_L^0(\hat{c}_L) - U_L^0(\hat{c}_L)] \leq 0,
\] (A.2)

and is indeterminate since the first term is negative and the second term is positive.
**Duty to Disclose vs. Code of Conduct.** The value of information and outcomes are summarized in Table A.1.

<table>
<thead>
<tr>
<th>Case</th>
<th>Duty to Disclose</th>
<th>Code of Conduct</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$I^0_1 &gt; 0, I^0_2 \geq 0$ or $I^0_2 &lt; 0$</td>
<td>$(0, \hat{c}_L)$</td>
<td>$(\hat{c}_U, \hat{c}_U)$</td>
</tr>
<tr>
<td>C</td>
<td>$I^0_1 &lt; 0, I^0_2 \geq 0$ or $I^0_2 &lt; 0$</td>
<td>$(\hat{c}_U, \hat{c}_U)$</td>
<td>$(\hat{c}_U, \hat{c}_U)$</td>
</tr>
</tbody>
</table>

In case A, the difference in welfare is given by (A.1), and the policies are Pareto non-comparable.

**Duty to Disclose vs. Consent Law.** The value of information and outcomes are summarized in Table B.2.

<table>
<thead>
<tr>
<th>Case</th>
<th>Duty to Disclose</th>
<th>Consent Law</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$I^0_1 &gt; 0, I^0_2 &gt; 0$</td>
<td>$(0, \hat{c}_L)$</td>
<td>$(0, \hat{c}_L)$</td>
</tr>
<tr>
<td>B</td>
<td>$I^0_1 &lt; 0, I^0_2 &gt; 0$</td>
<td>$(\hat{c}_U, \hat{c}_U)$</td>
<td>$(0, \hat{c}_L)$</td>
</tr>
</tbody>
</table>

In case B, the difference in welfare is given by equation (A.1) and since $I^0_1 < 0$, the duty to disclose is preferred.

**Duty to Disclose vs. Information Ban.** The value of information and outcomes are summarized in Table A.3.

<table>
<thead>
<tr>
<th>Case</th>
<th>Duty to Disclose</th>
<th>Information Ban I</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$I^0_1 &gt; 0, I^0_2 = 0$</td>
<td>$(0, \hat{c}_L)$</td>
<td>$(0,0)$</td>
</tr>
<tr>
<td>B</td>
<td>$I^0_1 &lt; 0, I^0_2 = 0$</td>
<td>$(\hat{c}_U, \hat{c}_U)$</td>
<td>$(0,0)$</td>
</tr>
</tbody>
</table>

In case B, the difference is welfare is given by

$$
\lambda U^0_H(0) + (1 - \lambda) U^0_L(0) - U^0_U(\hat{c}_U) = I^0_2 < 0,
$$  \hspace{1cm} (A.3)

And the duty to disclose is preferred.
Table A.3.2

<table>
<thead>
<tr>
<th>Case</th>
<th>Duty to Disclose</th>
<th>Information Ban II</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$I_1^0 &gt; 0, I_4^0 = 0$</td>
<td>$(0, \hat{e}_L)$</td>
<td>$(\hat{e}_H, \hat{e}_L)$</td>
</tr>
<tr>
<td>B</td>
<td>$I_1^0 &lt; 0, I_4^0 = 0$</td>
<td>$(\hat{e}_U, \hat{e}_U)$</td>
<td>$(\hat{e}_H, \hat{e}_L)$</td>
</tr>
</tbody>
</table>

In case A, the welfare comparison is given by equation (A.2). In case B the welfare comparison is

$$
\lambda U_H^0(\hat{e}_H) + (1 - \lambda) U_L^0(\hat{e}_L) - U_U^0(\hat{e}_U) = \bar{I}_2^0 < 0.
$$

(A.4)

**Code of Conduct vs. Consent Law.** The value of information under the code of conduct is negative, $I_2^0 < 0$, and all consumers choose $\hat{e}_U$. The value of information under the consent law is positive $I_3^0 > 0$. The high risks chose the null contract and the low risks chose the first best contract $\hat{e}_L$. The welfare comparison is given by equation (A.1) and is indeterminate.

**Code of Conduct vs. Information Ban.** The value of information under the code of conduct is negative, both $I_2^0 < 0$ and $I_4^0 < 0$, so all consumers choose $\hat{e}_U$. The value of information under the information ban is zero and consumers chose the null contract when $\bar{U}_L^0(0)$ does not cross the FL* locus. The welfare comparison is given by equation (A.3), and $I_2^0 < 0$ implies the code of conduct is preferred. When $\bar{U}_L^0(0)$ does cross the FL* locus, then under the information ban consumers obtain the MWS equilibrium contracts $(\hat{e}_H, \hat{e}_L)$. The welfare comparison is given by equation (A.4), and $\bar{I}_2^0 < 0$ implies the code of conduct is preferred.

**Consent Law vs. Information Ban.** The outcome under the consent law is $(0, \hat{e}_L)$. If, $\bar{U}_L^0(0)$ does not cross the FL* locus, the outcome under the information ban is $(0, 0)$. Then the consent law is preferred. Otherwise, there is a WMS equilibrium, and the outcome under the information ban is $(\hat{e}_H, \hat{e}_L)$. The welfare comparison is given by equation (A.2) and is indeterminate.
<table>
<thead>
<tr>
<th>Case</th>
<th>Mandatory Testing</th>
<th>Duty to Disclose</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_0 &gt; 0, I_4 &gt; 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>(0, $\hat{c}_L$)</td>
<td>Tie</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 &lt; 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>($\hat{c}_H$, $\hat{c}_L$)</td>
<td>Duty to Disclose</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>(0, $\hat{c}_L$)</td>
<td>Tie</td>
</tr>
<tr>
<td>$I_0 = 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>($\hat{c}_H$, $\hat{c}_L$)</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>(0, $\hat{c}_L$)</td>
<td>Mandatory Testing</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>($\hat{c}_H$, $\hat{c}_L$)</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 &gt; 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>(0, $\hat{c}_L$)</td>
<td>Tie</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 &lt; 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>($\hat{c}_H$, $\hat{c}_L$)</td>
<td>Duty to Disclose</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>(0, $\hat{c}_L$)</td>
<td>Tie</td>
</tr>
<tr>
<td>$I_0 = 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>($\hat{c}_H$, $\hat{c}_L$)</td>
<td>Duty to Disclose</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>(0, $\hat{c}_L$)</td>
<td>Duty to Disclose</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>($\hat{c}_H$, $\hat{c}_L$)</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>(0, $\hat{c}_L$)</td>
<td>Tie</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>($\hat{c}_H$, $\hat{c}_L$)</td>
<td>Duty to Disclose</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>(0, $\hat{c}_L$)</td>
<td>Tie</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>($\hat{c}_H$, $\hat{c}_L$)</td>
<td>Code of Conduct</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>(0, $\hat{c}_L$)</td>
<td>Tie</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>($\hat{c}_H$, $\hat{c}_L$)</td>
<td>Code of Conduct</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>(0, $\hat{c}_L$)</td>
<td>Tie</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>($\hat{c}_H$, $\hat{c}_L$)</td>
<td>Code of Conduct</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>(0, $\hat{c}_L$)</td>
<td>Tie</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>($\hat{c}_H$, $\hat{c}_L$)</td>
<td>Code of Conduct</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>(0, $\hat{c}_L$)</td>
<td>Tie</td>
</tr>
<tr>
<td>$I_0 &gt; 0, I_4 = 0$</td>
<td>(0, $\hat{c}_L$)</td>
<td>($\hat{c}_H$, $\hat{c}_L$)</td>
<td>Code of Conduct</td>
</tr>
</tbody>
</table>

Table A.4

Welfare Comparison of Policies When $\tau = \tau_0$
Appendix B: Proof of Proposition 7.

The comparison of the mandatory testing and duty to disclose regimes is carried out in the text.

**Mandatory Testing vs. Code of Conduct.** Under the mandatory testing policy the value of information is positive, \( I_0^0 > 0, I_0^1 > 0 \). The type 0s choose the contracts \((0, \hat{c}_L)\), and the type 1s choose the contracts \((\hat{c}_H, \hat{c}_L)\). The value of information under the code of conduct is negative \( I_2^0 < 0, I_2^1 < 0 \), so all consumers remain informed and choose the contract \(\hat{c}_U\). For the type 0s, the welfare comparison is given in equation (A.1) and is indeterminate. For the type 1’s the welfare comparison is given by

\[
\lambda U_H^1(\hat{c}_H) + (1 - \lambda) U_L^1(\hat{c}_L) - U_U^1(\hat{c}_U) = I_1^1 < 0. \quad (B.1)
\]

The duty to disclose is preferred by the type 1s. Since the welfare comparison for the types 0s is indeterminate, the two policies are Pareto non-comparable.

**Mandatory Testing vs. Consent Law.** Both policies lead to the same market outcome and are equivalent.

**Mandatory Testing vs. Information Ban I. Case MX.** The value of information for under the information ban with these parameter conditions is nonnegative and the outcome is \((\bar{c}_H, 0, \bar{c}_H, \bar{c}_L)\). In this case, under mandatory testing, the high risks obtain the null contract and the low risks obtain full insurance, while under the information ban, the low risks obtain the null contract while the high risks obtain full insurance. The welfare comparison for type 0s is given by

\[
\lambda U_H^0(0) + (1 - \lambda) U_L^0(\hat{c}_L) - [\lambda U_H^0(\bar{c}_H) + (1 - \lambda) U_L^0(0)]
\]

\[
= \lambda [U_H^0(0) - U_H^0(\bar{c}_H)] + (1 - \lambda) [U_L^0(\hat{c}_L) - U_L^0(0)] \geq 0 \quad (B.2)
\]
which is indeterminate. The welfare comparison for type 1s is given by
\[
\lambda U_H^1(\check{c}_H) + (1 - \lambda) U_L^1(\check{c}_L) - [\lambda U_H^1(\check{e}_H) + (1 - \lambda) U_L^1(\check{e}_L)] \\
= (1 - \lambda) [U_L^1(\check{c}_L) - U_L^1(\check{e}_L)] > 0.
\] (B.3)
The two policies are indeterminate for type 0s and mandatory testing is preferred by type 1s, so the two policies are Pareto non-comparable.

**Mandatory Testing vs. Information Ban I. Case M1.** Under the information ban I Case M1, the equilibrium outcome is \((0, 0, c_H^M, M)\). Type 0 individuals of both risk types obtain the null contract. The welfare comparison for type 0s is
\[
\lambda U_H^0(0) + (1 - \lambda) U_L^0(\check{c}_L) - [\lambda U_H^0(0) + (1 - \lambda) U_L^0(0)] > 0.
\] (B.4)
The welfare comparison for type 1s is
\[
\lambda U_H^1(\check{c}_H) + (1 - \lambda) U_L^1(\check{c}_L) - [\lambda U_H^1(\check{e}_H^M) + (1 - \lambda) U_L^1(M)] \\
= U_U^1(\check{c}_L) - U_U^1(M) > 0.
\] (B.5)
Therefore, under the parameter conditions of M1, mandatory testing Pareto superior to the information ban.

**Mandatory Testing vs. Information Ban I. Case MWS1.** The market outcome under the information ban with the parameter conditions of Case MWS1 the null contracts, \((0, 0)\) for the type 0s and the standard MWS contracts \((\check{c}_H, \check{c}_H^L)\) for the type 1s. The mandatory testing regime yields the outcome \((0, \check{c}_L)\) for the type 0s and \((\check{c}_H, \check{c}_L)\) for the type 1s. The welfare comparison for type 0s is given by (B.4). The type 0s prefer the mandatory testing regime. For the type 1s, the welfare comparison is given by
\[
\lambda U_H^1(\check{c}_H) + (1 - \lambda) U_L^1(\check{c}_L) - [\lambda U_H^1(\check{e}_H^M) + (1 - \lambda) U_L^1(\check{e}_L)] \\
= U_U^1(\check{c}_L) - U_U^1(M) > 0.
\] (B.6)
The mandatory testing regime is Pareto superior to the information ban under these parameter conditions.

*Mandatory Testing vs. Information Ban II.* The market outcome under the information ban with the parameter conditions of Case II is \((\tilde{c}_H, \tilde{c}_{H_L}, \tilde{c}_H, \tilde{c}_{H_L})\). The welfare comparison for the type 0s is

\[
\lambda U^0_H(0) + (1 - \lambda)U^0_L(\tilde{c}_L) - [\lambda U^0_H(\tilde{c}_H) + (1 - \lambda)U^0_L(\tilde{c}_L)] \\
= \lambda[U^0_H(0) - U^0_H(\tilde{c}_H)] + (1 - \lambda)[U^0_L(\tilde{c}_L) - U^0_L(\tilde{c}_L)] \geq 0. \tag{B.7}
\]

The welfare comparison for the type 1s is

\[
\lambda U^1_H(\tilde{c}_H) + (1 - \lambda)U^1_L(\tilde{c}_L) - [\lambda U^1_H(\tilde{c}_H) + (1 - \lambda)U^1_L(\tilde{c}_L)] \\
= U^1_H(\tilde{c}_L) - U^1_U(\tilde{c}_L) > 0. \tag{B.8}
\]

Therefore, although mandatory testing is preferred by type 1s, mandatory testing and the information ban under parameter conditions II are Pareto non-comparable.

**Duty to Disclose vs. Code of Conduct.** The value of information and outcomes are summarized in Table B.1. The contracts chosen are listed in the order H0, L0, H1, L1. The signs for the value of information under the consent law are the same when for Cases I and II, where \(U^0_L(0)\) does not cross, or does cross, the FL\(^*\) locus, respectively, i.e. \(I^j_k\) can be replaced with \(\tilde{I}^j_k\) in that B.1 and the same results will be obtained.\(^{16}\)

<table>
<thead>
<tr>
<th>Case</th>
<th>Duty to Disclose</th>
<th>Code of Conduct</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>(I^0_1 &gt; 0, I^1_1 &lt; 0, I^0_2 &lt; 0, I^1_2 &lt; 0)</td>
<td>((0, \tilde{c}_L, \tilde{c}_U, \tilde{c}_U))</td>
<td>((\tilde{c}_U, \tilde{c}_U, \tilde{c}_U, \tilde{c}_U))</td>
</tr>
<tr>
<td>B</td>
<td>(I^0_1 &lt; 0, I^1_1 &lt; 0, I^0_2 &lt; 0, I^1_2 &lt; 0)</td>
<td>((\tilde{c}_U, \tilde{c}_U, \tilde{c}_U, \tilde{c}_U))</td>
<td>((\tilde{c}_U, \tilde{c}_U, \tilde{c}_U, \tilde{c}_U))</td>
</tr>
</tbody>
</table>

\(^{16}\) Therefore, in what follows, we will not perform separate analyses for Case I and Case 2 for the Code of Conduct.
In Case A, the welfare comparison for the type 0s is given by equation (4.12), and $I_1^0 > 0$ implies the duty to disclose is preferred. The type 1s have the same outcome under both policies. In Case B, the two policies yield the same outcome. The duty to disclose is Pareto superior to the mandatory testing regime.

*Duty to Disclose vs. Consent Law.* The value of information and outcomes are summarized in Table B.2.

**Table B.2**

<table>
<thead>
<tr>
<th>Case</th>
<th>Duty to Disclose</th>
<th>Consent Law</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$I_1^0 &gt; 0, I_1^1 &lt; 0, I_3^0 &gt; 0, I_3^1 &gt; 0$</td>
<td>$(0, \hat{c}_L, \hat{c}_L, \hat{c}_U)$</td>
<td>$(0, \hat{c}_L, \hat{c}_H, \hat{c}_L)$</td>
</tr>
<tr>
<td>B</td>
<td>$I_1^0 &lt; 0, I_1^1 &lt; 0, I_3^0 &gt; 0, I_3^1 &gt; 0$</td>
<td>$(\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U)$</td>
<td>$(0, \hat{c}_L, \hat{c}_H, \hat{c}_L)$</td>
</tr>
</tbody>
</table>

In Case A, the type 0s are indifferent between the two policies. For the type 1s, the welfare comparison is given by equation (B.1), and $I_1^1 < 0$ implies the duty to disclose is preferred. In Case B, the welfare comparison for the type 0s is given by equation (4.12) and $I_1^0 < 0$ implies the duty to disclose is preferred. For the type 1s, the welfare comparison is again given by (B.1). The duty to disclose is Pareto superior to the consent law.

*Duty to Disclose vs. Information Ban.* Under the information ban, the value of information is always nonnegative. The value of information for the duty to disclose and all outcomes are summarized in Table B.3.
Table B.3

<table>
<thead>
<tr>
<th>Case</th>
<th>Duty to Disclose</th>
<th>Information Ban</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$I_0^0 &gt; 0, I_1^1 &lt; 0$, MX</td>
<td>$(0, \hat{c}_L, \hat{c}_U, \hat{c}_U)$</td>
<td>$(\bar{c}_H, 0, \bar{c}_H, \bar{c}_L)$</td>
</tr>
<tr>
<td>B</td>
<td>$I_0^0 &gt; 0, I_1^1 &lt; 0$, M1</td>
<td>$(0, \hat{c}_L, \hat{c}_U, \hat{c}_U)$</td>
<td>$(0, 0, c_M^M, M)$</td>
</tr>
<tr>
<td>C</td>
<td>$I_0^0 &gt; 0, I_1^1 &lt; 0$, MWS1</td>
<td>$(0, \hat{c}_L, \hat{c}_U, \hat{c}_U)$</td>
<td>$(0, 0, \hat{c}_H, \hat{c}_L)$</td>
</tr>
<tr>
<td>D</td>
<td>$I_0^0 &gt; 0, I_1^1 &lt; 0$, MII</td>
<td>$(0, \hat{c}_L, \hat{c}_U, \hat{c}_U)$</td>
<td>$(\bar{c}_H, \bar{c}_L, \bar{c}_H, \bar{c}_L)$</td>
</tr>
<tr>
<td>E</td>
<td>$I_0^0 &lt; 0, I_1^1 &lt; 0$, MX</td>
<td>$(\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U)$</td>
<td>$(\bar{c}_H, 0, \bar{c}_H, \bar{c}_L)$</td>
</tr>
<tr>
<td>F</td>
<td>$I_0^0 &lt; 0, I_1^1 &lt; 0$, M1</td>
<td>$(\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U)$</td>
<td>$(0, 0, c_M^M, M)$</td>
</tr>
<tr>
<td>G</td>
<td>$I_0^0 &lt; 0, I_1^1 &lt; 0$, MWS1</td>
<td>$(\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U)$</td>
<td>$(0, 0, \hat{c}_H, \hat{c}_L)$</td>
</tr>
<tr>
<td>H</td>
<td>$I_0^0 &lt; 0, I_1^1 &lt; 0$, MII</td>
<td>$(\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U)$</td>
<td>$(\bar{c}_H, \bar{c}_L, \bar{c}_H, \bar{c}_L)$</td>
</tr>
</tbody>
</table>

Case A. Under Case A, the welfare comparison for type 0s is given by (B.2) and is indeterminate. The welfare comparison for type 1s is given by

$$U^1_0(\hat{c}_U) - [\lambda U^1_H(\bar{c}_H) + (1 - \lambda) U^1_L(\bar{c}_L)]$$

$$= U^1_0(\hat{c}_U) - U^1_L(\bar{c}_L) \geq 0.$$  (B.9)

The comparisons are indeterminate for both types, so the two policies are Pareto non-comparable.

Case B. Under Case B, the welfare comparison for type 0s is given by (B.4) and the duty to disclose is preferred over the information ban. The welfare comparison for type 1s is given by

$$U^1_0(\hat{c}_U) - [\lambda U^1_H(\bar{c}_H) + (1 - \lambda) U^1_L(\bar{c}_L)]$$

$$= U^1_0(\hat{c}_U) - U^1_L(\bar{c}_L) \geq 0.$$  (B.10)

The duty to disclose is preferred by type 0s, but two policies are indeterminate for types 1s, so the two policies are Pareto non-comparable.

Case C. Under Case B, the welfare comparison for type 0s is given by (B.4) and the duty to disclose is preferred over the information ban. The welfare comparison for type 1s is given by

$$U^1_0(\hat{c}_U) - [\lambda U^1_H(\bar{c}_H) + (1 - \lambda) U^1_L(\bar{c}_L)] > 0$$  (B.11)

which is positive by (3.5). The duty to disclose is Pareto superior to the information ban.

Case D. Under Case D, the welfare comparison for type 0s is given by (B.7) and is
indeterminate. The welfare comparison for type 1s is given by (B.11) and is positive, so the two policies are Pareto non-comparable.

Case E. Under Case E, the welfare comparison for type 0s is given by

\[ U^0_U(\hat{c}_U) - [\lambda U^0_H(\hat{c}_H) + (1 - \lambda)U^0_L(0)] \geq 0 \]  (B.12)

which is indeterminate. The welfare comparison for type 1s is given by (B.9) and is indeterminate. The comparisons are indeterminate for both types, so the two policies are Pareto non-comparable.

Case F. Under Case F, the welfare comparison for type 0s is given by

\[ U^0_U(\hat{c}_U) - [\lambda U^0_H(0) + (1 - \lambda)U^0_L(0)] = U^0_U(\hat{c}_U) - U^0_U(0) > 0. \]  (B.13)

The welfare comparison for type 1s is given by (B.10) and are indeterminate. The duty to disclose is preferred by type 0s, but two policies are indeterminate for types 1s, so the two policies are Pareto non-comparable.

Case G. Under Case G, the welfare comparison for type 0s is given by (B.13) so the duty to disclose is preferred by type 0s. The welfare comparison for type 1s is given by (B.11) and is positive, so the duty to disclose is Pareto superior to the information ban.

Case H. Under Case H, the welfare comparison for type 0s is given by

\[ U^0_U(\hat{c}_U) - [\lambda U^0_H(\hat{c}_H) + (1 - \lambda)U^0_L(\hat{c}_L)] > 0 \]  (B.14)

which is positive by (3.5). The welfare comparison for type 1s is given by (B.11). Therefore, the duty to disclose is Pareto superior to the information ban.

**Code of Conduct vs. Consent Law.** Under the code of conduct, \( I^0_2 < 0 \), \( I^1_2 < 0 \) implies that all consumers chose \( \hat{c}_U \). The outcomes under the consent law are the same as under mandatory testing, and the two policies are Pareto non-comparable.
Code of Conduct vs. Information Ban. The outcomes under the code of conduct are the same as the outcomes under duty to disclose when $I_1^0 < 0, I_1^1 < 0$, and, therefore, are the same as under Cases E-H in Table B.3.

Consent Law vs. Information Ban. Under the consent law, $I_3^0 > 0, I_3^1 > 0$ implies the type 0s obtain (0, $\hat{c}_L$) and the type 1s obtain ($\hat{c}_H, \hat{c}_L$). This is the same outcome as under mandatory testing, so the relationships between the consent law and the information ban are the same as those between mandatory testing and the information ban.

Table B.4

<table>
<thead>
<tr>
<th>Case</th>
<th>Mandatory Testing</th>
<th>Duty to Disclose</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_0^j &gt; 0, I_1^j &gt; 0, I_1^j &lt; 0$</td>
<td>(0, $\hat{c}_L, \hat{c}_H, \hat{c}_L$)</td>
<td>(0, $\hat{c}_L, \hat{c}_U, \hat{c}_U$)</td>
<td>Duty to Disclose</td>
</tr>
<tr>
<td>$I_0^j &gt; 0, I_1^0 &lt; 0, I_1^1 &lt; 0$</td>
<td>(0, $\hat{c}_L, \hat{c}_H, \hat{c}_L$)</td>
<td>($\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U$)</td>
<td>Duty to Disclose</td>
</tr>
</tbody>
</table>

<table>
<thead>
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<th>Case</th>
<th>Mandatory Testing</th>
<th>Code of Conduct</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_0^j &gt; 0, I_2^j &lt; 0$</td>
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<td>($\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U$)</td>
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<table>
<thead>
<tr>
<th>Case</th>
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<th>Consent Law</th>
<th>Policy</th>
</tr>
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<tbody>
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<td>$I_0^j &gt; 0, I_3^j &lt; 0$</td>
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<td>(0, $\hat{c}_L, \hat{c}_H, \hat{c}_L$)</td>
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<table>
<thead>
<tr>
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<th>Mandatory Testing</th>
<th>Information Ban</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
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<td>$I_0^j &gt; 0, MX$</td>
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<td>($\hat{c}_H, 0, \hat{c}_H, \hat{c}_L$)</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>$I_0^j &gt; 0, M1$</td>
<td>((0, $\hat{c}_L, \hat{c}_H, \hat{c}_L$)</td>
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<td>Mandatory Testing</td>
</tr>
<tr>
<td>$I_0^j &gt; 0, MWS1$</td>
<td>(0, $\hat{c}_L, \hat{c}_H, \hat{c}_L$)</td>
<td>(0, 0, $\hat{c}_H, \hat{c}_L$)</td>
<td>Mandatory Testing</td>
</tr>
<tr>
<td>$I_0^j &gt; 0, II$</td>
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<th>Code of Conduct</th>
<th>Policy</th>
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<tbody>
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<td>($\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U$)</td>
<td>Duty to Disclose</td>
</tr>
<tr>
<td>$I_0^j &lt; 0, I_1^j &lt; 0, I_2^j &lt; 0$</td>
<td>($\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U$)</td>
<td>($\hat{c}_U, \hat{c}_U, \hat{c}_U, \hat{c}_U$)</td>
<td>Tie</td>
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<th>Case</th>
<th>Duty to Disclose</th>
<th>Consent Law</th>
<th>Policy</th>
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<tbody>
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<td>$I_0^j &lt; 0, I_1^j &lt; 0, I_3^j &gt; 0$</td>
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<td>Duty to Disclose</td>
</tr>
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<td>Duty to Disclose</td>
<td>Information Ban</td>
<td>Policy</td>
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<td>-------------------</td>
</tr>
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<td>$I_1^0 &gt; 0, I_1^1 &lt; 0, MX$</td>
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</tr>
<tr>
<td>$I_1^0 &gt; 0, I_1^1 &lt; 0, M1$</td>
<td>$(0, c_L, c_U, c_U)$</td>
<td>$(0, 0, c_H^M, M)$</td>
<td>Indeterminate</td>
</tr>
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<tr>
<td>$I_1^0 &lt; 0, I_1^1 &lt; 0, M1$</td>
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<td>$(0, 0, c_H^M, M)$</td>
<td>Indeterminate</td>
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<tr>
<td>$I_1^0 &lt; 0, I_1^1 &lt; 0, MWS1$</td>
<td>$(c_U, c_L, c_U, c_U)$</td>
<td>$(0, 0, c_H, c_L)$</td>
<td>Duty to Disclose</td>
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<td>Duty to Disclose</td>
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<tr>
<th>Case</th>
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<th>Consent Law</th>
<th>Policy</th>
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<table>
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<tr>
<th>Case</th>
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<th>Information Ban</th>
<th>Policy</th>
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<tbody>
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<td>$(c_H, 0, c_H, c_L)$</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>$I_2^0 &lt; 0, M1$</td>
<td>$(c_U, c_U, c_U, c_U)$</td>
<td>$(0, 0, c_H^M, M)$</td>
<td>Indeterminate</td>
</tr>
<tr>
<td>$I_2^0 &lt; 0, MWS1$</td>
<td>$(c_U, c_U, c_U, c_U)$</td>
<td>$(0, 0, c_H, c_L)$</td>
<td>Code of Conduct</td>
</tr>
<tr>
<td>$I_2^0 &lt; 0, II$</td>
<td>$(c_U, c_U, c_U, c_U)$</td>
<td>$(c_H, c_L, c_H, c_L)$</td>
<td>Code of Conduct</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Case</th>
<th>Consent Law</th>
<th>Information Ban</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_3^0 &gt; 0, MX$</td>
<td>$(0, c_L, c_U, c_U)$</td>
<td>$(c_H, 0, c_H, c_L)$</td>
<td>Indeterminate</td>
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