What You Don't See Can't Hurt You: An Economic Analysis of Morality Laws*

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Abstract

This paper provides an explanation for laws regulating sex, drugs and gambling based on efficiency. The argument is motivated by the observation that the design of these laws often promotes discretion by the people engaging in such activities. We propose that morality laws can be best explained by considering the proscribed activities to impose a negative externality on others *when the activity is observed*. In such a case, efficiency requires discretion on behalf of the individual who engages in such activities. Since discretion is often difficult to regulate, the activities are instead proscribed thereby giving individuals incentive to hide their actions from others. In addition, since some level of activity is efficient, the optimal sanctions are not maximal. Finally, the result that these activities are banned outright but with small penalties is shown to be generic.

Key Words: Crime; Externality; Laws; Morality; Enforcement
JEL: K42; K32; H32

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1 Introduction

Morality laws include prohibitions against exchanging sexual favors for money, gambling and the use of narcotics. The reason for such prohibitions have presented a puzzle for economists. As noted by Posner (1992), arguments for such laws often claim that such activities can have deleterious effects for not only the individual committing the act(s) in questions, but also others. Economists tend not to be concerned with the harmful effects of drug use, for example, on the user. The presence of an externality presents a better explanation for the introduction of legislation. Close examination of existing social regulation shows that such laws systematically differ from other forms of regulation, however.

First, these laws often promote discretion by the people engaging in the activity in question. For example, prostitution is legal in Canada, while solicitation is not. In other words, it is legal to exchange money for sexual favors in Canada, it is just not legal to discuss it in public[1]. The second observation is that the majority the activities covered by morality laws are completely banned. For other forms of externalities, like pollution, a positive legal level or quota is usually set. Finally, the typical penalty for the infraction of these laws seems unusually low[2].

This paper proposes that these stylized facts about morality laws can be best explained by considering the proscribed activities to impose a negative externality on others *when the activity is observed*. In such a case, efficiency requires discretion on behalf of the individual who engages in such activities. Since discretion is often difficult to regulate, the activities are instead proscribed, thereby giving individuals

[1]The Canadian Criminal Code states that "every person who in a public place or in any place open to public view (a) stops or attempts to stop any motor vehicle, (b) impedes the free flow of pedestrian or vehicular traffic or ingress to or egress from premises adjacent to that place, or (c) stops or attempts to stop any person or in any manner communicates or attempts to communicate with any person for the purpose of engaging in prostitution or of obtaining the sexual services of a prostitute is guilty of an offense punishable on summary conviction". It should further be noted that this can be (and is) applied to both prostitutes and johns.

[2]For example, in the city of Vancouver, the maximum penalty for excessive noise while cleaning your carpet with a vehicle mounted cleaner on a Sunday before noon is $2000 while the maximum sentence for a first offense of cocaine possession is six months in prison and $1000.

incentive to hide their actions from others (including the police). It should be noted that it is not always case that regulations about discretion cannot be implemented. As such, there exist many examples of legislation directed at the visibility of an activity. This is expanded upon in the next section.

Optimal policy in the presence of negative externalities has been well studied in economics. With respect to morality laws, Rasmusen (1997) notes that the law need not differentiate between real externalities and externalities that are purely psychic. For example, if person A is willing to pay person B to stop using drugs, and willing to pay more than B needs to be willing to stop, then efficiency requires that B stop using drugs. However, transaction costs might prevent the gains from trade from being exploited, and so regulation should be passed. The problem becomes more complex, however, if we consider an example in which A is willing to pay B to do drugs only out of A's sight. Suppose willing to pay \$100 for B to stop using drugs altogether and \$40 for B to stop using drugs in A's presence. If B needs at least \$120 to be compensated for not doing drugs, and \$30 to do drugs away from A, then efficiency requires that B do drugs only out of A's sight. Legislation that allows B to do drugs only in private can often be difficult to enforce, however. In such a case, legislators may wish to provide incentive for B to consume drugs discretely by making drug use illegal but with a low penalty. This may deter B from using drugs in public, where the probability of getting caught is relatively high, but not from doing them in private, which is efficient.

The reasons that an individual may prefer that activities such as drug use and prostitution be done out of sight are not explicitly considered in this model. In general, it seems plausible that the visibility of the activity may be unpleasant in and of itself (i.e. be a purely psychic externality), or it may lead to harm of a real nature. In particular, it seems quite probable that a large source of harm that stems from the visibility of drug and alcohol use stems from the impact on children. Exposing children to alcohol and drug abuse at a young age may have severe consequences for later life, and so be very important in determining legislation. The model developed in this paper is consistent with the idea that visibility of an activity causes real harm, but will typically refer to such an externality as psychic.

We construct a model in which an agent, called the injurer, chooses the level of consumption for a good which causes harm to another agent, called the victim. This harm may be either real (incurred independent of observation of the activity) or psychic (incurred only when the activity is observed) or both. In the absence of legislation, the injurer will choose to consume until the marginal benefit equals the private marginal cost, leading to consumption greater than the socially efficient level. The government is assumed to have three instruments with which it can affect the injurer's consumption. First, it can set a legal limit to consumption. Second, it can choose a penalty, or sanction, for consumption above the legal limit. Finally, it chooses a level of effort in enforcing the quota, which affects the probability that the injurer is caught when consuming a proscribed level. However, this probability can also be affected by the injurer. The injurer is assumed to be able to reduce the probability of detection through costly hiding.

Hiding on behalf of criminals has already been examined in the literature to some extent. Malik (1990) shows that when criminals can invest effort in hiding their crimes, maximal sanctions may be sub-optimal even when sanctions are costless. Higher sanctions increase the incentive to hide, which is welfare reducing. In our framework, some amount of hiding is welfare enhancing. Further, if hiding behavior cannot be legislated directly, an injurer will choose to hide her consumption only if it is illegal. That is, if an injurer does not consume above a quota (possibly zero), then they have no incentive to engage in hiding. As a result, the government will wish to set the quota below the socially efficient level but choose sanctions and enforcement such that the injurer will choose to consumer a proscribed level and engage in socially beneficial hiding. It should be noted that this implies that optimal fines are not maximal and that a certain level of crime is socially desirable.

The following section examines some stylized facts about morality laws. Section 3 outlines the model and the results. All proofs are in the appendix.

2 Stylized Facts about Morality Laws

As noted above, the body of regulation often called "morality laws" differs from other regulation concerning externalities. First, there exist many laws that do not proscribe an activity completely but instead regulate the visibility of the consumption. Alcohol is legal in all common law countries, but is subject to many restrictions. While these restrictions vary somewhat from country to country, they all entail keeping consumption of alcohol to specific areas and preventing public drunkenness. Canada has less regulation on sexual activity than the US, although the regulation that does exist is clearly designed to keep the activity discrete. As mentioned above, prostitution is legal in Canada while solicitation is not. In addition, brothels, or "bawdy houses" are also illegal. As such, anyone wishing to engage in prostitution must do so discretely. Anal intercourse is also subject to regulation in Canada. The Canadian Criminal Code allows for anal intercourse only in private, where "private" is defined as follows: "an act shall be deemed not to have been engaged in in private if it is engaged in in a public place or if more than two persons take part or are present".

Other forms of legislation that promote discretion include laws in North Carolina that prohibit any sexual position other than missionary and require that the shades to all windows be pulled while engaging in the sex act. In Wisconsin, condoms must be kept behind the pharmacist's counter; they may not be displayed. It should be noted that the activities being regulated may impart *real* negative externalities on others. However, the regulations described above, we argue, do little to reduce any real externalities. In some cases, these regulations would exacerbate them. For example, one could argue that the reason sex is so heavily regulated is because of real externalities pertaining to STDs. Wisconsin's law that requires condoms to be kept hidden from view would certainly not help in this regard. If anything, it would make purchasing condoms more embarrassing, thereby leading to *more* unprotected sex.

When regulation directly on hiding does not exist, we note that the activities in question are usually banned outright. This is in contrast to other forms of externalities where quotas are often set. Drugs (other than alcohol) are always banned; there is never a positive quota. It should be mentioned, however, that Canada is currently reconsidering its marijuana laws. The two options being considered are decriminalization (legal to possess up to some small quantity) or a reduction in the penalty. These are two of the three instruments described in our model.

Perhaps more importantly, the expected penalties associated with the banned activities do not appear to provide much deterrence. The Alcohol and Other Drugs Survey of 1994 found that 23% of Canadians had tried marijuana at least once[3] and that there were an estimated 14 million *current* users of marijuana in 2000[4]. In the United States, the National Task Force on Prostitution estimates that in the 1980s over 1 million people and 1% of American women have been employed as prostitutes[5]. An estimated 2.7 million Americans were chronic cocaine users in 2000, and an additional 3 million Americans were recreational users. In 1990, Americans consumed $69.9 billion (US), or 447 metric tons worth of cocaine[6]. In comparison, an estimated $23 billion (US) worth of merchandise is shoplifted on an annual basis[7]. Finally, during prohibition in the US, sanctions were relatively small. As pointed out by Levitt (2003) and MacCoun and Reuter (2001), the average punishment was 35 days and a $100 fine.

We feel that these stylized facts cannot be entirely explained using conventional analysis of externalities. In particular, an attempt to keep the above activities out of the public eye seems apparent.

3 The Model

3.1 The Environment

We consider the following simple economy with two agents and a government. The first agent, who we call the injurer, I, derives utility from the consumption of a single

[3]Taken from Canada's 2002 Report of Senate Special Committee on Illegal Drugs (p.91).

[4]ibid (p.101).

[5]Taken from Prostitutes' Education Network, http://www.bayswan.org/stats.html.

[6]Taken from the Office of National Drug Control Policy webpage, http://www.whitehousedrugpolicy.gov/publications/factsht/cocaine/index.html.

[7]Taken from http://www.shopliftersalternative.org/pages/problem.html.

good or activity.[8] Denote the injurer's consumption by θ, and let $B(\theta)$ be the benefit derived from consumption, where $B(\cdot)$ is continuous and differentiable and $B'(\cdot) > 0$. The injurer can also choose to hide her consumption. Let h denote the level of hiding, which has a per-unit cost of 1. The second agent we call the victim, V. The victim suffers some disutility from the injurer's consumption. This disutility is reduced by the injurer's hiding. Denote the harm incurred by the continuous and differentiable function $C(\theta, h)$, where $C_\theta(\cdot) > 0$ and $C_h(\cdot) \leq 0$. Note that the victim does not make any decisions in this simple model. It is assumed that transaction costs are high enough so that bargaining cannot take place.

3.2 Efficiency

In the absence of transaction costs, the injurer and victim would be able to bargain so that the injurer's consumption and hiding maximized the sum of the injurer's and the victim's utilities. That is, the efficient levels of consumption and hiding, denoted by θ^o and h^o, respectively, solve the following problem:

$$\max_{\theta,h} B(\theta) - C(\theta, h) - h$$

Suppose that a solution exists, i.e. that the socially optimal levels of consumption and hiding are finite. Denote these efficient levels by θ^o and h^o, respectively. If both θ^o and h^o are positive, then the social optimum is characterized by the system of equations

$$B'(\theta^o) = C_\theta(\theta^o, h^o) \tag{3.1}$$

$$-C_h(\theta^o, h^o) = 1 \tag{3.2}$$

The analysis of this paper will be restricted to this scenario. It should be noted that it is possible for the efficient level of hiding to be zero. For example, this occurs when hiding does not affect the harm incurred by victim. Such cases correspond to the traditional environment of externalities and regulation. In addition, if socially optimal level of consumption is zero, then the traditional analysis of crime applies.

[8] Here we use the example of a consumption externality, but using a production externality will lead to the same results.

3.3 The Government's Problem

The government is assumed to maximize the sum of agents' utilities derived from the injurer's consumption less enforcement costs. It should be noted that the set of instruments available to the government could vary depending on the particular good or activity being regulated. In particular, the government may or may not be able to regulate hiding behavior directly. If the government is able to regulate hiding, then the optimal policy would be to set a quota equal to θ^o and to require that the injurer choose h^o. This would be accompanied by minimal enforcement and penalties for deviating from θ^o and h^o sufficiently high to ensure that the injurer complies. As noted above, examples of such regulation can be readily found.

Regulation on hiding behavior may not always be possible, however. In this case, the government is limited to choosing a quota for the good and enforcement (monitoring and penalty). Denote by $\bar{\theta}$ the maximum legal consumption of θ. If the injurer decides to consume more than the legal level, she will be fined with some probability. The probability that illegal consumption is detected is given by $p(e, h)$, where e is the enforcement effort chosen by the government. The cost of enforcement effort is given by $\kappa(e)$ where $\kappa'(e) > 0$ and $\kappa''(e) \geq 0$. It is also assumed that $\kappa'(0) = 0$. The larger the effort by the government, the larger the probability of being detected ($p_e(\cdot) > 0$), but at a decreasing rate ($p_{ee}(\cdot) < 0$). The injurer's hiding behavior decreases the probability of being caught, $p_h(\cdot) < 0$. Since the probability of being caught cannot go below zero, it must be that for every e, there exists an $\bar{h}$ such that $p_{hh}(\cdot) > 0, \forall h > \bar{h}$. That is, hiding eventually has decreasing returns with respect to its effect on hiding. Finally, we assume that there exists a small chance that the injurer will get caught when consuming a proscribed amount, even if the government does not expend any enforcement effort. That is, we assume $p(0, h) > 0$, $\forall h$[9].

An injurer who gets caught consuming a proscribed level, i.e. $\theta > \bar{\theta}$, receives a sanction $S\left(\theta - \bar{\theta}\right)$. The sanction is an increasing function of the difference between the actual consumption and the legal level. We concentrate our efforts on the case

[9]This assumption is made purely to simplify the analysis. Without this assumption, attention would be restricted to suprema of the government's objective function as opposed to maxima.

where the sanction is linear and given by $S = s\left[\theta - \bar{\theta}\right]$. It is assumed that these sanctions can be collected without cost. As such, any sanction levied acts as a transfer between individuals and does not appear in the government's objective function. The government's maximization problem is given by

$$\max_{\bar{\theta},e,s} B\left(\theta\left(\bar{\theta},e,s\right)\right) - C\left(\theta\left(\bar{\theta},e,s\right), h\left(\bar{\theta},e,s\right)\right) - h\left(\bar{\theta},e,s\right) - \kappa(e)$$

As is indicated above, the injurer's behavior will depend on the government's choice of policy, $\left(\bar{\theta},e,s\right)$. In order to examine the government's optimal policy, it is necessary to examine how the injurer's decisions of θ and h depend on $\left(\bar{\theta},e,s\right)$. The following section examines the behavior of the injurer.

3.4 The Injurer's Behavior

Given a government's policy in place, $\left(\bar{\theta},e,s\right)$, the injurer can decide to commit crime (choose $\theta > \bar{\theta}$), or comply with the law. If the injurer does not consume above the quota, her utility is given by

$$U^I = B\left(\theta\right) - h$$

If the injurer chooses to consume more than the legal limit, then her (expected) utility is given by

$$U^I = B(\theta) - p(e,h)[\theta - \bar{\theta}]s - h$$

First, note that when the injurer complies with the legal limit, her utility is strictly increasing in θ and strictly decreasing in h. Thus one possible solution to the injurer's maximization problem is given by $\theta = \bar{\theta}$ and $h = 0$. We shall refer to this solution as compliance. Another possible solution is for the injurer to choose $\theta > \bar{\theta}$. In this case, the optimal choices for θ and h are characterized by the following first order conditions:

$$B'\left(\theta^*\right) = p\left(e,h^*\right)s \tag{3.3}$$

$$-p_h\left(e,h^*\right)s\left[\theta^* - \bar{\theta}\right] = 1 \tag{3.4}$$

Equation 3.3 states that when the injurer chooses her level of consumption, she equalizes the marginal benefit of consumption with its marginal cost, which is given by the probability of being detected times the marginal sanction. Simultaneously, the injurer chooses the level of hiding to equalize the marginal reduction in the expected sanction, with its marginal cost of one.[10] We assume that the solution to equations 3.3 and 3.4 is unique for every policy $\left(\bar{\theta}, e, s\right)$. Let θ^* and h^* denote this solution. For simplicity, it is assumed that in the case that the injurer is indifferent between committing crime and complying ($B\left(\theta^*\right) - p\left(e, h^*\right) s \left[\theta^* - \bar{\theta}\right] - h^* = B\left(\bar{\theta}\right)$), the injurer chooses to commit crime. As a result, these first order conditions characterize the optimal choice of θ and h when $B\left(\theta^*\right) - p\left(e, h^*\right) s \left[\theta^* - \bar{\theta}\right] - h^* \geq B\left(\bar{\theta}\right)$.

We now consider the response of the injurer to changes in the each of the government's three instruments. First, recall that when the injurer complies with the quota (chooses $\theta = \bar{\theta}$ and $h = 0$), then both θ and h are independent of the sanction and of the probability of detection. In other words, a change in either s or e leads to no change in θ and h (assuming the continuance of compliance). However, an increase in the legal level, $\bar{\theta}$, leads to a one-for-one increase in the actual consumption level (assuming the injurer continues to comply) and has no impact on hiding.

The comparative statics of the injurer's behavior conditional on committing crime is more complex. The most straightforward is the response to a change in $\bar{\theta}$. When the injurer chooses to consume above the legal level, an increase in $\bar{\theta}$ has no direct effect on consumption (equation 3.3), but decreases the marginal benefit of hiding (equation 3.4). This leads to a decrease in hiding effort h^*, which then has a second order effect on consumption. Since less hiding is going on, the marginal cost of consumption goes up, and so consumption decreases. The result is a decrease in both the level of hiding and the level of consumption. Thus criminal activity (consumption above the legal limit) and hiding are strategic complements.

As either the per-unit sanction or level of monitoring increases, the expected cost of illegal consumption increases, but so does the expected benefit of hiding. In other words, the first order effect is to increase hiding but to decrease consumption. Since

[10] The second order will be satisfied as long as $B''\left(\theta^*\right) < 0$, $-p_{hh}\left(\cdot\right) < 0$ and $-B''\left(\theta^*\right) p_{hh}(\cdot) \left[\theta^* - \bar{\theta}\right] s - p_h(\cdot)^2 s^2 > 0$, which we assume to be the case.

hiding and consumption are complements, there is an second order effect that works in the opposite direction. That is, the second order effect causes hiding to increase and consumption to decrease. The net effect of an increase in these instruments therefore depends on which effect dominates. The usual result in the crime literature is that an increase in either detection efforts or the sanction leads to a decrease in illegal activity. This need not be the case here. This result is consistent with the findings of Malik (1990). The following lemma characterizes the injurer's response to changes in the quota, monitoring effort and per-unit sanction, when the injurer chooses to consume above the quota.

Lemma 1: *When consuming above the quota, the injurer's behavior changes as the each of the quota, monitoring effort and sanction changes in the following manner:*

1. *Both consumption and hiding decrease as the quota increases.*

2. *Both consumption and hiding may be either increasing or decreasing in monitoring effort. If hiding decreases as monitoring increases, then so does consumption. A sufficient condition for both to be decreasing is* $p_{he} > 0$.

3. *Both consumption and hiding may be either increasing or decreasing in the per-unit sanction. If hiding decreases, then so does consumption. Consumption is decreasing if and only if* $p(e, h)$ *is log convex in* h.

As will be seen in the next section, these comparative statics can play an important role in determining the optimal policy.

3.5 Optimal Policy

Given the injurer's behavior described above, we can now examine the government's optimal policy. We begin by noting that the government has a greater number of instruments (three) than the injurer has choice variables (two). Only one of these instruments, monitoring effort, is costly. In general, the government is able to implement the first best in such situations. We find this to be the case here, under certain conditions. First, the government is assumed to have to pick nonnegative quotas and this constraint may be binding. In particular, it binds when the efficient level of consumption is low and hiding is effective at reducing the externality but not very effective at reducing the probability of getting caught. In such a case, the injurer does not have sufficient incentive to engage in the efficient level of hiding. The injurer's incentive to hide is increasing in the amount of *illegal* consumption she chooses (i.e. consumption over and above the legal limit). As such, it is possible that, in order for her to choose h^o, it would take an amount of illegal consumption, $\theta^* - \bar{\theta}$, greater than the efficient level, θ^o.

In addition, the injurer only engages in hiding when consuming above the legal level. As noted above, the injurer will choose to commit crime only when $B(\theta^*) - h^* - p(e, h^*)\, s\left[\theta^* - \bar{\theta}\right] \geq B\left(\bar{\theta}\right)$. Thus, in order to implement the first best, it must be that the expected benefit to choosing the efficient level of consumption and hiding (i.e. committing crime) is greater than the benefit to compliance. Suppose that hiding is very effective at reducing the probability at getting caught. Since hiding and illegal consumption are complements, the government will have to choose a quota close to the efficient level in order to make sure the injurer doesn't engage in too much hiding. If, however, the government chooses a quota close to the efficient level in order to get the efficient levels of hiding and consumption, then the marginal benefit to exceeding the quota will be small and the injurer may prefer to comply. These conditions are made explicit in the following result.

Result 1: *The first best is implementable if and only if*

$$B'(\theta^o)\epsilon_{ph}(0, h^o) \geq \frac{h^o}{\theta^o} \tag{3.5}$$

$$B(\theta^o) - B\left(\theta^o - \frac{h^o}{\epsilon_{ph}(0, h^o)B'(\theta^o)}\right) \geq h^o\left(1 + \frac{1}{\epsilon_{ph}(0, h^o)}\right) \tag{3.6}$$

where $\epsilon_{ph}(0, h^o) = -\frac{h^o p_h(0,h^o)}{p(0,h^o)}$*. A sufficient condition for 3.6 is that* $h^o \geq \frac{-p_h}{2p_{hh}}$.

A corollary to this theorem is that the optimal sanction is not maximal. Since the solution involves the injurer choosing $\theta^* > \bar{\theta}$, the sanction s has to be set to a finite value even though it is costless. This provides another example of the non-optimality of maximal sanctions to complement the results of Andreoni (1991), Kaplow (1990), Malik (1990), Polinsky and Shavell (1984) and Shavell (1991). Also of interest is the fact that efficiency requires crime to be committed even though it is costless to deter it. To our knowledge, this paper provides the first example of such a result.

Now suppose that the nonnegativity condition on the quota is not satisfied. In this case, the government will not be able to implement the first best and so must trade off social costs associated with inefficient consumption, social costs associated with inefficient hiding, and costs of enforcement. Suppose that the government is trading off these costs optimally. Since the sanction is costless, it must be that chosen so that the marginal social cost associated with inefficient consumption is exactly equal to the social marginal cost associated with inefficient hiding. That is, the sanction must be chosen so that

$$[B'(\theta) - C_\theta(\theta, h)] \frac{\partial \theta}{\partial s} = [C_h(\theta, h) + 1] \frac{\partial h}{\partial s} \tag{3.7}$$

Note that if $[C_h(\theta, h) + 1] < 0$, then social welfare *increases* as h increases. Now consider the possible effects that the sanction can have on consumption and hiding. First, suppose that consumption is decreasing in the sanction. In other words, the first order effect as described in the section on the injurer's behavior dominates. Further suppose that the marginal social benefit of consumption is negative so that the left hand side of equation 3.7 is positive. Then it must be that $\frac{\partial h}{\partial s}$ and $[C_h(\theta, h) + 1]$ have the same sign. Suppose that both are positive. In this case, social welfare is increasing as both consumption and hiding decrease. However, this cannot be an optimum because consumption and hiding are both decreasing in the quota, and so welfare could be increased by increasing the quota. Thus it must be that both are negative and social welfare is increasing as consumption decreases and hiding increases.

Now suppose that consumption decreases as the sanction increases and that the marginal social welfare from consumption is positive. In this case, the marginal social cost of inefficient consumption is decreased when the sanction is increased. Since the left hand side of 3.7 is negative, then it must be that one of $\frac{\partial h}{\partial s}$ and $[C_h(\theta, h) + 1]$ is negative while the other is positive. Suppose that $\frac{\partial h}{\partial s}$ is negative and $[C_h(\theta, h) + 1]$ is positive. In this case, the social costs of inefficient hiding are decreased by decreasing the sanction. This, however, cannot be an optimum. In order for $\frac{\partial h}{\partial s}$ to be negative, the second order effect of the sanction must dominate. Since consumption is decreasing in the quota purely through a second order effect, there exists an increase in both the quota and sanction that leads to a net decrease in hiding and a net increase in consumption, thereby leading to an increase in welfare. Thus it must be that $\frac{\partial h}{\partial s}$ is positive and $[C_h(\theta, h) + 1]$ is negative. Note that if consumption is decreasing in the sanction, then it must be that $[C_h(\theta, h) + 1] < 0$ and the marginal social benefit of hiding is positive.

Now consider the case where $\frac{\partial \theta}{\partial s} > 0$. From Lemma 1, it must be that $\frac{\partial h}{\partial s} > 0$. Thus $[C_h(\theta, h) + 1]$ and $[B'(\theta) - C_\theta(\theta, h)]$ must have the same sign. Suppose that they are both negative. This cannot be an optimum. Note that the impact on consumption of a change in both the sanction and the quota is driven by the second order effect. Thus if both the quota and the sanction change, then the effect on consumption will be driven entirely by the net effect on hiding. Consider an increase in both the quota and the sanction such that hiding increases, thereby increasing social welfare. This would also lead to a decrease in consumption, reducing welfare, but since the effects on consumption are second order, the net change in welfare would be positive. Thus it must be that $[C_h(\theta, h) + 1]$ and $[B'(\theta) - C_\theta(\theta, h)]$ are both positive. The following result formalizes the above intuitions.

Result 2: *Consider the scenario in which 3.5 is not satisfied, but the injurer chooses to commit crime. In this case, the optimal policy is to set the quota equal to zero, and choose the sanction to tradeoff the social costs associated inefficient consumption with the social costs associated with inefficient hiding. Specifically, the tradeoffs are as follows:*

1. *The marginal social benefit of hiding is positive if and only if consumption is decreasing in the per-unit sanction.*
2. *The marginal social benefit of consumption is positive if and only if hiding is increasing in the per-unit sanction.*

Further, the government will choose not to monitor if and only if $\frac{\partial^2}{\partial e \partial h} \ln(p(e, h)) > 0$.

4 Further Issues

This paper does not explicitly consider the case in which condition 3.6 is not met. In general, not much can be said about the government's optimal policy in this case. If the injurer would not choose to commit crime when the government attempts to implement the first best, then the government will have to choose either the best policy in which the injurer complies, or the best policy in which the injurer is indifferent between complying and choosing crime (and therefore chooses to commit crime). The former is characterized by zero enforcement, an arbitrarily large sanction and a quota such that

$$B'\left(\bar{\theta}\right) = C_{\theta}\left(\bar{\theta}, 0\right)$$

The latter is found by solving

$$\begin{gathered} \max_{\bar{\theta}, s, e} B\left(\theta^*\right) - C\left(\theta^*, h^*\right) - h^* - \kappa\left(e\right) \\ \text{subject to } B\left(\theta^*\right) - p\left(e, h^*\right) s\left[\theta^* - \bar{\theta}\right] - h^* = B\left(\bar{\theta}\right) \end{gathered}$$

which can be rewritten as

$$\max_{\bar{\theta}, s, e} B\left(\bar{\theta}\right) - C\left(\theta^*, h^*\right) + p\left(e, h^*\right) s\left[\theta^* - \bar{\theta}\right] - \kappa\left(e\right)$$

5 Appendix

Proof to Lemma 1:

When committing crime, the injurer's choices of consumption and hiding are characterized by equations 3.3 and 3.4. Using Cramer's Rule to solve for the effects of a change in the quota yields

$$\begin{aligned}\frac{\partial\theta^*}{\partial\bar{\theta}} &= \frac{-[p_h(\cdot)s]^2}{soc} < 0\\ \frac{\partial h^*}{\partial\bar{\theta}} &= \frac{-B''(\theta^*)\,p_h(\cdot)\,s}{soc} < 0\end{aligned}$$

where soc denotes the expression used in the second order condition $-B''(\theta^*)\,p_{hh}\left[\theta^*-\bar{\theta}\right]s-(p_h)^2 s^2>0$. Thus both hiding and consumption decrease as the quota increases.

The effects of a change in monitoring effort are given by

$$\begin{aligned}\frac{\partial\theta^*}{\partial e} &= \frac{[p_h(\cdot)p_{he}(\cdot)-p_e(\cdot)p_{hh}(\cdot)][\theta^*-\bar{\theta}]s^2}{soc}\\ \frac{\partial h^*}{\partial e} &= \frac{B''(\theta^*)p_{he}(\theta^*-\bar{\theta})s+p_e(\cdot)p_h(\cdot)s^2}{soc}\end{aligned}$$

Note that since $p_e, p_{hh}>0$ and $p_h<0$, if $p_{he}>0$, then both derivatives are negative. Now suppose that $p_{he}<0$ and $\frac{\partial h^*}{\partial e}<0$. This occurs if and only if $B''(\theta^*)\left[\theta^*-\bar{\theta}\right]>-\frac{p_e p_h s}{p_{he}}$. Since the second order condition above must also be satisfied, it must also be that $B''(\theta^*)\left[\theta^*-\bar{\theta}\right]<-\frac{(p_h)^2 s}{p_{hh}}$. Thus, if $p_{he}<0$ and $\frac{\partial h^*}{\partial e}<0$, it must be that $-\frac{(p_h)^2 s}{p_{hh}}>-\frac{p_e p_h s}{p_{he}}$. This can be rewritten as $p_h p_{he}-p_e p_{hh}<0$, which is necessary and sufficient for $\frac{\partial\theta^*}{\partial e}<0$.

Finally, consider the effects of a change in the per-unit sanction.

$$\begin{aligned}\frac{\partial\theta^*}{\partial s} &= \frac{[(p_h)^2-p_{hh}p\,(e,h^*)][\theta^*-\bar{\theta}]s}{soc}\\ \frac{\partial h^*}{\partial s} &= \frac{B''(\theta^*)p_h(\cdot)(\theta^*-\bar{\theta})+p(\cdot)p_h(\cdot)s}{soc}\end{aligned}$$

Suppose that $\frac{\partial h^*}{\partial s}<0$. This occurs if and only if $B''(\theta^*)\left[\theta^*-\bar{\theta}\right]>-ps$. As above, the second order condition implies $B''(\theta^*)\left[\theta^*-\bar{\theta}\right]<-\frac{(p_h)^2 s}{p_{hh}}$. Thus, if $\frac{\partial h^*}{\partial s}<0$, then $-\frac{(p_h)^2 s}{p_{hh}}>-ps$, which can be rewritten as $(p_h)^2-p_{hh}p<0$, which implies that $\frac{\partial\theta^*}{\partial s}<0$. Finally, note that $\frac{\partial\theta^*}{\partial s}<0$ if and only if $(p_h)^2-p_{hh}p\,(e,h^*)<0$. This occurs if and only if $\frac{\partial^2}{\partial h^2}\ln\left(p\,(e,h)\right)<0$. ■

Proof to Result 1:

If the government chooses the policy $\left(\bar{\theta}, e, s\right) = \left(\theta^o - \frac{h^o}{\epsilon_{ph}(0,h^o)B'(\theta^o)}, 0, \frac{B'(\theta^o)}{p(0,h^o)}\right)$ and the injurer chooses to commit crime, her optimal choice is $\theta = \theta^o$ and $h = h^o$. This can be seen as follows. Recall that the injurer chooses θ and h to solve equations 3.3 and 3.4. The injurer will choose $\theta = \theta^o$ and $h = h^o$ when $e = 0$ if $\bar{\theta}$ and s are such that

$$
\begin{aligned}
B'(\theta^o) &= p(0, h^o)\, s \\
-p_h(0, h^o)\, s\left[\theta^o - \bar{\theta}\right] &= 1
\end{aligned}
$$

The first equation yields $s = \frac{B'(\theta^o)}{p(0,h^o)}$. Substituting into the second equation and solving yields $\bar{\theta} = \theta^o - \frac{h^o}{\epsilon_{ph}(0,h^o)B'(\theta^o)}$. Note that in order to implement this policy, the optimal quota must be nonnegative. This occurs when $\theta^o - \frac{h^o}{\epsilon_{ph}(0,h^o)B'(\theta^o)} \geq 0$, which is condition 3.5.

Since the injurer is choosing the efficient levels of consumption and hiding and the government is not incurring any costs, this must be the optimal policy as long as the injurer chooses to commit crime. This occurs when $B\left(\bar{\theta}\right) < B(\theta^o) - h^o - p(0, h^o)\, s\left[\theta^o - \bar{\theta}\right]$. Substituting in the values for $\bar{\theta}$ and s and rearranging yields condition 3.6, $B(\theta^o) - B\left(\theta^o - \frac{h^o}{\epsilon_{ph}(0,h^o)B'(\theta^o)}\right) > h^o\left(1 + \frac{1}{\epsilon_{ph}(0,h^o)}\right)$.

The sufficiency of $h^o > \frac{-p_h}{2p_{hh}}$ can be seen as follows. First, take the Taylor expansion series of $B(\cdot)$ around θ^o and rearrange:

$$
\begin{aligned}
B(\theta^o - x) &= B(\theta^o) - B'(\theta^o)\, x + \frac{1}{2}B''(\theta^o)\, x^2 - R_3 \\
B(\theta^o) - B(\theta^o - x) &= B'(\theta^o)\, x - \frac{1}{2}B''(\theta^o)\, x^2 + R_3
\end{aligned}
$$

where $R_3 = \frac{1}{6}B'''(\theta^o - \xi)\, x^3, \xi \in [0, x]$. Letting $x = \frac{h^o}{\epsilon_{ph}B'(\theta^o)}$ and substituting into 3.6 yields

$$
\begin{aligned}
B'(\theta^o)\frac{h^o}{\epsilon_{ph}B'(\theta^o)} - \frac{1}{2}B''(\theta^o)\left(\frac{h^o}{\epsilon_{ph}B'(\theta^o)}\right)^2 + R_3 &> h^o\left(1 + \frac{1}{\epsilon_{ph}}\right) \\
B'(\theta^o) - \frac{1}{2}B''(\theta^o)\frac{h^o}{\epsilon_{ph}B'(\theta^o)} + \frac{R_3}{x} &> \left(\epsilon_{ph}B'(\theta^o)\right)\left(1 + \frac{1}{\epsilon_{ph}}\right) \\
-B''(\theta^o)\frac{h^o}{\epsilon_{ph}B'(\theta^o)} + \frac{2R_3}{x} &> 2B'(\theta^o)\,\epsilon_{ph} \\
-B''(\theta^o) &> 2\frac{\left(B'(\theta^o)\,\epsilon_{ph}\right)^2}{h^o} - \frac{2R_3}{x^2}
\end{aligned}
$$

Further note that if the injurer is choosing to commit crime, then the second order condition is satisfied

$$-B''(\theta^o)\,p_{hh}\left[\frac{h^o}{\epsilon_{ph}B'(\theta^o)}\right]\frac{B'(\theta^o)}{p(0,h^o)} > p_h^2\left(\frac{B'(\theta^o)}{p(0,h^o)}\right)^2$$

$$-B''(\theta^o) > \frac{p_h^2}{h^o}\frac{(B'(\theta^o))^2}{p(0,h^o)}\frac{\epsilon_{ph}}{p_{hh}}$$

A sufficient condition is therefore

$$\frac{p_h^2}{h^o}\frac{(B'(\theta^o))^2}{p(0,h^o)}\frac{\epsilon_{ph}}{p_{hh}} > 2\frac{(B'(\theta^o)\,\epsilon_{ph})^2}{h^o}$$

$$\frac{p_h}{p(0,h^o)}\frac{p_h}{p_{hh}} > 2\epsilon_{ph} = 2\left(-\frac{p_h\cdot h^o}{p(0,h^o)}\right)$$

$$h^o > \frac{-p_h}{2p_{hh}}$$

■

Proof to Result 2:

The necessary first order conditions for the government's problem are given by

$$[B'(\theta) - C_\theta(\theta,h)]\frac{\partial\theta}{\partial\bar{\theta}} - [C_h(\theta,h)+1]\frac{\partial h}{\partial\bar{\theta}} \leq 0 \tag{5.1}$$

$$[B'(\theta) - C_\theta(\theta,h)]\frac{\partial\theta}{\partial e} - [C_h(\theta,h)+1]\frac{\partial h}{\partial e} - \kappa'(e) \leq 0 \tag{5.2}$$

$$[B'(\theta) - C_\theta(\theta,h)]\frac{\partial\theta}{\partial s} - [C_h(\theta,h)+1]\frac{\partial h}{\partial s} = 0 \tag{5.3}$$

where the inequalities hold with equality if the optimal quota and monitoring effort, respectively, are positive.

First note that there exists a solution in which $e = 0$ and $\bar{\theta}$ and s are such that the injurer chooses to comply and $B'\left(\bar{\theta}\right) - C_\theta\left(\bar{\theta},0\right) = 0$. This, however, cannot be a maximum. To see this, consider a reduction in $\bar{\theta}$ and a reduction in s such that the injurer chooses the same level of consumption (the previous quota) and some $h > 0$. This is clearly an improvement since the same level of consumption occurs, but hiding is non-zero. This solution represents a saddlepoint.

Now consider the first order condition on the per-unit sanction, 5.3. Since it is not feasible to induce the injurer to choose θ and h such that $B'(\theta) - C_\theta(\theta,h) = 0$ and $C_h(\theta,h)+1 = 0$ the only remaining solution entails $[B'(\theta) - C_\theta(\theta,h)]\frac{\partial\theta}{\partial s} = [C_h(\theta,h)+1]\frac{\partial h}{\partial s}$, which can be rewritten as

$$B'(\theta) - C_\theta(\theta,h) = [C_h(\theta,h)+1]\frac{\partial h/\partial s}{\partial\theta/\partial s} \tag{5.4}$$

Now consider the first order condition on the quota, 5.1. Substituting in 5.4 yields

$$[C_h(\theta,h)+1]\left[\left(\frac{\partial h/\partial s}{\partial\theta/\partial s}\right)\frac{\partial\theta}{\partial\bar{\theta}}-\frac{\partial h}{\partial\bar{\theta}}\right] \;\leq\; 0 \tag{5.5}$$

Examining the second term in square brackets yields

$$\frac{B''(\theta^*)\cdot p_h\cdot(\theta^*-\bar{\theta})+p\cdot p_h\cdot s}{[(p_h)^2-p_{hh}\cdot p][\theta^*-\bar{\theta}]s}\left(\frac{-[p_h\cdot s]^2}{soc}\right)-\frac{-B''(\theta^*)\,p_h\cdot s}{soc}$$
$$\left(\frac{-p_h\cdot s}{soc}\right)\left[\frac{p\cdot(p_h)^2\cdot s^2+B''(\theta^*)\cdot p_{hh}\cdot p\cdot[\theta^*-\bar{\theta}]\cdot s}{[(p_h)^2-p_{hh}\cdot p][\theta^*-\bar{\theta}]s}\right]$$
$$\left(\frac{p\cdot p_h}{[(p_h)^2-p_{hh}\cdot p][\theta^*-\bar{\theta}]}\right)$$

The term in brackets is therefore positive if and only if $\frac{\partial\theta}{\partial s}<0$. Therefore 5.5 is satisfied if and only if $[C_h(\theta,h)+1]$ and $\frac{\partial\theta}{\partial s}<0$ have the same sign. Since the interpretation of $[C_h(\theta,h)+1]<0$ is that there is too little hiding relative to the efficient level, this proves that there is too little hiding in the social optimum if and only if $\frac{\partial\theta}{\partial s}<0$.

Recall from Lemma 1 that there are three possible scenarios for $\left(\frac{\partial\theta}{\partial s},\frac{\partial h}{\partial s}\right)$. First, they could both be negative. Second, they could both be positive. Third, it could be that $\frac{\partial\theta}{\partial s}<0$ and $\frac{\partial h}{\partial s}>0$. If they have the same sign, then 5.3 dictates that $[C_h(\theta,h)+1]$ and $[B'(\theta)-C_\theta(\theta,h)]$ have the same sign. If they have the opposite sign, then $[C_h(\theta,h)+1]$ and $[B'(\theta)-C_\theta(\theta,h)]$ have the opposite sign. Thus $[B'(\theta)-C_\theta(\theta,h)]>0$ if and only if $\frac{\partial h}{\partial s}>0$, and so there is too little consumption in the optimum if and only if hiding is increasing in the per-unit sanction.

Finally, let us consider the first order condition for monitoring effort. Substituting 5.4 into 5.2 gives

$$[C_h(\theta,h)+1]\left[\left(\frac{\partial h/\partial s}{\partial\theta/\partial s}\right)\frac{\partial\theta}{\partial e}-\frac{\partial h}{\partial e}\right] \;\leq\; \kappa'(e) \tag{5.6}$$

Examining the second term in square brackets and simplifying yields

$$\frac{(p_e\cdot p_h-p\cdot p_{he})}{(p_h)^2-p\cdot p_{hh}}$$

Thus we have

$$[C_h(\theta,h)+1]\left[\frac{(p_e\cdot p_h-p\cdot p_{he})}{(p_h)^2-p\cdot p_{hh}}\right]\leq\kappa'(e)$$

where the inequality holds with equality if the optimal choice of e is nonzero. From above, we have that $[C_h(\theta, h) + 1]$ and $\left[(p_h)^2 - p \cdot p_{hh}\right]$ must have the same sign, and so

$$[C_h(\theta, h) + 1] \left[\frac{(p_e \cdot p_h - p \cdot p_{he})}{(p_h)^2 - p \cdot p_{hh}} \right] \leq \kappa'(0)$$

if and only if $(p_e \cdot p_h - p \cdot p_{he}) < 0$, which holds if and only if $\frac{\partial^2}{\partial e \partial h} \ln(p(e, h)) > 0$. ■

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