The Right Carrot for an Unruly Jungle

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Statement of Originality

I hereby declare that this submission is my own work and to the best of my knowledge it contains no materials previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at University of Sydney or at any other educational institution, except where due acknowledgement is made in the thesis. Any contribution made to the research by others, with whom I have worked at University of Sydney or elsewhere, is explicitly acknowledged in the thesis. I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the projects design and conception or in style, presentation and linguistic expression is acknowledged.

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Abstract

This thesis examines the U.S. Department of Justice leniency program setup involving both corporate and individual leniency. Specifically, the interaction between corporate and individual leniency programs in concurrent operation, the design of optimal leniency program structure to elicit corporate leniency applications and the behaviour of economic agents subject to such programs comprise the primary directions of this thesis. In addressing corporate malfeasance under the option to apply for leniency, the intra-firm interplay of agents is modeled as a dynamic game of incomplete information. The principle findings are that if agents are *symmetric* in their access to leniency the concurrent operation of corporate and individual leniency programs is suboptimal as the presence of the individual leniency program detracts from corporate leniency applications due to a reallocation of incentives to report. On the other hand, under *asymmetric* access it is in fact optimal to utilise both leniency programs concurrently as there is no distortion in incentives to report but rather a threat effect in motion. Agent access to these leniency programs is imperative in determining the success of the combinatory policy structure.

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Chapter 1

Introduction

Mechanisms to combat illegal corporate activity have been a focal point in law enforcement in the last few decades. For the most part, authorities have sought to detect and put to end cartel activity which limits competition in the market. What then is an appropriate mechanism to accomplish this? What of course makes this question challenging is quite simply the nature of crime; it is difficult, albeit sometimes impossible to gather accurate information in these circumstances. This lack of data translates to regulators and politicians championing one policy arrangement over another based on perhaps ill conceived notions of effectiveness.

Alas, no one can claim to know the whole story when investigating illegalities, however it is imperative that causality with respect to policy administration be determined to the best of the regulators ability. Case in point, a popular medium through which corporate crime, specifically cartel activity, has been fought are leniency programs offered by the states authority on justice. The idea behind leniency programs stems from plea bargaining whereby persons who have been apprehended for a crime are offered the chance to exchange information for a lesser sentence. Following this, the advent of leniency programs initialised with corporate leniency programs that comprised amnesty in the case of after detection information exchange which was then followed by justice authorities shifting the focus instead to proliferating pre-detection spontaneous self-reports. The exact structure of leniency programs and the level of amnesty granted naturally play a significant role in generating these spontaneous self-reports which is the type of policy administration this thesis is concerned with.

Targeting spontaneous self-reports admits two-fold reasoning and of course restructuring of the leniency program itself. Having a leniency program that encourages persons/firms engaged in criminal activity to self-report reduces detection/inspection costs of the authority responsible in addition to perhaps preempting illegal activity in the first instance. So there clearly exists a strong incentive to determine the optimal policy setup to elicit spontaneous self-reports especially given the usual case of limited resources for the justice authority.

In recent times, policies governing competition and antitrust have received almost complete revisal. Spagnolo (2008) gives a succinct review of the recent evolution of leniency programs in the United States and European Union in addition to surveying the theoretical analyses conducted on said leniency programs. Essentially, the achievements of U.S. leniency policies manifest in an unprecedented number of cartels currently being detected and successfully prosecuted, which has prompted several other countries (including Australia) to adopt analogous programs. These policies include both *Corporate* and *Individual* leniency programs introduced in the mid 1990's by the U.S. Department of Justice (DoJ).

Following this, what served to instigate this research was in fact a bureaucratic assertion by the now Deputy Assistant Attorney General of the United States Department of Justice, Scott Hammond, in which it was stated (see Hammond (2004)):

> The real value and measure of the Individual Leniency Program is not in the number of individual applications we receive, but in the number of corporate applications it generates. It works because it acts as a watchdog to ensure that companies report the conduct themselves.

The central aim of this thesis therefore is to ascertain through a formal model the impact of having both corporate and individual leniency concurrently in operation thereby ultimately either lending weight to the above claim or refuting it. In conducting research into the validity of the assertion natural outcomes of interest are the optimal policy structure of leniency programs to induce corporate reports as well as the behaviour of economic agents subjected to these programs. When referred to, the optimality of leniency programs always concerns the success of the programs in eliciting corporate self-reports with the optimal being the leniency setup that maximises corporate self-reports in the class of leniency specifications considered. Furthermore, this thesis primarily considers spontaneous self-reports by agents rather than post-detection prosecution and exchange of information.

The finding in this thesis is that the assertion above holds true *conditional* on asymmetric agent access to the leniency programs within a firm. Specifically, the bureaucratic conjecture requires that individual leniency be offered to only a subset of a firm to generate a threat effect thereby inducing greater numbers of corporate reports. If access is symmetric however, the conjecture ceases to hold true but rather leads to a suboptimal outcome because an incentive effect rather than a threat effect is dominant as agents simply weigh up the benefits of each program and submit themselves under the more attractive one. In the symmetric case, the presence of individual leniency actually detracts from corporate report numbers. Pursuant to these results, it is found that if asymmetric access can not be implemented then the optimal policy is to offer corporate leniency in isolation, and if feasible, go as far as rewarding corporate self-reports. If on the other hand access is asymmetric, then it is optimal to offer both corporate and individual leniency concurrently if the objective is to elicit greater numbers of corporate reports.

A consequence of these results is the need for authorities to refrain from utilising trends and other characteristics in historical data on face value to advise policy construction but rather consider a formal model and more micro founded approach to developing policies, with leniency programs and justice authorities the subjects of this writing.

The remainder of this thesis is organised as follows. Chapter 2 presents an overview of the literature in the general subject area of leniency programs and subsequently stakes the position this thesis will take up in the research void.

Chapter 3 briefly lays out the leniency programs in question. Chapter 4 sets out the model under symmetric access, the equilibrium concept and the general solution to said model. Chapter 5 characterises the equilibria whilst Chapter 6 comprises comparative static analysis. Chapter 7 maps out the extension to asymmetric access. The implications and supplemental discussion comprise Chapter 8 whilst concluding remarks are contained in Chapter 9.

Chapter 2

Literature Review

Though closely related to the much renowned Prisoners Dilemma game in economics, research concerning leniency programs and their impact on criminal behaviour did not exist until relatively recently. Throughout this diminutive time period the literature concerning leniency policies has not had one direct approach to modeling, though several facets of these models incorporate similar structure brought about by necessity. For the most part models of oligopolistic competition imbedded within a dynamic framework have served as the basis for the literature concerning leniency programs with particular emphasis on cartel detection and deterrence. As the vast majority of literature studies corporate leniency in isolation, the following survey of literature is somewhat peripheral to this thesis.

Prior to the literature explicitly dealing with leniency programs, Kaplow and Shavell (1994) were the first to analyse the crux of leniency programs which is the self-reporting behaviour of culpable parties in law enforcement. Self-reporting is examined within a model of the control of harmful externalities through which the optimal scheme is characterised. Kaplow and Shavell (1994) found that schemes inclusive of self-reporting save enforcement resources because reporting avoids the need for detection and that risk borne by reporting parties is reduced as sanctions are certain rather than uncertain. Although an insightful analysis which supports the potential benefits of eliciting self-reports from culpable parties the study is a preliminary to the formal modeling of leniency programs.

The literature can be divided into those primarily concerned with ex-post deterrence, that of halting cartel activity after a cartel has formed, and those having as their focus ex-ante deterrence, which is to say deterring cartel formation in the first instance. The main concern of the literature early on was that of ex-post deterrence.

2.1 Ex-Post Deterrence

Following Kaplow and Shavell (1994) the first paper to explicitly address leniency programs using a dynamic model structure was Motta and Polo (1999, 2003), where previous to this the literature focused on the related issue of plea-bargaining and as mentioned self-reporting in lieu of leniency programs. In this paper, leniency programs apply to cartels using a dynamic construction in which firms interact repeatedly in an oligopoly and choose whether to collude or not given the risk of being detected and prosecuted by an Antitrust Authority.

The Antitrust Authority is endowed with an exogenous budget, which it then commits to a certain enforcement policy. At the beginning of the game the authority decides the policy parameters, which include leniency, the probability of investigation and probability of prosecution. Introducing a leniency program entails reduced fines for cartel members that provide information on said cartel.

Motta and Polo (1999, 2003) found leniency programs ineffective (even procollusive), stipulating that if the Antitrust Authority has sufficient resources available to prevent collusion, inspections and full fines should be utilised. However, when limited resources are considered, which of course is the practical case, leniency programs may in fact be warranted *if* they are equally applicable to information disclosure both before and after an investigation has begun in addition to granting the same lenient treatment to all reporting firms irrespective of who reports first. In essence, leniency programs are justified in the case of constrained resources as a second-best policy when they are applied in an immensely flexible manner. The conclusions of Motta and Polo (1999, 2003) are only applicable to cases of ex-post deterrence however as they disregard the ex-ante deterrence effects of leniency by focusing exclusively on post-detection reporting thereby limiting the usefulness of leniency programs and possibly generating the negative result.

Further highlighting the negative repercussions of leniency programs Spagnolo (2000b) also found that leniency programs may actually enforce collusive behaviour. Moderate leniency programs that either reduce or cancel sanctions for price fixing firms that self-report may enforce collusion in one-shot competitive games such as Bertrand oligopolies where in the absence of a leniency program collusion would otherwise be unsupportable. The essence of the argument revolves around the credible threat in the form of punishment strategies that leniency provides in order to prevent deviation from collusive agreements hence sustaining collusion.

Though leniency is commonly examined in the context of cartels and collusive behaviour, as somewhat a corollary to Spagnolo (2000b), Buccirossi and Spagnolo (2006) applied leniency in the realms of corruption and drug dealing amongst other forms of illegal activities and trade. Lending further weight to Spagnolo (2000b), it was found that improperly setup leniency programs may be highly counterproductive in that they may be utilised as a means to enforce one-shot illegal transactions in addition to sustaining long-term illegal trade relationships.

Hinloopen (2002) investigated cartel members incentives to report under the European construction of antitrust legislation. Casting doubt on the effectiveness of leniency programs, he argued that the lower bound on fines for leniency to work is unrealistically high in that it is very unlikely a cartel member prefers reporting as opposed to sustaining the cartel agreement. Similar to previous literature, the narrow focus of Hinloopen (2002) on ex-post reporting behaviour by failing to incorporate a prior stage governing cartel formation in the model drives the main result and discards the benefits of leniency programs on ex-ante deterrence.

Harrington (2008) focuses exclusively on corporate reports from cartels already under investigation, as in Motta and Polo (1999, 2003). Drawing similarities with both Motta and Polo (1999, 2003) and Spagnolo (2004) in focusing on post-detection reports and legal culpability for previous cartel activity respectively the model is embedded in a dynamic oligopolistic framework with a stochastic continuous probability of successful prosecution after detection. The reporting behaviour of firms was found to be contingent on the realised probability of successful prosecution whereby if this probability is high reports take place though when low detected firms fair best not reporting. In addition, Harrington (2008) showed the optimality of restricting leniency to the first reporting agent and that in most instances maximal leniency is optimal however given the focus on post-detection reports a limitation of the model is that inference can not be drawn on *spontaneous* self-reporting behaviour of parties subject to leniency programs.

Whilst the literature at the onset of examining leniency programs for the most part found them to be ineffective even to the extent of being pro-collusive, this outcome is highly contingent on whether ex-ante or ex-post deterrence is the subject in addition to focusing on either pre or post detection reporting. The literature discussed above having focused on ex-post deterrence overwhelmingly conclude corporate leniency as being ineffective though this narrow focus is precisely their limitation in determining the effectiveness of corporate leniency programs.

2.2 Ex-Ante Deterrence

The conclusions of Motta and Polo (1999, 2003) and Spagnolo (2000b) directly clashed with the views of several prominent academics and the U.S. Department of Justice regarding the effectiveness of leniency programs in combating cartels. Most notably Spagnolo (2000a) seemingly in an about-face and unsatisfied with key assumptions in Motta and Polo (1999, 2003) sought to focus on the positive direct effects of leniency programs neglected in Motta and Polo (1999, 2003); namely the ability of leniency programs to induce undetected wrongdoers to spontaneously self-report and to prevent initial cartel formation by undermining trust between wrongdoers. Essentially Spagnolo (2000a) investigated the merits of corporate leniency programs in inducing ex-ante deterrence.

Developing on the restricted focus to ex-post reporting behaviour, it follows that the one dimensional analysis on post-detection prosecution in Motta and Polo (1999, 2003) severely limited the potential of leniency programs beyond making prosecution easier. In light of this, Spagnolo (2000a) deals explicitly with deterrence and spontaneous self reports rather than on leniency in exchange for information at the prosecution stage by restricting focus to leniency programs reserved for firms that spontaneously report when their cartel has not been detected.

The key findings of Spagnolo (2000a) were that optimal leniency programs restrict full amnesty to the first party to report, programs which give rewards financed by fines to the first reporting firm could completely deter cartels and that programs that only reduce or cancel fines had limited deterrence effects.

Following revision, a critical and limiting assumption made in both Motta and Polo (1999, 2003) and Spagnolo (2000a) whereby if a cartel member unilaterally defects, they are immune from conviction for any previous cartel activities and subsequently can not report on former partners was dispensed with in Spagnolo (2004). Furthermore, the more recent paper extends consideration of rewards and incorporates strategic risk alongside several punishment strategies (Motta and Polo (1999, 2003) only consider grim trigger strategies) in order to maintain collusive agreements. In both contrast and support of his previous studies, Spagnolo (2004) stipulates that it is in fact always optimal to have a leniency program, even if it does not consist of rewards.

Ellis and Wilson (2002) analysed corporate leniency programs in the context of Bertrand competition with differentiated products. They found the effect of leniency policy two-sided, whereby it can effectively prevent anti-competitive behaviour by inducing cartel members to report in order to damage competitors and gain market advantage whilst also being utilised as a mechanism with which cartels are enforced. Developing along similar lines as Ellis and Wilson (2002), Hinloopen (2003) considered a dynamic model with time variable detection probability and found, as intuition would suggest, that leniency program effectiveness markedly improves as the reduction in fine payments for reporting becomes more generous and as the future period cartel detection probability increases. As noted by Spagnolo (2008) however is that both Ellis and Wilson (2002) and Hinloopen (2003) only consider two possible deviations from a cartel; undercutting the collusive arrangement or self-reporting the cartel. Moreover, in both models the optimal defection strategy is none of these two only considered but rather both undercutting *and* reporting the cartel, which casts doubt on the robustness of their results as it is unclear the ramifications if this were incorporated in their models.

In a contrasting study, Feess and Walzl (2004) provide an insightful comparison of European and American corporate leniency programs. Specifically, they contrast several differences in the implementation of leniency between the systems including the restriction (respectively non-restriction) of leniency to the first reporting party as well as there being no (resp. a) threshold evidence amount before being eligible for leniency in the U.S. (resp. European) setup. Optimal fines are found to be increasing in the quantity of evidence given by other parties with independence between evidentiary provisions of parties. Unlike the majority of literature examining leniency programs, Feess and Walzl (2004) utilised a static rather than dynamic framework thus there being uncertainty regarding the feasibility of extending the implications to a dynamic setup.

In a comprehensive analysis of leniency programs, Aubert, Kovacic and Rey (2006) investigated the deterrence effects of leniency programs by comparing reduced fines and positive rewards to individuals. Rewarding individuals, inclusive of employees within the firm, is argued to increase deterrence of collusion through creation of an agency problem between firms and employees. However, there exists the possibility of negative effects on firm structure and performance in that reward and leniency schemes may deter productive cooperation, lead to an inefficient reduction in employee turnover and alter incentives to innovate. These points nevertheless are shown to either be trivial to deal with or useful in promoting cartel deterrence and potentially increasing welfare. Additionally, the paper addresses the observed retainment of cartel evidence by managers and finds that reward programs increase the incentive to hold such evidence.

Chen and Harrington (2007) conducted a simulation study examining the deterrence effects of leniency programs. Utilising a dynamic Bertrand oligopoly model where the probability of detection and penalties are functions of firms prices, their numerical analysis found that maximally generous leniency programs do act to deter cartels ex-ante, perturb cartels that have formed in the first instance and dampen prices charged by said cartels. However, at moderate or partial levels of leniency, much like Spagnolo (2000b) and Buccirossi and Spagnolo (2006), they find the presence of leniency pro-collusive.

Clearly, the theoretical literature thus far has more or less been championed by a select few with most having focused on the actions of Antitrust Authorities with respect to optimal policy structure relating to corporate leniency and cartels. Moreover, there is a distinct divergence regarding the effectiveness of leniency programs, whether they are pro-collusive and under what conditions they are optimal in deterring collusive behaviour brought about mostly because of disparity in the primary focus of the authors in considering either ex-post or ex-ante deterrence as well as pre or post detection reports.

2.3 Empirical and Experimental Studies

In a pioneering move Hamaguchi and Kawagoe (2005) conducted an experimental study which controlled for cartel size and the number of firms that are granted amnesty under corporate leniency. The experiment results suggest that leniency programs become more effective the larger the cartel but that altering the number of parties in a cartel that are ultimately granted leniency (for example only the first party to report) has no significant impact on the effectiveness of a leniency program. It is important to note however that Hamaguchi and Kawagoe (2005) only consider ex-post reports as cartels are formed in an automatic collectively exhaustive manner prior to the onset of the experiment rather than endowing participants with the decision to collude.

Hinloopen and Soetevent (2008) carried out a thorough examination of cartels and leniency programs that lacked the drawback of Hamaguchi and Kawagoe (2005) in that subjects of the experiment chose whether or not to engage in collusion. Moreover, leniency was applied in a staggered manner whereby the first reporting party received full leniency, the second to report received partial (half) lenient treatment whilst the remaining parties received no amnesty. The experiment affirmed the deterrence power of leniency programs as fewer cartels were established in the first instance. In addition, the presence of the leniency program dampened the collusive price charged and decreased the survival rate of cartels that did form.

Finally, in an isolated empirical examination Brenner (2009) conducted an econometric study of the 1996 European Union Leniency Program and found that the program assisted with information acquisition from cartels regarding their criminal conduct though had limited ex-ante deterrence effects. In addition, the program sped up investigation and prosecution by approximately one and a half years, however with respect to the ability of the leniency program in destabilising the number and duration of detected cartels the analysis deemed the European Union Leniency Program inadequate.

The empirical and experimental studies further support the inference drawn from the theoretical analyses in that leniency program effectiveness is conditional on whether ex-post or ex-ante deterrence is modeled. As this thesis aims to analyse the behaviour of economic agents given both corporate *and* individual leniency programs are in operation, the above mentioned literature provide ample context for leniency programs but are somewhat peripheral with respect to the principle aims of this study. One paper however has concerned itself with analysing the combination of corporate and individual leniency programs.

2.4 Corporate vs. Individual Leniency

Having drawn inspiration from the same source as this thesis, Festerling (2005) explores interdependencies between corporate and individual leniency programs within a duopoly model. An innovative aspect incorporated in this paper is the partitioning of corporations into representing owners and operating managers with potential conflict stemming from the presence of both corporate and individual leniency.

Festerling (2005) makes the assumption that cartel activity is commenced only by operating managers with owners made aware of these illegal activities only if the Antitrust Authority opens an investigation or through internal sources by some exogenous detection probability. If however this corporate partition of owners and managers is abandoned then the underlying model roughly corresponds to that of Motta and Polo (1999, 2003).

Contrary to Motta and Polo (1999, 2003) however is the designation of leniency to the first and only the first agent to come forward coupled with the reporting agent receiving a complete fine reduction. The aim of the paper is to replicate the setup of the U.S. leniency program in order to theoretically examine these key features of the U.S. legal system.

Festerling (2005) found that while corporate and individual leniency programs are offered concurrently, individual leniency applications are never observed. However lending weight to bureaucratic contention, it is claimed that threats by managers to apply for individual leniency may in fact move the owners to self report under corporate leniency. On the other hand, the individual leniency program may increase owners tolerance for cartel activity because the option to apply for individual leniency by managers is pertinent only when owners move toward terminating the cartel activity in progress, thereby creating a credible threat against the owners who then permit managers to continue the cartel.

While Festerling (2005) moves away from the traditional viewing angle of leniency and incorporates a fruitful approach to modeling the internal dynamics of firms within cartels, this thesis seeks to move further in this direction by explicitly dealing with individual agent behaviour under both uncertainty and concurrently operating leniency programs. Furthermore, the partitioning of the firm in Festerling (2005) into owners and managers whilst innovative serves as a limitation in that the supposed threat that individual leniency generates is somewhat mechanically inserted by said partitioning. This thesis seeks to formally model the internal workings of the firm under as general a framework as possible, especially espousing generality with respect to firm structure and agent characteristics.

2.5 Synthesis

The literature thus far has focused for the most part on modeling leniency programs with specific interest in determining optimal leniency policy administration through analysing cartels. This thesis is primarily centered around the process preceding self reports *within* a firm and so inter-firm competition for leniency is not a relevant consideration but rather intra-firm competition. Essentially a formal model is developed in order to account for and analyse the behaviour of individual agents given two separate leniency programs are in concurrent operation yielding a somewhat more micro perspective. As stated earlier the focus on combinatory leniency programs requires an entirely different modeling approach to those before as corporate leniency was the sole interest previously.

Following Festerling (2005), it is assumed that leniency only applies to the first to come forward to the regulatory authority. However in contrast, leniency is not restricted to a particular concession, such as fine reduction, but rather some lesser penalty where the penalty is generalised such that it could be anything ranging from fines to prison sentences. Moreover, this thesis deals with ex-post deterrence as the aim is to analyse the reporting behaviour of agents given concurrently operating leniency programs (in effect to ascertain whether this threat effect of individual leniency exists or not) and so the process prior to undertaking illegal activity is taken as given. Hence, ex-ante deterrence is not of interest in this thesis but rather the reporting behaviour of agents after illegal activity commences.

Therefore, this thesis departs from the traditional viewpoint in the field of leniency by not specifically studying corporate leniency under cartels and by focusing on individuals within firms instead of firms set in oligopolistic competition. Furthermore, building upon Spagnolo (2000a) in his critique of Motta and Polo (1999, 2003), the emphasis in this research is on spontaneous self reports rather than post-detection prosecution and exchange of information.

Chapter 3

Institutional Requisites

In order to elicit a complete understanding of the model in this thesis, it is imperative that leniency programs and the program designs be discussed before presenting the model underpinning this research. As stated previously, the principal innovator with respect to leniency program design is the United States Department of Justice and so the program design is primarily drawn from the U.S. example. The U.S. DoJ has currently on offer both corporate and individual leniency programs (since 1994) with certain conditions having to be met before leniency is granted. In the realm of the U.S. DoJ, *leniency* translates to not charging the firm/individual criminally, if their application is successful, for the activity being reported. In the context of this thesis, and the majority of prior literature in the field, leniency is taken as a reduction in penalty for the successful applicant whether it be fines, imprisonment or some other penalty that is synonymous with the DoJ's perspective. The following briefly outlines the structure of the leniency programs in question.

3.1 Corporate Leniency Program

The U.S. Department of Justice stipulates that leniency will be granted to a corporation reporting illegal activity before an investigation has begun, if the following six conditions are met[1]:

1. At the time the corporation comes forward to report the illegal activity, the Division has not received information about the illegal activity being reported from any other source;
2. The corporation, upon its discovery of the illegal activity being reported, took prompt and effective action to terminate its part in the activity;
3. The corporation reports the wrongdoing with candor and completeness and provides full, continuing and complete cooperation to the Division throughout the investigation;
4. The confession of wrongdoing is truly a corporate act, as opposed to isolated confessions of individual executives or officials;
5. Where possible, the corporation makes restitution to injured parties; and
6. The corporation did not coerce another party to participate in the illegal activity and clearly was not the leader in, or originator of, the activity.

[1] DoJ Corporate Leniency: http://www.justice.gov/atr/public/guidelines/0091.htm

In the ensuing model it will be assumed that a firm who applies for corporate leniency automatically satisfies the above criteria. There do in fact exist alternative requirements for corporate leniency if a firm fails to meet all six conditions above however this prospect is irrelevant for the considerations that follow given the assumption of automatic compliance.

As per the DoJ, if a corporation qualifies for leniency, *all* personnel of the corporation who admit their involvement in the illegal activity as part of the corporate confession will receive leniency.

An interesting condition, though not considered in this thesis, is that if a corporation does not qualify for leniency, personnel who come forward with the corporation will be considered for immunity from criminal prosecution on the same basis as if they had approached the DoJ individually. For simplicity this factor is not integrated in the model to come, done away with by the assumption of automatic compliance.

3.2 Individual Leniency Program

The individual leniency program applies to all individuals who approach the DoJ on their own behalf, not as part of a corporate confession, to seek leniency for reporting illegal activity of which the department has not previously been made aware. Leniency will be granted to an individual reporting illegal activity before an investigation has begun, if the following three conditions are met[2]:

[2] DoJ Individual Leniency: http://www.justice.gov/atr/public/guidelines/0092.htm

1. At the time the individual comes forward to report the illegal activity, the Division has not received information about the illegal activity being reported from any other source;

2. The individual reports the wrongdoing with candor and completeness and provides full, continuing and complete cooperation to the Division throughout the investigation; and

3. The individual did not coerce another party to participate in the illegal activity and clearly was not the leader in, or originator of, the activity.

Once again these conditions are assumed to be automatically satisfied when an individual applies for leniency as a singleton in the model thereby discarding administrative quandaries that may possibly accompany a leniency application. Furthermore, observe that both the U.S. corporate and individual leniency programs restrict leniency to the first reporting party; a requisite carried through in the forthcoming model. Having outlined the content of the relevant leniency programs, attention can now turn to the model underpinning this thesis.

Chapter 4

The Model

4.1 Preliminaries

In order to study the behaviour of agents under both corporate and individual leniency consider the following. There is a firm, $\mathscr{F}$ that has committed an illegal act whereby each and every member of this firm is liable and knows it. There is no need to specify any particular form of wrongdoing though it is common to assume cartel activity. $\mathscr{F}$ is assumed a representative firm.

In addition, there exists an exogenous authority, $\mathscr{A}$ that imposes penalties on firms and/or individuals for misdemeanour. In order to induce firms or agents within these firms to come forward the authority has on offer both corporate ($\mathscr{L}^C$) and individual leniency ($\mathscr{L}^I$) policies. Note that when the term leniency is used it refers to both types.

It is assumed the combination of policies is administered by the authority in the following manner. If a firm comes forward as a group under $\mathscr{L}^C$, penalty of size X is levied against everyone in the firm. However, if leniency is applied for under $\mathscr{L}^I$ only the first agent within the firm to come forward receives penalty of size Y whilst the complement within the firm receive penalty of size Z.

Observation 1. The parameter X is maintained generally, which is to say that it can take any value on the real number line at this point, specifically, $X \in \mathbb{R}$. Y and Z however are restricted to be non-negative values, $Y,Z \in \mathbb{R}^+$ with the proviso that $X,Y \leq Z$ which is a reasonable assumption to make.

In what follows, though it may seem counter-intuitive at this point, when the parameter X takes a negative value this corresponds to players that self-report successfully under $\mathscr{L}^C$ receiving a reward from $\mathscr{A}$ with of course positive values denoting a penalty being imposed. It is best to think of this from the point of view of $\mathscr{A}$. The reader may take the parameters to denote fiscal quantities, which is a natural interpretation, however this is not strictly necessary for the following exposition.

In addition, let S be defined as the *status quo* payoff for a player each period the illegal activity continues undetected by $\mathscr{A}$, where in this model the only means by which the authority is made aware of illegalities is by either firm or player self-reports. Therefore, each player in $\mathscr{F}$ receives S each period the illegal activity goes undetected.

4.2 The Three Player/Two Period Case

The game is nested in a 2 period environment with $t = 0, 1$. Since there are only two periods in this game, for simplicity, discounting is ignored. The set of players $N = \{1, 2, 3\}$ are contained within the firm $\mathscr{F}$. From the onset all players know they are guilty of some crime which was carried out in the name of the firm. This results in a whole firm vote in the first period to determine whether or not the firm as a group should come forward to the authority under $\mathscr{L}^C$. The voting mechanism yields a binary outcome, namely come forward as a group or not.

The agents within the firm are modeled such that each has a certain private cost for bearing a penalty imposed by the regulatory authority.

Observation 2. A digression regarding the relationship between agent cost, rewards and penalties. The model deals with the cost of bearing a penalty because if an agent has a low cost for penalties they reap (from their point of view) less of the penalty relative to others with higher costs which works in their favour. Nevertheless, they also take less out of the reward in relative terms because their low cost would potentially allow them to sustain illegal activity in accordance with their strong tolerance for possible penalties. A diametric argument applies to those with high costs for bearing penalties. Therefore, scaling the penalty parameters by the agents 'cost' works both ways.

The private cost of agent i is represented by a type c_i whereby the possible set of types for agent i is given by $C_i = [\underline{c}, \overline{c}]$ for $i = 1, 2, 3$ with $\underline{c} \geq 0$. Let $C = C_1 \times C_2 \times C_3$ of which a realisation is denoted $c = (c_1, c_2, c_3)$. Each agent $i \in N$ knows her own cost and believes that the costs of others are distributed independently over $[\underline{c}, \overline{c}]$ according to a common cumulative distribution function F. Note that given the support of the cost types it must that $F(\underline{c}) = 0$ and $F(\overline{c}) = 1$. Furthermore F admits a continuous density function f.

Agent i is uncertain about the types of the other players, denoted by the vector $c_{-i} = (c_1, \ldots, c_{i-1}, c_{i+1}, \ldots, c_n)$. In accordance with Harsanyi (1967) the game is structured as follows. It is assumed at the beginning of the game that nature draws a cost type vector $c = (c_1, c_2, c_3)$ where c_i is drawn from C_i according to the prior distribution F. Nature then reveals c_i to agent i but not to any other player.

Each agent must take part in a whole firm vote in the first period where agents can vote either y or n and cast their votes anonymously in a simultaneous manner. Intuitively, these correspond to a vote in favour of coming forward as a firm and not coming forward as a firm respectively. Having described the voting procedure for each agent, the overall outcome from the first period vote is determined by majority ruling where the overall outcome of the first period vote is represented by $\mathbb{Y}$ or $\mathbb{N}$ if the majority vote y or n respectively.

Contingent on the outcome in the first period vote, the game may progress to a second period. The game ends after the first period if the majority vote y. The second period is reached if the majority vote n whereby no vote is held but rather agents can individually come forward to the regulatory authority under $\mathscr{L}^I$.

4.2.1 The Second Period

Each agent i has two possible actions in the second period, come forward individually ('fink') or do not come forward individually. These actions are denoted r and d respectively. Actions are made simultaneously in the second period with whoever coming forward individually *first* in the second period getting the penalty Y with the others in $\mathscr{F}$ receiving Z. The probability of being first is given by $1/k$ where k denotes the number agents who played r. In this model therefore, every agent $i \in N$ has two leniency options at hand, corporate and individual leniency.

Definition 1. As agents are identical in their access to the leniency programs in that they are able to report under either corporate and individual leniency, agent access to leniency is deemed *symmetric*. Of course when agents are not identical in their access to leniency this is termed *asymmetric* access.

In order to maintain notational simplicity, let 1 denote voting y at time $t = 0$ or playing r at $t = 1$. Similarly, let 0 denote voting n at $t = 0$ or playing d at $t = 1$. Thus 1 represents reporting and 0 represents not reporting irrespective of leniency program allowing each agent i's action set in each period $t = 0, 1$ to be defined as $A_i = \{0, 1\}$. From here on 1 and 0 are used interchangeably with y and n respectively in discussion, though it is generally such that y and n are used when discussing the first period vote explicitly.

Given this timeline there are five possible histories of the game for each agent, with the set given by $H = (\emptyset, h_1, h_2, h_3, h_4)$. Within this set, $\emptyset$ is the (null) history in the first period, $h_1 = (1,\mathbb{Y}), h_2 = (1,\mathbb{N}), h_3 = (0,\mathbb{Y})$ and $h_4 = (0,\mathbb{N})$ where $h_j(.,.)$ is interpreted as containing the individual agents first period voting action as well as the result from said vote, in that order.

The only two histories of relevance though are those of h_2 and h_4 since these are the only elements in H that result in the second period being reached. In light of this, let $h_y = h_2$ and $h_n = h_4$ from this point onwards with the subscript representing the individual agents vote in the history.

Each agent i's payoffs are best described in terms of the evolution of the game. If the majority vote y in the first period, then the game ends and each agent receives payoff $-Xc_i$. If however the majority vote n, the second period is reached and S accrues to each agent. Now agents decide whether to apply for individual leniency or not. If there is at least one reporting agent let i^* denote the agent to report first under $\mathscr{L}^I$. Agent i^*'s payoff is $S - Yc_i$ whilst $N \setminus i^*$ receive payoff $S - Zc_i$. If no agent chooses to report under $\mathscr{L}^I$ then the game finishes and each agent receives payoff $2S$.

To complete the description of the model, an agents strategy in the first period and subsequent period given the history of the game is a mapping from her type space to action space. A strategy in the game consists of a tuple $\sigma = (\sigma_0, \sigma_y, \sigma_n)$ such that $\sigma_j : [\underline{c}, \overline{c}] \mapsto \{0,1\}$ for $j = 0, y, n$. The strategy space for each player is hence defined as $\Omega = \{\sigma \mid \sigma = (\sigma_0, \sigma_y, \sigma_n)\}$.

Therefore, the foregoing exposition describes a Bayesian game which shall be denoted by $\mathscr{G}$.

4.3 Equilibrium Concept

The equilibrium concept is Bayes Nash. It requires a strategy profile and beliefs be specified. In order to solve $\mathscr{G}$, consider the equilibrium postulate $\sigma^* = (\sigma_0^*, \sigma_y^*, \sigma_n^*)$ such that

$$\sigma_0^*(c) = \begin{cases} 1 & \text{if } c \geq c_0 \\ 0 & \text{if } c < c_0 \end{cases} \tag{4.1}$$

$$\sigma_y^*(c) = \begin{cases} 1 & \text{if } c \geq c_y \\ 0 & \text{if } c < c_y \end{cases} \tag{4.2}$$

$$\sigma_n^*(c) = \begin{cases} 1 & \text{if } c \geq c_n \\ 0 & \text{if } c < c_n \end{cases} \tag{4.3}$$

Note that c_0 is defined as the cost type who is indifferent between playing 1 or 0 at time $t = 0$ with c_y and c_n representing the equivalent cost type expressing indifference at time $t = 1$ following histories h_y and h_n respectively.

Moreover, players must hold beliefs over c_{-i}. The beliefs that players hold over the cost types of other players in the first period is given by the prior distribution F. The second period beliefs are contingent on the history of the game. Specifically, let $\mu_y = \mu(c_{-i} \,|\, h_y)$ and $\mu_n = \mu(c_{-i} \,|\, h_n)$ denote these second period beliefs which are derived through Bayesian updating.

4.4 Solution

In order to proceed, several notational necessities must be defined and the game illustrated.

Definition 2. Let q_n denote the probability that a player will play 1 in the second period having played 0 in the first. Similarly, let q_y denote the probability that a player plays 1 in the second period having played 1 in the first. The probabilities, q_n and q_y provide the intertemporal probabilistic link between the first and second period.

To illustrate the game in question and thus gain a stronger intuition for the exposition, refer to Figure 4.1. The figure maps out the game, information sets and nodes within which will help in understanding the next few sections.

Let us take the position of the first player who's vote is the first element of the triple within each node. As is evident from the figure, this player can distinguish nodes *ynn* and *nyy* from the others however there remain two information sets that each contain three nodes which of course the player can not distinguish between. Now, the information set consisting of three nodes where this player votes y does not require any further analysis since the game ends after the first period, conversely the tri-node information set where the player votes n and the game continues demands further attention.

In line with information sets what is required at this point is this players beliefs in the second period be outlined. This player must have beliefs μ_y and μ_n in the second period. Since the only node that consists of both the first player voting y and

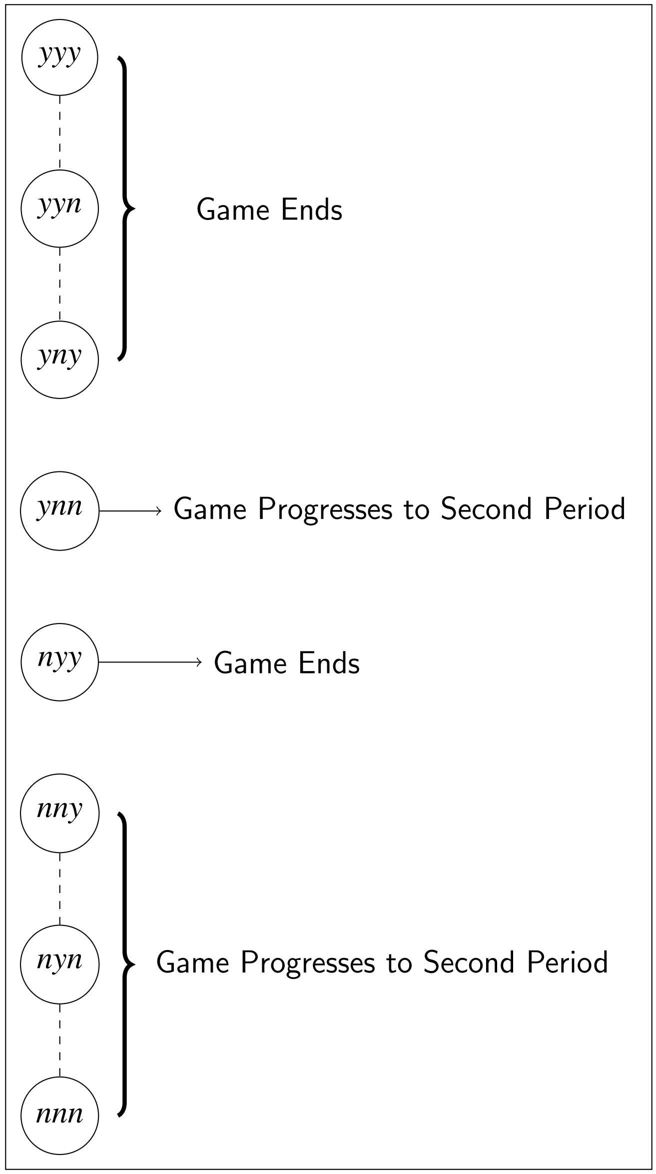

Figure 4.1: The Game

the second period being reached is within a singleton information set, the players belief is trivially $\mu_y = 1$. On the other hand, μ_n is slightly more complicated. Denote the event E as the probability of the player being in the tri-node information set where said player has voted n in the first period. It is straightforward to derive the event probability $E = \left[1-(1-F(c_0))^2\right] = F(c_0)\left[2-F(c_0)\right]$.

Having derived the event probability E this can be used in conjunction with Bayes rule to yield the belief $\alpha = F(c_0)\left[1-F(c_0)\right]/E = \left[1-F(c_0)\right]/\left[2-F(c_0)\right]$ assigned to node *nny*. Node *nyn* has of course the same belief attached to it with *nnn* naturally having belief probability $(1-2\alpha)$. Therefore, the players beliefs in this instance are stated more precisely as $\mu_n(nny) = \alpha$, $\mu_n(nyn) = \alpha$ and $\mu_n(nnn) = 1-2\alpha$.

For use in later sections note that $2\alpha = \left[2-2F(c_0)\right]/\left[2-F(c_0)\right]$ whilst $(1-2\alpha) = F(c_0)/\left[2-F(c_0)\right]$.

4.4.1 Payoffs

As traditionally done, moving backward through the game enables a clearer understanding of the payoff construction. Hence the payoffs from playing 1 and 0 for an arbitrary type c at time $t = 1$ will be detailed first followed by the payoffs from the identical action set for an arbitrary type c at time $t = 0$. In determining the second period payoffs, the beliefs of the players are utilised at non-singleton information sets such that the *expected* payoffs from playing 1 or 0 at time $t = 1$ can be calculated which will ultimately lead to finding expressions for the second period indifferent cost types. What follows are the payoffs from playing 1 and 0 at each information set in the second period. For the singleton node information set *ynn* the payoff from playing 1 at time $t=1$ for a type c is given by

$$\begin{aligned} & -\left[q_n^2\left(\frac{Y}{3}+\frac{2Z}{3}\right)+2q_n(1-q_n)\left(\frac{Y}{2}+\frac{Z}{2}\right)+(1-q_n)^2Y\right]c \\ = & -\left(1-q_n+\frac{q_n^2}{3}\right)Yc-\left(q_n-\frac{q_n^2}{3}\right)Zc \qquad (4.4) \end{aligned}$$

and the payoff from playing 0 at time $t=1$ is given by

$$\begin{aligned} & -\left(q_n^2Z+2q_n(1-q_n)Z\right)c+(1-q_n)^2S \\ = & -(2q_n-q_n^2)Zc+(1-q_n)^2S. \qquad (4.5) \end{aligned}$$

For the other information set in the second period, the overall expected payoff from playing 1 or 0 at time $t=1$ arises as a weighted average of the payoffs present at each node within the information set. In that respect, the beliefs that the player holds over each node in this information set need to be incorporated in order to calculate c_n. Therefore, contingent on being at node *nny* or *nyn*, the payoff from playing 1 at time $t=1$ for a type c is

$$-\left[q_n q_y \left(\frac{Y}{3}+\frac{2Z}{3}\right)+[q_n+q_y-2q_n q_y]\left(\frac{Y}{2}+\frac{Z}{2}\right)+(1-q_n)(1-q_y)Y\right]c$$

$$=-\left(1-\frac{q_y}{2}-\frac{q_n}{2}+\frac{q_n q_y}{3}\right)Yc-\left(\frac{q_y}{2}+\frac{q_n}{2}-\frac{q_n q_y}{3}\right)Zc. \tag{4.6}$$

The payoff from playing 0 is given by

$$\begin{aligned} & -\left[(q_n q_y Z+[q_n(1-q_y)+q_y(1-q_n)]Z)c-(1-q_n)(1-q_y)S\right] \\ = & -\left[(q_n+q_y-q_y q_n)Zc-(1-q_n)(1-q_y)S\right]. \end{aligned} \tag{4.7}$$

Finally, contingent on being at node *nnn* the payoff of playing 1 at time $t=1$ for a type c is given by

$$\begin{aligned} & -\left[q_n^2\left(\frac{Y}{3}+\frac{2Z}{3}\right)+2q_n(1-q_n)\left(\frac{Y}{2}+\frac{Z}{2}\right)+(1-q_n)^2Y\right]c \\ = & -\left(1-q_n+\frac{q_n^2}{3}\right)Yc-\left(q_n-\frac{q_n^2}{3}\right)Zc \end{aligned} \tag{4.8}$$

with the equivalent expression for when 0 is played given by

$$
\begin{aligned}
& -\left[\left(q_n^2 Z + 2q_n(1-q_n)Z\right)c - (1-q_n)^2 S\right] \\
= & -\left[(2q_n - q_n^2)Zc - (1-q_n)^2 S\right]. \qquad (4.9)
\end{aligned}
$$

Before proceeding to determine the first period payoffs, the *expected* payoffs of the non-singleton information set need to be determined. Using the beliefs detailed previously, the expected payoff from playing 1 at the non-singleton information set where n is the first element of the triple is given by

$$
\begin{aligned}
-2\alpha & \left[\left(1 - \frac{q_y}{2} - \frac{q_n}{2} + \frac{q_n q_y}{3}\right) Yc + \left(\frac{q_y}{2} + \frac{q_n}{2} - \frac{q_n q_y}{3}\right) Zc\right] \\
& -(1-2\alpha)\left[\left(1 - q_n + \frac{q_n^2}{3}\right) Yc + \left(q_n - \frac{q_n^2}{3}\right) Zc\right]. \qquad (4.10)
\end{aligned}
$$

Whilst the expected payoff from playing 0 is given by

$$
\begin{aligned}
-2\alpha & \left[(q_n + q_y - q_y q_n)Zc - (1-q_n)(1-q_y)S\right] \\
& -(1-2\alpha)\left[(2q_n - q_n^2)Zc - (1-q_n)^2 S\right]. \qquad (4.11)
\end{aligned}
$$

Having defined the second period payoffs, the payoffs from playing 1 and 0 at time $t = 0$ for an arbitrary type c can be detailed. Firstly the payoff from playing 1 at time $t = 0$ for a type c is given by,

$$-F(c_0)^2\left\{q_y\left[\left(1-q_n+\frac{q_n^2}{3}\right)Yc+\left(q_n-\frac{q_n^2}{3}\right)Zc\right]\right.$$
$$\left.+(1-q_y)\left[(2q_n-q_n^2)Zc-(1-q_n)^2S\right]-S\right\}-\left[1-F(c_0)^2\right]Xc \tag{4.12}$$

The payoff from playing 0 at time $t=0$ is given by

$$-\left[1-F(c_0)\right]^2Xc+\left\{1-\left[1-F(c_0)\right]^2\right\}\left[q_n\times(4.10)+(1-q_n)\times(4.11)+S\right] \tag{4.13}$$

4.4.2 Threshold Solutions

Given the payoffs for each of the information sets, attention can move to finding the thresholds c_0, c_y and c_n. Observe that these types simply express indifference between playing 1 or 0 in their respective time periods. It follows that c_j for $j=0,y,n$ is hence obtained through setting the payoff from playing 1 equal to that of playing 0 at the relevant information set in the game, however prior to this, consider the equilibrium conjecture such that $c_n,c_y\leq c_0$. The reason for this assumption is intuitive in the sense that if the second period is reached, it is quite reasonable to think that the indifferent type lies closer to $\underline{c}$, specifically $c_i\in[\underline{c},c_0]$ for $i=y,n$. This implies that $q_y=1$ and $q_n=[F(c_0)-F(c_n)]/[F(c_0)-F(\underline{c})]$

under the postulate. If the above inequality is strict, the indifferent cost type in the first period c_0, plays 1 with absolute certainty in the second period of the game.

Observation 3. Given the conjecture that $c_n \leq c_0$ which yields the form of q_n above, by construction $c_0 \neq \underline{c}$. This means equilibria where $c_0 = \underline{c}$ can be ruled out a priori.

Using the implications above in conjunction with the first period payoffs, the first period indifferent cost type c_0, whilst due to the complexity of the function does not have a closed form solution, is given by the following implicit function

$$-F(c_0)^2\left\{\left[\left(1-q_n+\frac{q_n^2}{3}\right)Yc_0+\left(q_n-\frac{q_n^2}{3}\right)Zc_0\right]-S\right\}-\left[1-F(c_0)^2\right]Xc_0$$

$$=$$

$$-\left[1-F(c_0)\right]^2Xc_0+\left\{1-\left[1-F(c_0)\right]^2\right\}\left[q_n\times(4.10)+(1-q_n)\times(4.11)+S\right] \tag{4.14}$$

Of course as it stands the above equality does not admit a straightforward economic interpretation, however in the ensuing characterisation of equilibria and under leniency permutations (4.14) concedes relevant policy considerations.

Now given the conjecture yields probability $q_y = 1$, c_y is in fact redundant since any agent who plays 1 in the first period will with absolute certainty play 1 in the second period. Hence c_y can be fixed at the lower bound of the support $\underline{c}$ under the equilibrium conjecture.

On the other hand, in order to find c_n, the *expected* payoff from playing 1 must be set equal to the *expected* payoff from playing 0 at time $t = 1$ given 0 was the action in the first period. Thus, setting (4.10) equal to (4.11) and using $q_y = 1$ yields the following threshold value

$$c_n = \frac{(1-2\alpha)(1-q_n)^2 S}{A}. \tag{4.15}$$

Where

$$\begin{aligned} A &= 2\alpha\left(\frac{1}{2} - \frac{q_n}{6}\right)(Z - Y) \\ &\quad + (1-2\alpha)\left[\left(q_n - \frac{2q_n^2}{3}\right) Z - \left(1 - q_n + \frac{q_n^2}{3}\right) Y\right]. \end{aligned}$$

As expected c_n is contingent on parameters Z, Y and S. Equilibria of the model will now be characterised using the above expressions for the indifferent cost types.

Chapter 5

Equilibria

Having derived the threshold values under general specification of the model parameters, it is now prudent to examine the equilibria arising from said threshold solutions. Furthermore, the equilibria of the model will allow for consideration of different policy combinations by $\mathscr{A}$. This can involve several different specifications of the parameters at the disposal of $\mathscr{A}$ (X,Y and Z) and whilst the previous thresholds maintain the solution to the problem in general form, in order to achieve meaningful results the exact level of lenient treatment must be quantified.

Definition 3. An equilibrium is deemed *interior* if $\underline{c} < c_0 < \overline{c}$ and/or $\underline{c} < c_n < c_0$. Furthermore, if an equilibrium is not interior it is deemed a *corner* solution. Recall that c_y is redundant under the equilibrium conjecture.

The following considers equilibria arising when c_n takes a corner value.

5.1 Lower Bound Equilibria

To begin, consider the case when $c_n = \underline{c}$. In this situation all agents report under $\mathscr{L}^I$ at time $t = 1$.

Proposition 1. *An equilibrium arises when c_n takes the lower corner solution. Specifically, $c_n = \underline{c} = 0$ and*

$$c_0 = \frac{S}{(1/3)Y + (2/3)Z - X}. \tag{5.1}$$

Proof. Since $c_n = \underline{c}$, $q_n = [F(c_0) - F(\underline{c})] / [F(c_0) - F(\underline{c})] = 1$. This reduces the equation (4.14) to

$$-F(c_0)^2 \left[\frac{1}{3}Yc_0 + \frac{2}{3}Zc_0 - S\right] - \left[1 - F(c_0)^2\right] Xc_0$$

$$=$$

$$-\left[1 - F(c_0)\right]^2 Xc_0 + F(c_0)\left[2 - F(c_0)\right]\left\{-\left[\frac{1}{3}Yc_0 + \frac{2}{3}Zc_0\right] + S\right\} \tag{5.2}$$

Rearranging the above the result follows. Finally, using $q_n = 1$ in (4.15) gives $c_n = 0$.

Q.E.D

Remark 1. In keeping with the support of c_0, X must be strictly less than $(1/3)Y + (2/3)Z$ so as to prevent infeasible thresholds.

The result is rather intuitive in that every player will play 1 in the second period and so the game will end in said period. Therefore, the surplus from successfully keeping the illegal activity undetected for one period is weighed against the penalty differential between the two periods. The expected penalty in the second period for a player is a weighted average of the possible penalties accruing to the player, contingent on the probability of reporting first.

Hence to induce a larger number of firms to self-report under $\mathscr{L}^C$ the authority must maximise $(1/3)Y + (2/3)Z - X$. To render the analysis more concrete in a practical sense further assume that there exists an exogenous upper penalty limit $\mathscr{K}$ and an exogenous budget for the authority $\mathscr{B}$ such that $X \in [-\mathscr{B}, \mathscr{K}]$ and $Y, Z \in [0, \mathscr{K}]$. An upper penalty limit concurs with legal restrictions on penalty levels and/or public sentiment. Now, under this equilibrium the optimal policy specification for the authority to induce corporate reports requires $Z = Y = \mathscr{K}$ and $X = -\mathscr{B}$. In words, penalties in the second period should be set equal at their maximal values, whilst corporations should be offered the largest reward feasible under the authority's budget. Note that if $\mathscr{B} = 0$ it is optimal for $\mathscr{A}$ to set $X = 0$ in this equilibrium which corresponds to full corporate leniency.

In the view of the U.S. DoJ, eliciting corporate reports is the primary objective of leniency programs. As was stated earlier the purpose of having individual leniency operate concurrently to corporate leniency is to induce more corporate applications because of the threat that individuals within the company will self-report under $\mathscr{L}^I$. It seems, having observed this equilibrium under symmetric access, that this idea should be taken with a grain of salt in that the potential attractiveness of $\mathscr{L}^I$ may in fact prompt a decrease in corporate applications, as $\mathscr{F}$ is a representative firm, and an increase in individual applications. Clearly, in this instance as every agent is playing a strategy consisting of 1 in the second period, $\mathscr{L}^I$ becomes essentially redundant so $\mathscr{A}$ optimally sets $Y = Z$ which means there is no penalty concession for reporting individually. Observe however that as the leniency parameter Y is decreased (making $\mathscr{L}^I$ more attractive) this moves the first period indifferent threshold higher resulting in less corporate reports on average which is exactly the opposite of the primary goal.

From the DoJ's perspective the focus on inducing corporate leniency applications as opposed to individual leniency applications most likely is due to informational advantages. It most probably works in the favour of the DoJ having corporate applicants both in an administrative sense in addition to learning about and subsequently shutting down any illegal activity. In the model utilised the focus on corporate leniency applications by the DoJ is mirrored in the benefit of garnering first period reports since the illegal activity ends sooner hence less surplus from misdemeanour is reaped by the agents in $\mathscr{F}$.

Observation 4. Under symmetric access to leniency, players in the game compare the relative merits of reporting under $\mathscr{L}^C$ and $\mathscr{L}^I$. Specifically, a consequence of having two competing leniency programs is that the *relative* penalty is of interest as opposed to the *absolute* penalty size.

5.2 Upper Bound Equilibria

Now consider the case where $c_n = c_0$. This corresponds to each agent playing their initially chosen action in each period $t = 0, 1$.

Proposition 2. *Multiple equilibria arise when c_n takes the upper corner solution $(c_n = c_0)$. Specifically, two equilibria come about, with the first having*

$$F(c_0) = F(c_n) = \frac{2(Y - Z)}{2X - Y - 3Z} \tag{5.3}$$

and the second having $F(c_0) = F(c_n) = 1$ which implies $c_0 = c_n = \overline{c}$.

Proof. Since $c_n = c_0$, $q_n = [F(c_0) - F(c_0)] / [F(c_0) - F(\underline{c})] = 0$. This reduces equation (4.14) to

$$c_0 = \frac{F(c_0)\,[2 - F(c_0)]\,S}{2F(c_0)\,[1 - F(c_0)]\,[Z - X] - F(c_0)^2 Y} \tag{5.4}$$

Whilst (4.15) reduces to

$$c_n = \frac{F(c_0)S}{[1 - F(c_0)]\,[Z - Y] - F(c_0)Y} \tag{5.5}$$

Setting (5.4) equal to (5.5) and manipulating yields a quadratic in terms of $F(c_0)$ with roots 1 and $2(Y - Z)/(2X - Y - 3Z)$.

Q.E.D

Remark 2. For $Y \neq Z$ implicit in the first upper bound equilibrium is an interior solution for c_0. Note however that when $Y = Z$ the payoff from reporting in the first period is strictly greater than the payoff from not reporting $\forall c$.

The second upper bound equilibrium ($F(c_0) = F(c_n) = 1$) is trivial in the sense that if the majority are playing 0 in the first period it does not matter whether an individual agent plays 0 or 1 and since $c_0 = c_n$ in this equilibrium, this follows for the second period.

The non-trivial equilibrium expression does not have an interpretation as the subject is not c_0 but rather the cumulative distribution function F. Note however that this equilibrium entails all agents playing the same action in both periods and so it is important to keep in mind that policy specification has exactly the same effect on both indifferent thresholds.

Remark 3. As F is a cumulative distribution function it has support $[0,1]$ which entails restrictions on the parameter space such that $Y \leq Z$ to ensure $F(.) \geq 0$ (note the denominator is always negative) and $X \leq (3/2)Y + (1/2)Z$ to ensure $F(.) \leq 1$.

Now it is clear that the functional form of F in this equilibrium requires $Y = Z$ as the optimal policy specification. In accordance with the lower bound equilibrium, these parameters are best set at the maximal permissable level, namely $Y = Z = \mathscr{K}$. However, when considering this upper bound equilibrium in isolation no such direction regarding the optimal *level* of these parameters is given, though when $Y = Z = 0$ it cannot be the case that $X = 0$ as the function is undefined. This is of particular relevance when $\mathscr{A}$ has no budget for rewards, $\mathscr{B} = 0$, whereas if rewards are possible no issue arises.

So to summarise, the lower bound equilibrium stipulates that optimal policy construction requires X to be minimised, which corresponds to greater immunity and possibly rewards under $\mathscr{L}^C$, and $Y = Z = \mathscr{K}$. The upper bound equilibrium stipulates that any optimal policy arrangement necessitates $Y = Z$, with certain conditions on the parameter space when these are set to zero. It is clear that consistency across equilibria demands X be minimised and parameters Y and Z be set equal at the feasible maximum value for penalties.

What then are the ramifications in terms of having concurrently operating leniency programs? The conclusion reached above casts doubt on the merits of individual leniency as a mechanism to generate increasing numbers of corporate reports since the optimal policy specification has $Y = Z$ which corresponds to granting absolutely no immunity to individuals whatsoever; identical to having no individual leniency program but only corporate leniency on offer. Whilst the U.S. DoJ championed the competition generated from having both individual leniency and corporate leniency on offer as leading to an increase in corporate reports due to the threat individual leniency posed, under symmetric access it appears as though this competition is working in the opposite direction. Namely, individual leniency competes with corporate leniency for applications in that it draws away reports under $\mathscr{L}^C$ rather than promotes corporate reports.

In essence, there are two effects of interest in this analysis. Firstly, and what is championed by the DoJ, is the *threat* effect the presence of individual leniency has on corporations. In addition, there is clearly an *incentive* effect taking place in that incentives to report are reallocated when individual leniency is introduced and as amnesty under $\mathscr{L}^I$ is increased. With respect to self-reports under symmetric access to leniency, the presence of $\mathscr{L}^I$ has the incentive effect dominate the threat effect which is contrary to the assertion by the DoJ and results in a suboptimal outcome.

Of particular interest is the special case where full leniency is offered. This being a focal point in the literature concerning leniency makes it particularly relevant for discussion in this study. Several full leniency arrangements are evaluated in the forthcoming section.

5.3 Full Leniency

Full Individual Leniency. Firstly consider the case where $Y = 0$, which corresponds to full leniency when reporting under $\mathscr{L}^I$. X and Z are left unspecified. If, as per the U.S. DoJ, eliciting corporate reports is the primary objective, as was shown previously full individual leniency is never an optimal policy specification as the incentive to report under $\mathscr{L}^I$ pulls agents away from reporting under $\mathscr{L}^C$. However, if generating individual leniency reports is the main interest then it is obvious that the optimal policy is reversed in that immunity under $\mathscr{L}^I$ should be made as generous as possible whilst to deter reports under $\mathscr{L}^C$, corporate reports should be made as unattractive as possible so as to dampen the incentive effect when access is symmetric.

Full Corporate Leniency. Next consider the case where $X = 0$, which corresponds to full leniency when reporting under $\mathscr{L}^C$. Y and Z are left unspecified. Whether offering full immunity under $\mathscr{L}^C$ is optimal is dependent upon the exogenous budget that $\mathscr{A}$ has at its disposal. Full corporate immunity is justified in the case where rewards are not possible as a next best option, though it is important to note that $\mathscr{A}$ should strive to offer rewards to induce more corporate reports.

Full Corporate and Individual Leniency. Perhaps the most practically compelling case is where both corporate and individual leniency, when applied for, grant full immunity to those who are self-reporting. In this context, both types of leniency are offering the same level of indemnity to reporting agents. Whilst it has been established that this policy specification is not ideal, it is meaningful to discuss the ramifications of said policy as it is the most naturally occurring setup a justice authority may consider. In fact recall that the U.S. DoJ defines leniency as not charging entities criminally for the activity reported regardless of whether the reporting party is an individual or a corporation which is roughly analogous to offering both full corporate and individual leniency in this discussion. The result where $X = Y = 0$ follows as a corollary from the above propositions.

Corollary 1. *Under full corporate and individual leniency an equilibrium arises where* $c_n = \underline{c} = 0$ *and* $c_0 = 3S/2Z$.

Proof. Immediate from using $X = Y = 0$ in Proposition 1. Q.E.D

Remark 4. Once again, under this equilibrium everyone plays a strategy which consists of action 1 in the second period whilst the first period indifferent type is determined by the ratio of the surplus from illegal activity, $3S$, to the penalty accruing to two of the three agents in $\mathscr{F}$.

Hence, whilst all reap the status-quo payoff S individually, one will be granted full immunity under $\mathscr{L}^I$ whilst her partners will be handed penalty Z. Though offering both full corporate and individual leniency has been shown to be sub-optimal, if this policy regime happens to be in place, to induce a greater number of reports under $\mathscr{L}^C$ the authority should set Z at its maximal value, namely $Z = \mathscr{K}$ to maximise the likelihood of the total penalty outweighing the surplus from illegal activity.

Corollary 2. *Under full corporate and individual leniency an equilibrium arises where $c_n = c_0$ with $F(c_0) = 2/3 = F(c_n)$.*

Proof. Immediate from using $X = Y = 0$ Proposition 2. Q.E.D

Remark 5. Under this equilibrium, the action played by each agent in both periods $t = 0, 1$ is the same. Offering both full corporate and full individual leniency achieves a suboptimal outcome again as the unique interior (respectively corner) solution to c_0 (resp. c_n) is where $F(c_0) = 2/3$ (resp. $F(c_n) = 2/3$) which as a result means the probability of the illegal activity progressing till the end of the game is substantially higher than that of it ending via a self-report under either $\mathscr{L}^I$ or $\mathscr{L}^C$. Clearly, in this case offering full immunity under both types of leniency yields an unfavourable outcome for $\mathscr{A}$ as it renders the indifferent cost types invariant to their other policy option Z.

It can therefore be inferred that under symmetric access the current policy structure established by the U.S. DoJ is suboptimal in that having an individual leniency program operate concurrently with the corporate leniency program in the first instance is not ideal or necessary to induce corporate reports, in addition to specifying the absolute parameters at an inefficient level.

To better understand the movement of the indifferent thresholds in response to changes in the parameter values, the next chapter deals with comparative statics.

Chapter 6

Comparative Statics

Consider the first period threshold solution $c_0 = S/\left[(1/3)Y + (2/3)Z - X\right]$ where $c_n = \underline{c} = 0$ in the previous chapter. Interest lies in how c_0 responds to changes in the policy parameters of the system.

In this instance, the effect of changes in S, Y, Z and X need to be ascertained though of course S lies outside the control of $\mathscr{A}$. The total differential is $dc_0 = \frac{\partial c_0}{\partial S}dS + \frac{\partial c_0}{\partial Y}dY + \frac{\partial c_0}{\partial Z}dZ + \frac{\partial c_0}{\partial X}dX$ and it is clear that the effect of a change in a parameter of the system, holding all else constant, is given by the partial derivative with respect to said parameter. Pursuant to this the partial derivatives are given as follows. For S:

$$\frac{\partial c_0}{\partial S} = \frac{1}{(1/3)Y + (2/3)Z - X} > 0 \tag{6.1}$$

The denominator is positive when $X < (1/3)Y + (2/3)Z$ which is in keeping with the support of c_0. Adhering to expectations, an increase in S, the status-quo payoff from committing the crime each period undetected, leads to an increase in the threshold value of the first period indifferent type. In other words, this means that on the average more agents will play 0 in the first period given this increase in S. Now, taking the partial derivative with respect to Y:

$$\frac{\partial c_0}{\partial Y} = -\frac{(1/3)S}{[(1/3)Y + (2/3)Z - X]^2} < 0 \tag{6.2}$$

The negative sign concurs with the previous findings in that less immunity offered under $\mathscr{L}^I$ (Y is increased) decreases c_0 which corresponds to more agents playing 1 in the first period, hence more corporate reports on average will be filed. Clearly the presence of individual leniency has a dominant incentive effect that detracts from corporate reports since if Y is decreased more agents will play 0 at time $t = 0$ on average leading to less corporate reports. The effect of changes in Z:

$$\frac{\partial c_0}{\partial Z} = -\frac{(2/3)S}{[(1/3)Y + (2/3)Z - X]^2} < 0 \tag{6.3}$$

The partial derivative yields the expected sign as an increase in the penalty for those who are *finked* on leads to, on average, more agents playing 1 in the first period as there exist a greater expected penalty to each player if the second period is reached.

$$\frac{\partial c_0}{\partial X} = \frac{S}{[(1/3)Y + (2/3)Z - X]^2} > 0 \tag{6.4}$$

Finally when immunity under corporate leniency is lessened (X is increased), this leads to on average more agents playing 0 in the first period since reporting under $\mathscr{L}^C$ is not as attractive. Clearly as greater immunity is offered, and perhaps rewards if feasible, this induces more agents to vote in the affirmative to file a corporate report. In sum, the movement of c_0 in response to changes in the exogenous parameters of the model concur with expectations and further lend weight to the findings drawn previously.

Before conducting comparative static analysis on the upper bound equilibrium the cumulative distribution function F must be addressed explicitly. Observe that the properties of the cumulative distribution function are such that F is monotone non-decreasing in its argument as well as having $\lim_{c \to \underline{c}} F(c) = 0$ and $\lim_{c \to \overline{c}} F(c) = 1$ in this instance. Furthermore, F admits a first differentiable function f which of course is the probability density function with the property that $f(c) \leq F(c)$. Given these properties of F, consideration can now move to examining the impact of variations in the exogenous parameters of the model in the upper bound equilibrium.

Consider now the case where $c_n = c_0$ in the previous chapter. In this instance c_0 and c_n are not explicitly known however $F(c_0) = F(c_n)$ are used as proxies, as per the properties of F detailed previously, in order to determine how the indifferent cost types respond to changes in the policy parameters of the system. In this discussion analysis is focused on c_0 as $c_0 = c_n$ the conclusions drawn for c_0 apply in the exact same manner to c_n.

In this equilibrium, $F(c_0) = 2[Y - Z] / [2X - Y - 3Z]$. Letting $x = F(c_0)$, therefore $dx = f(c_0)dc_0$ where f recall is the probability density function associated with F. Hence, the total differential is $dx = \frac{\partial F(c_0)}{\partial Y}dY + \frac{\partial F(c_0)}{\partial X}dX + \frac{\partial F(c_0)}{\partial Z}dZ$. Using the definition of dx this yields $f(c_0)dc_0 = \frac{\partial F(c_0)}{\partial Y}dY + \frac{\partial F(c_0)}{\partial X}dX + \frac{\partial F(c_0)}{\partial Z}dZ$. Thus rearranging gives $dc_0 = \left[\frac{\partial F(c_0)}{\partial Y}dY + \frac{\partial F(c_0)}{\partial X}dX + \frac{\partial F(c_0)}{\partial Z}dZ\right]/f(c_0)$.

Now to determine the impact of changes in Y, holding X and Z constant, set $dX = dZ = 0$. The partial derivative with respect to Y: $\frac{\partial F(c_0)}{\partial Y} = \frac{4[X-2Z]}{[2X-Y-3Z]^2}$. Therefore,

$$\frac{dc_0}{dY} = \frac{4\,[X-2Z]}{[2X-Y-3Z]^2\, f(c_0)} < 0 \tag{6.5}$$

Which is the expected sign since $X \leq Z$ and is in accord with the lower bound equilibrium result. For X, letting $dY = dZ = 0$ now and using the partial derivative with respect to X: $\frac{\partial F(c_0)}{\partial X} = \frac{4[Z-Y]}{[2X-Y-3Z]^2}$ yields

$$\frac{dc_0}{dX} = \frac{4\,[Z-Y]}{[2X-Y-3Z]^2\, f(c_0)} > 0 \tag{6.6}$$

Where once again the expected sign follows as $Y \leq Z$. Finally, for Z setting $dY = dX = 0$ and using the partial derivative with respect to Z: $\frac{\partial F(c_0)}{\partial Z} = \frac{4[2Y-X]}{[2X-Y-3Z]^2}$

$$\frac{dc_0}{dZ} = \frac{4\,[2Y-X]}{[2X-Y-3Z]^2\, f(c_0)} \tag{6.7}$$

In keeping with the support of $F(c_0)$ in the upper bound equilibrium, it must be that $X \leq (3/2)Y + (1/2)Z$. For the derivative with respect to Z to yield the expected sign (negative) it must be the case that $X \geq 2Y$. The two inequalities infer that $2Y \leq (3/2)Y + (1/2)Z$ which yields $Y \leq Z$. Thus, the condition for the expected sign is consistent with the restrictions on the parameter space of the exogenous variables. Therefore, the comparative statics are consistent with preconceived expectations in both equilibria.

Chapter 7

An Extension

Having established that under the earlier model specification the concurrent operation of corporate and individual leniency programs is neither necessary nor sufficient to induce greater numbers of corporate reports through the supposed threat effect individual leniency has, an obvious question arises in that how does one procure the opposite result. Namely, in what circumstances does individual leniency have a dominant threat effect thereby inducing a greater number of corporate self-reports? Essentially, this revolves around the notion of creating a tournament amongst players involved in the race for leniency through asymmetric access to leniency programs.

7.1 The Modified Model

Closer in line with Festerling (2005) it is now supposed that individual leniency is only available to a subset of the firm $\mathscr{F}$. Specifically, the firm contains a set of owners $Q = \{1,2,3\}$ and a set of operations managers $M = \{4\}$ which in this case is a singleton for ease of exposition. Thus the set of players in this modified game is $N = Q \cup M$ where all agents in N are culpable for some continuing illegal activity.

Similar to Festerling, $\mathscr{L}^I$ is only available to managers whereas $\mathscr{L}^C$ can be applied for by the owners on behalf of the firm as a whole. Hence, in this setup owners only have the one avenue for immunity whereas managers directly have the one, individual leniency, and indirectly through the owners have corporate leniency. The players within $\mathscr{F}$ are assumed to be fully informed of this asymmetry.

The authority $\mathscr{A}$ utilises the same leniency parameters as before, namely X, Y and Z where recall these are the leniency parameters corresponding to corporate leniency, successfully applying for individual leniency and the penalty for not reporting (or failing to report first) where another has respectively. Recall that $X, Y \leq Z$. The set of private cost types and the action set of each player is identical to the previous model as is the cumulative distribution function F. What does change is the timeline, the game play within time periods and the addition of an exogenous detection probability for a more practical treatment to be described shortly.

In this setup, the game now has three periods. At time $t = 0$ the agents in Q engage in a vote to determine whether or not to report under $\mathscr{L}^C$. If the firm does not report at time $t = 0$, the game moves to the second period $t = 1$ where agent four now has the option of self-reporting under $\mathscr{L}^I$ or not. Players in Q only move in the first period in accord with their having only $\mathscr{L}^C$ at their disposal and it is assumed for simplicity that the reporting behaviour of the manager is independent of the executive vote in the first period. If player four chooses not to report then the game continues to time $t = 3$ whereby no agent moves but rather there now exist an exogenous probability p of the firm being detected by $\mathscr{A}$.

Remark 6. In addition to being practically relevant, the inclusion of an exogenous detection probability in the third period ensures that playing 1 is not strictly dominated by playing 0 for agent four.

Observe that a strategy in this game for each player in N is simply σ such that $\sigma : [\underline{c}, \overline{c}] \mapsto \{0, 1\}$. Thus, the strategy space for each agent in N is $\Omega = \{\sigma \mid \sigma = \sigma\}$.

Finally, the payoffs are again best described in terms of the evolution of the game. If the firm reports under $\mathscr{L}^C$ at time $t = 0$ then every agent in N gets $-Xc_i$. If the game is sustained till the second period and agent four reports under $\mathscr{L}^I$, players in Q receive $S - Zc_i$ whilst player four gets $S - Yc_i$ where recall S is the payoff to each agent in N each period they go undetected. If though agent four does not report at time $t = 1$ then the third and final period is reached where there is probability p the firm will be detected by $\mathscr{A}$ in which case each player receives $2S - Zc$. If the firm remains undetected, probability $1 - p$, then each agent keeps the surplus $2S$ accrued to them. Without loss of generality, it is supposed that no surplus is reaped in the third period if the firm remains undetected so as to render the analysis to come less cumbersome.

The solution concept in this instance takes the form

$$\sigma^*(c) = \begin{cases} 1 & \text{if } c \geq c_t \\ 0 & \text{if } c < c_t \end{cases} \tag{7.1}$$

for $t = 0, 1$. Where the subscript on the indifferent type follows from the fact that the threshold solution at time $t = 0$ will be different to that at $t = 1$ due to the asymmetry ascribed to the model.

7.2 Solution

Firstly, consider the expected payoffs to the players in Q, the owners. These players are symmetric and move in the first period and so correspond to the indifferent type c_0. The expected payoff from playing 1 in at time $t = 0$ for an arbitrary type c is

$$F(c_0)^2 \{F(c_1)[S - pZc] + [1 - F(c_1)](-Zc) + S\} - \left[1 - F(c_0)^2\right] Xc \tag{7.2}$$

whilst the expected payoff from playing 0 is

$$
\begin{aligned}
&-[1-F(c_0)]^2 Xc + \left[1-(1-F(c_0))^2\right] \times \\
&\quad \{F(c_1)[S-pZc] + [1-F(c_1)](-Zc) + S\}
\end{aligned}
\tag{7.3}
$$

Now consider agent four who moves at time $t = 1$. At time $t = 1$ the expected payoff from playing 1 for an arbitrary type c is $-Yc$ whilst the expected payoff from playing 0 is $S - pZc$. The threshold solutions are hence obtained by equating the relevant expected payoffs. For c_0, the first period indifferent type, this is defined by setting (7.2) equal to (7.3).

In order to obtain the result that individual leniency prompts greater numbers of corporate reports rather than detracting from the number it needs to be the case that a decrease in the parameter Y (greater immunity offered to self-reporting managers) leads to on average more of the owners playing 1 in the first period which corresponds to a decrease in c_0.

Proposition 3. *Under asymmetric access to leniency an increasing generosity in the immunity level under the individual leniency program yields an increase in the number of corporate self-reports.*

Proof. To prove this requires $dc_1/dY > 0$ and $dc_0/dc_1 > 0$. To begin, the second period indifferent type is given by $c_1 = S/[pZ - Y]$. Clearly,

$$
\frac{dc_1}{dY} = \frac{S}{[pZ - Y]^2} > 0 \tag{7.4}
$$

This satisfies the first requirement. Now, the first period indifferent type is given by

$$c_0 = \frac{[1+F(c_1)]\,S}{[1+F(c_1)(p-1)]\,Z - X} \tag{7.5}$$

The total derivative in this instance is given by $dc_0 = \frac{\partial c_0}{\partial x}dx + \frac{\partial c_0}{\partial S}dS + \frac{\partial c_0}{\partial X}dX + \frac{\partial c_0}{\partial Z}dZ$ where $x = F(c_1)$. Using the fact that $dx = f(c_1)dc_1$ and holding all exogenous parameters constant thus

$$\frac{dc_0}{dc_1} = \frac{S\,[(2-p)Z - X]\,f(c_1)}{[X + (F(c_1)(1-p) - 1)\,Z]^2} \tag{7.6}$$

Which is positive since $0 \leq p \leq 1$ and $X \leq Z$. Thus the second requirement is satisfied and therefore when greater individual immunity is offered (Y decreased) more agents in Q play 1 at time $t = 0$ on average. Since $\mathscr{F}$ is a representative firm there will hence be more corporate reports on average.

Q.E.D

The result therefore lends weight to the potential usefulness of individual leniency operating concurrently to corporate leniency in order to elicit corporate reports due to the threat effect. It is clear in this manifestation that the presence of individual leniency creates a tournament between owners and managers due to conflicting incentives provided by the leniency programs. What is required to ensure this tournament exists is for $\mathscr{A}$ to make a clear distinction between who can apply for what leniency program, essentially mechanically partitioning the firm in question.

Given asymmetric access is a necessary condition, the precise form of this asymmetry in a practical sense would take the form of offering individual leniency to non-owners, or the ‘little guys’ in a firm. This structure is the foundation for the threat effect by creating competition internal to the firm that is legally culpable. However, whilst under an asymmetric setup individual leniency is found to be of merit with respect to generating corporate reports, the question remains as to whether offering corporate and individual leniency does better than simply offering corporate leniency in isolation.

Proposition 4. *The authority $\mathscr{A}$ under asymmetric agent access is strictly better off by offering corporate and individual leniency relative to offering only corporate leniency in isolation.*

Proof. Observe that with only corporate leniency on offer, agents in M do not take part in the game. Let c^* denote the solution to the game with only corporate leniency on offer. Note that having only corporate leniency on offer is equivalent to $\mathscr{A}$ setting $Y = Z$ and $X < Z$.

Now, consider the case where both leniency programs are offered. This means that $Y \neq Z$ and since Y is constrained such that $Y \leq Z$ it must be that $Y < Z$. Let c' denote the owners solution. As it has been shown that $dc_1/dY > 0$ and $dc_0/dc_1 > 0$ it must be that $c' < c^*$ which means there are more corporate reports on average and therefore $\mathscr{A}$ is strictly better off offering both corporate and individual leniency concurrently. Q.E.D

It can therefore be said that if the individual leniency policy is structured in the correct manner, with respect to access, then $\mathscr{A}$ is better off utilising the concurrent combination of the two leniency programs as opposed to just the one in the circumstance whereby the focus is on generating corporate self-reports, as has been the case in this thesis.

Chapter 8

Discussion and Implications

Having outlined the model, solved said model, conducted comparative statics and provided an extension attention can move to discussion and summary of the principle findings of this thesis, their alignment regarding the initial bureaucratic assertion as well as their relation to previous studies.

What served to instigate this research was an assertion by the U.S. Department of Justice whereby both corporate and individual leniency are concurrently offered. The DoJ's primary focus is on garnering corporate self-reports of illegal activities with individual leniency mainly a means to achieve this goal. Accordingly, one of the departments explanations for the recent increase in corporate self-reports was in fact the presence of these two leniency programs where the individual leniency program has a net threat effect that prompts more corporations to report before an individual within said corporate does. In examining the validity of this claim, this thesis has restricted attention to the interplay of agents within a firm thus bringing a more micro focused analysis to the issue of leniency. An offshoot of this focus is uncovering agent behaviour within a firm under legal culpability in addition to perhaps determining the optimal leniency structure to elicit corporate reports from the point of view of a justice authority.

With these aims in mind several implications can now be drawn from this analysis. First and foremost it can be said that agent access to the relevant leniency programs is imperative in determining the success of the concurrent operation of said programs. Specifically, when agents within a firm are symmetric in their access to leniency it was found that the presence of individual leniency actually detracts from corporate reports which directly contradicts the primary aim of the DoJ. The intuition for this result lies in the incentives of the agents. When access to leniency is symmetric then there is no threat effect, as postulated by the DoJ, but rather an incentive effect in operation. Players, now having two options for leniency, simply weigh up the relative benefits of each program and submit themselves under whichever offers greater immunity. Therefore, if individual leniency is attractive even in the slightest, this will detract from corporate reports on average as more players switch programs. Moreover, with further increases in individual immunity, this will result in more and more defectors from corporate leniency. In this circumstance, there is no threat effect but rather a reallocation of incentives to report for the agents concerned.

So when individual leniency is not restricted to certain agents within a firm it is found to be suboptimal for an authority to offer any immunity under individual leniency which is equivalent to having corporate leniency offered in isolation as the optimal policy specification. In light of this, the model was extended to the case of asymmetric access to leniency. Specifically, individual leniency was then only on offer to managers whilst owners could only report under corporate leniency. With leniency prescribed in this fashion it was found that the presence of individual leniency does in fact have a dominant threat effect on the owners thereby supporting the DoJ's contention. What is critical is this partitioning of the firm by the authority with respect to leniency access and with this proviso the combination of individual and corporate leniency was shown to do better than corporate leniency in isolation with regard to eliciting corporate reports.

What then can be inferred with respect to the initial bureaucratic assertion? It is clear that conditioned on asymmetric access within a firm the statement holds true in that the presence of individual leniency does prompt greater numbers of corporate reports. However, as stated previously the postulate only holds under asymmetric access for under symmetric access to leniency programs within a firm the opposite result eventuates in that the presence of individual leniency actually detracts from corporate report numbers.

Hence two cases must be considered when broaching the arena of policy advice. If for reasons such as legal or institutional, a justice authority can not restrict individual leniency to a subset of the firm, usually consisting of lower down the chain employees, then it is optimal to offer corporate leniency (at maximum allowable immunity levels) in isolation and if possible go as far as rewards. Conversely, if this restricted access is feasible then it is optimal for the justice authority to offer both corporate and individual leniency concurrently. A potential means to achieve this asymmetry would perhaps be an amendment clause in the individual leniency policy which stipulates that only non-owners are capable of accessing the program.

It may seem as though imposing this restriction diminishes the sources of information to the justice authority by disbanding potential singleton reporting owners from individual leniency, however this is a necessary trade-off as the increased threat effect from this restriction will induce more corporate reports which in turn is associated with better information acquisition for the authority.

The connotations for justice authorities come back to determining causality with respect to policy administration. Whilst it is straightforward to derive conclusions from a simple observation regarding for example a variable trend perhaps, authorities must be aware of the Lucas (1976) critique. In this case the potential reactions and adjustments of economic agents subject to the leniency policies *must* be taken into account. This agent behaviour is demonstrated clearly under symmetric leniency access as agents, due to the presence of individual leniency, substitute away from corporate leniency as a consequence of a redistribution of incentives to report. This illustrates that as per the Lucas critique, drawing inference from historical data regarding the effect of a policy or change in policy is at best a risky proposition.

Having established this policy manifesto it is prudent to consider the policy setup of the U.S. Department of Justice. As per the institutional requisites outlining the two leniency policies, it appears to be the case that the individual leniency program is not restricted to particular persons within a firm but rather open to all individuals who seek to approach the department as a singleton. Drawing upon the findings in this thesis this arrangement is not optimal in general and certainly contravenes the stated intention of the DoJ to glean corporate self-reports.

With respect to previous literature, namely Festerling (2005), there is both a contrast and an overlap in results though for the most part the avenues taken to analyse the interdependence of corporate and individual leniency are quite disparate. Festerling's analysis from the onset partitions the firm into managers and owners thus immediately pandering to the asymmetric outcome.

One of the principle findings of Festerling is that individual leniency applications are never observed when both corporate and individual leniency programs are in concurrent operation. This stands in contrast with the results in this thesis due to the exclusion (respectively inclusion) of incomplete information in Festerling (resp. this thesis) since here in both the symmetric and asymmetric instances if an agents cost type is sufficiently high, she will report under *a* leniency program with the precise choice dependent upon agent access and relative attractiveness of the programs. If agent access is symmetric and individual leniency is sufficiently attractive (recall this is not optimal but instead illustrates a point) agents will report as individuals. Under asymmetric access, a manager can and is the only one who can report under individual leniency and will do so if her cost is high enough. Thus the proposition in Festerling stipulating that individual leniency applications are never observed is one not mirrored in this exposition.

Nevertheless, the results in this thesis in the asymmetric case do lie in accord with Festerling with respect to supporting the DoJ's postulate, viz. that the presence of individual leniency does prompt greater numbers of corporate reports. Beyond these points however, the underlying structure of the models in Festerling and this thesis diverge in both their construction and application thereby precluding any meaningful comparison beyond that already made. What serves as significant validation though is the congruence of results under similar assumptions (asymmetry in leniency access) notwithstanding the disparity regarding the observation of individual leniency applications.

Similar to though not nearly as negative a result as Spagnolo (2000b) and Buccirossi and Spagnolo (2006) is the importance of ensuring the leniency program(s) setup is proper and in line with the primary goals of the justice authority. Whilst said previous papers found improperly setup leniency programs to be pro-collusive, the results here highlight the fact that the structure of each of the leniency programs in question, if incorrectly specified, may lead to a suboptimal outcome when the aim is to elicit corporate self-reports.

Chapter 9

Conclusion

Having concluded the analysis with specific determination of leniency structure and effect, the overarching conclusions are the following. Firstly, the U.S. DoJ's assertion is in need of qualification and only holds conditionally in that agent access to leniency is paramount in determining the success of leniency program concurrency. Secondly, in line with the Lucas critique of policymaking, there is a need for authorities to be fastidious with respect to cause and effect of their policies. With these in mind, the field of leniency and more generally corporate malfeasance is one that is highly receptive to differing research agendas given its direct practicality and relevance to the realm of the political economy. There are several potential extensions to this research that can be made.

What immediately comes to the forefront of thought is perhaps making further use of the probability of detection. In the modified model an exogenous detection probability exists in the last period of the game. One could perhaps incorporate this detection probability into every period of the game however the usefulness of this remains to be seen. Intuitively, all an exogenous probability of detection serves to do is in effect scale down the payoff from engaging in illegal activity thus most likely leaving the principle results from this analysis unchanged. Nevertheless, an interesting extension could endogenise the probability of detection such that it is contingent on the type and/or scale of illegal activity. A similar potential inclusion are damage payments after prosecution, however this in all probability will work much the same way as the detection probability in simply scaling down the illegal surplus.

Moving toward the angle of previous literature, cartel activity can be focused on explicitly. Cartel activity being a focal point in the literature, it would be of relevance to embed the firm in oligopolistic competition. This extension would thus render the firm susceptible to competition for leniency both internally and externally. Whilst yielding a more practical treatment of the problem the focus in such an endeavour would be pulled away from the interplay of corporate and individual leniency, which has been the principle matter in this thesis, and rather focused on the usual culprit of cartels. This though would be of substantial merit as leniency programs are primarily in existence as an avenue to terminate cartel activity, however for the purposes of analysing corporate versus individual leniency examining cartels explicitly was not necessary in this research.

In this exposition it has been assumed that agents are identical with respect to the surplus they command, essentially being a special case of every agent having equal bargaining power. Incorporating a bargaining stage where bargaining power is derived from the cost type (lower cost types having more bargaining power) or position within the firm could very well alter the result under the case of symmetric access to leniency. The division of the illegal surplus could be accomplished by virtue of the Shapely value which would precisely represent the bargaining power of agents. Given this, the threat of higher cost players who receive very little of the surplus could nullify the incentive effect under symmetric access and further support the conjecture at the root of this thesis, though this may not be true as the reason symmetric access renders concurrent operation of programs ineffective is precisely because *every* agent has the option to report under *either* program. Under asymmetric access, the unequal division of surplus would most probably serve to amplify the already dominant threat effect.

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