

WHU-Forschungspapier Nr. 37/September 1996

**A Positive Economic Analysis of
Law Enforcement**

von Peter-J. Jost*

Wissenschaftliche Hochschule für Unternehmensführung (WHU)
- Otto-Beisheim-Hochschule -
Burgplatz 2
D - 56179 Vallendar/Rhein

* Prof. Dr. Peter-J. Jost ist Inhaber des Lehrstuhls für BWL,
insbesondere Organisationstheorie an der WHU

A Positive Economic Analysis of Law Enforcement

Abstract

The responsibilities of a regulatory agency involved in the law enforcement process vary considerably. In this paper we consider three different legal procedures in the process of law enforcement: First, we assume that the regulatory agency is in charge of the detection of offences. Conviction takes place via court trial. Second, we assume that the regulatory agency has the power to fine an individual if there is some evidence that he did not comply with the law. An individual who has been fined by the agency has the right to lodge an appeal. If he makes use of this right, the question whether or not he complied with the law will be reconsidered. Here we discuss two different legal procedures: The case is decided by court and the regulatory agency is required to provide sufficient evidence for its decision. Or, the agency reconsiders its decision and decides whether or not to press charges in court.

We formalise these three legal procedures in a game-theoretic context and analyse the implications of the procedural regulations on the decision of a potential offender to behave illegally.

1. Introduction

The responsibilities of administrative agencies involved in the law enforcement process vary considerably. German law, for example, distinguishes strictly between the regulations of proceedings in the enforcement of minor offences (Ordnungswidrigkeiten) and major offences (Straftatbestände): In the first case, an administrative agency has the right to fine suspected offenders at a pre-trial stage, if its prosecution and investigation provide sufficient evidence for non-compliance. The fined offender has the right to appeal against the agency's decision before a court. If an appeal is lodged, the agency is required to provide sufficient evidence for its decision. In the second case, an administrative agency, called the public prosecutor, is responsible only for the detection and, possibly, prosecution, of suspected offenders. When it finds sufficient evidence for criminal activity, the case is subject to court proceedings.¹

What factors may determine the choice of proceedings? How do procedural rules affect the strategic behaviour of possible offenders and administrative agencies? How are certain aspects of the law enforcement process related to possible sanctions at a pre-trial stage, such as the requirement for the agency to provide sufficient evidence for its decision if a case is subject to court proceedings? The purpose of this paper is to answer these questions by means of a game-theoretical model of the law enforcement process.

We model a situation in which individuals are required by law not to behave in a specified manner. However, an individual may decide not to comply with the law and instead behave illegally. We assume that there are two agencies involved in the law enforcement process, a regulatory agency and a court. The regulatory agency is in charge of monitoring individuals' behaviour and, where appropriate, prosecution. In addition, the regulatory agency may have the responsibility to fine an individual at a pre-trial stage, if its investigation provides sufficient evidence for non-compliance. The court's task is to make the final decision whether an individual has behaved illegally, and - if illegal behaviour has taken place - to fix an appropriate fine.

Where the evidential requirements to establish non-compliance are strict, the regulatory agency incurs high cost for a complete and full investigation of the behaviour of an individual. As the agency has only a limited enforcement budget available, high investigation costs imply restricted investigation activities. This, in turn, implies that if an individual anticipates low investigation activities by the agency, his incentives to comply with the rules decrease. In this context, we analyse how legislation ought to design procedural rules to increase compliance with the law. We consider three different legal procedures in the process of law enforcement:

- In the first type of law enforcement proceedings the regulatory agency is responsible only for detection of offences. Conviction takes place via court trial. In this situation, we assume that detection is equivalent to conviction which is a standard assumption

¹ The public prosecutor plays a role in court.

in most models in the literature of crime and punishment. In fact, since the agency is required to fully investigate an individual's behaviour, there is no uncertainty about whether or not the individual did commit the offence.

- The second type of law enforcement proceedings is characterised by a regulatory agency that has the power to fine an individual (we will call this possibility *pre-trial sanction*), if there is some evidence that he did not comply with the law. The evidential requirements for a pre-trial sanction is lower than the requirements in a court trial. An individual who has been fined by the regulatory agency admits his offence, if he does not lodge an appeal against the fine. If, however, the suspected offender makes use of his right to lodge an appeal, the question whether or not he complied with the law will be reconsidered. Here, we discuss two different possible legal procedures:
 - The case is decided by court and the regulatory agency is required to fully investigate the actual behaviour of the individual.
 - The agency reconsiders its decision and decides whether or not to press charges in court.

Both procedural rules imply that detection does not necessarily amount to conviction which is a standard assumption in the literature of the economics of crime and punishment: Since the eventual burden for pre-trial sanctions are lower than for court sanctions, the regulatory agency can save enforcement costs by limited investigative activities. Limited investigative activities, however, increase the risk that an individual complying with the law, is accidentally fined. Hence, there is uncertainty about an individual's behaviour once apprehended. How this uncertainty is removed in the law enforcement process then depends on the actions, the two parties - the individual and the agency - take during the proceedings.

We formalise the three legal procedures in the process of law enforcement in a game-theoretic context. We assume that each individual maximises his expected utility when deciding whether or not to comply with the law. The law enforcement agents, both the regulatory agency and the court, wish to minimise the number of offences.² To do so, the regulatory agency allocates its resources to enforcement activities, given its enforcement budget, whereas the court decides to impose the maximal permissible sanction only if the agency's investigation fully reveals non-compliance with the law. Given this analytical framework we analyse the effects of the procedural rules on the rate of compliance.

² That is, the harm caused by a non-complying behavior.

In the literature to date no one has analysed procedural aspects in the law enforcement process as developed in this paper.³ Instead the literature has focused on two distinct issues: One line of research deals with an individual's decision to commit an offence and the determination of the optimal probability of conviction and/or sanction.⁴ The second line of research deals with the question under which circumstances law suits are settled by pre-trial negotiation or brought to trial. However, pre-trial negotiation between the prosecutor and a defendant, i.e. plea-bargaining, is specific to the American Law.⁵

The paper proceeds as follows. In Section 2, we describe the main aspects of criminal and administrative fine proceedings of German Law. In Section 3, we formalise these procedural rules in a game-theoretic framework and analyse the optimal behaviour of the parties involved in the law enforcement process. Section 4 investigates on the optimal design of procedural rules and Section 5 discusses the limitations of our results.

2. The Legal Framework

In the following we describe the procedural rules introduced in the previous section in more detail. In particular, we regard these procedural rules in the context of the administrative fine proceedings (Gesetz über Ordnungswidrigkeiten, OWiG) and criminal proceedings (Strafprozeßrecht, StPO) under German Law.

Two agencies are involved in the law enforcement process, a regulatory agency and a court. According to their responsibilities in the law enforcement process we can distinguish between the following three procedural rules:

1. Strict separation between prosecution and punishment: In this situation the regulatory agency is responsible only for the apprehension of offenders. Conviction takes place only in a court trial. This structure of procedural rules is essentially the one of the German Code of Criminal Procedure (StPO),⁶ where the regulatory agency is the public prosecutor. The following figure 1 shows the structure of the procedural rules in detail.

³ See e.g. Posner (1973) or Easterbrook (1983) for the analysis of legal procedures in the context of the American Law.

⁴ See e.g. Ehrlicher (1973), Becker and Landes (1974), Heinecke (1978), Andreano and Siegfried (1980), Pyle (1983), or the symposium on the economics of crime in the *Journal of Economic Perspectives* Vol. 10 (1) (1996) and the references therein.

⁵ See e.g. Landes (1971), Grossman and Katz (1983), or Kobayashi and Lott (1992).

⁶ See Roxin (1985).

During the stage of investigation the regulatory agency ascertains the facts indicating a non-complying behaviour. If its investigation provides some evidence for non-compliance, the regulatory agency has to decide whether or not to bring a charge against the offender. If the regulatory agency regards the evidence as insufficient, the case is dropped. Otherwise, the agency files a charge and the court has to decide whether or not to open the trial. If the court decides to open the trial, the main proceedings end with the court's decision whether to sanction the offender. Alternatively, the court may decide to dismiss the case during the preliminary proceedings.

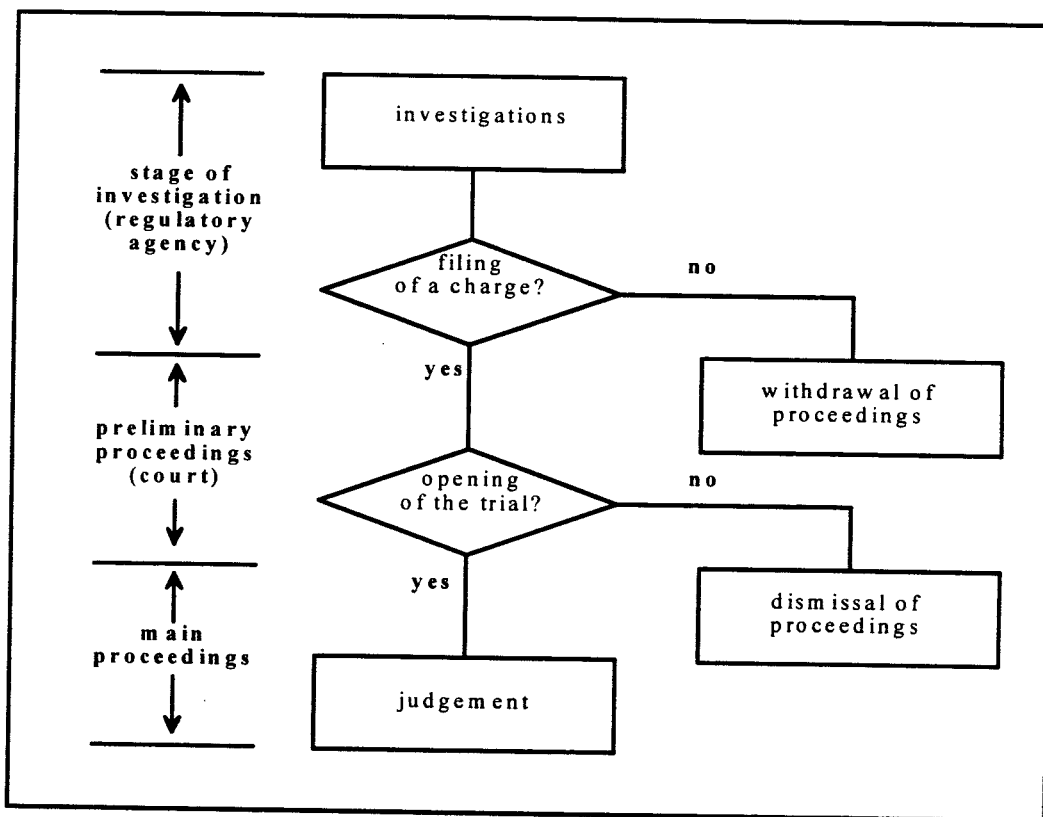


Figure 1: Strict separation between prosecution and punishment

2. Possibility of pre-trial sanctions in preliminary proceedings: In this situation, the regulatory agency is not only in charge of the prosecution of offences but also has the right to fine an individual if its investigation provides sufficient evidence for non-compliance. This structure of procedural rules corresponds to the administrative fine proceedings under German Law (Ordnungswidrigkeitengesetz, OWiG).⁷ The following figure 2 shows the structure of procedural rules in detail:

⁷ See Göhler (1992).

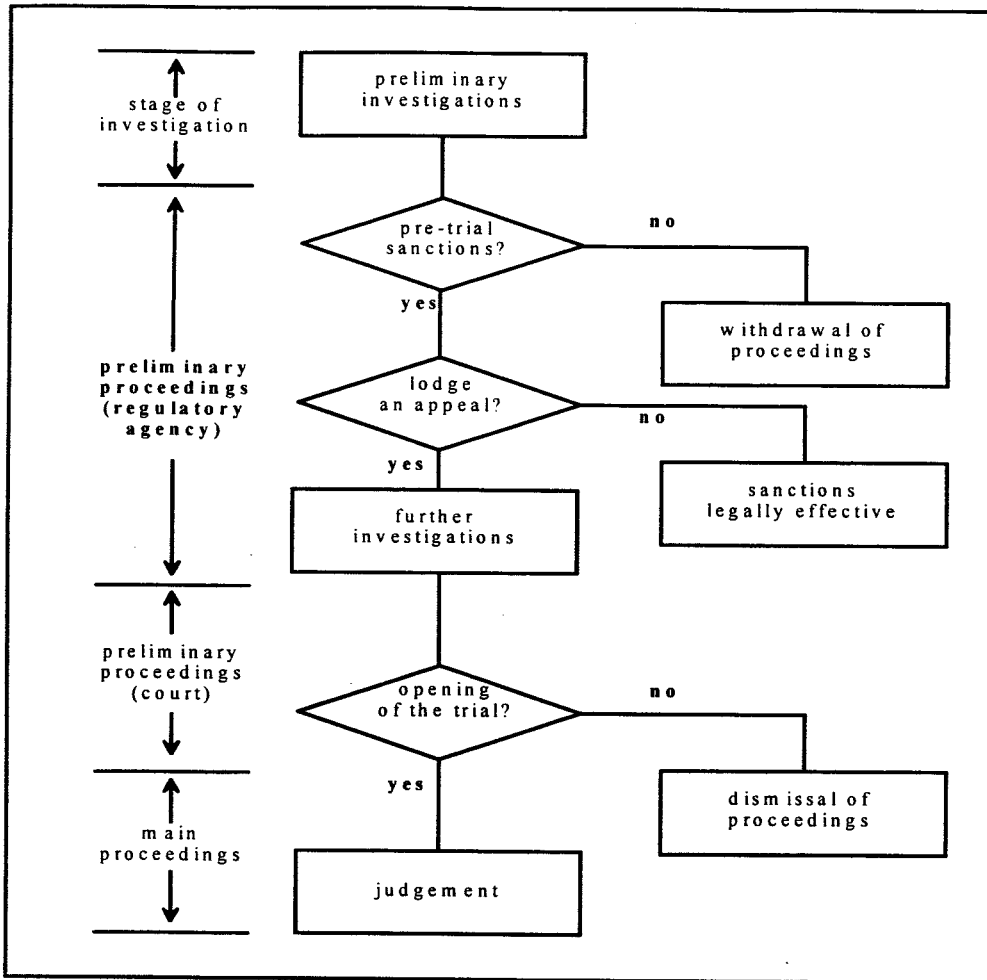


Figure 2: Possibility of pre-trial sanctions in preliminary proceedings

The regulatory agency has the power to fine an individual although it did not fully investigate his behaviour.⁸ The size of the sanction is determined by the agency. An individual who was fined by the agency, however, has the right to lodge an appeal. If he does so, the regulatory agency is required to fully investigate the case⁹ which is then subject to court proceedings. The court then decides to open the trial. If court decides to sanction the individual, the size of the sanction may differ from the pre-trial sanction.

3. Pre-trial sanctions and the possibility to abandon proceedings after an appeal: In this situation, the regulatory agency has the possibility to drop the case, if an individual who is fined by the agency lodges an appeal. Dropping the case

⁸ See Göhler (1992, p.432) and § 46 OWiG

⁹ See Göhler (1992, p.598f)

implies that the individual has not to pay a fine. Figure 3 shows the structure of the procedural rules in detail:

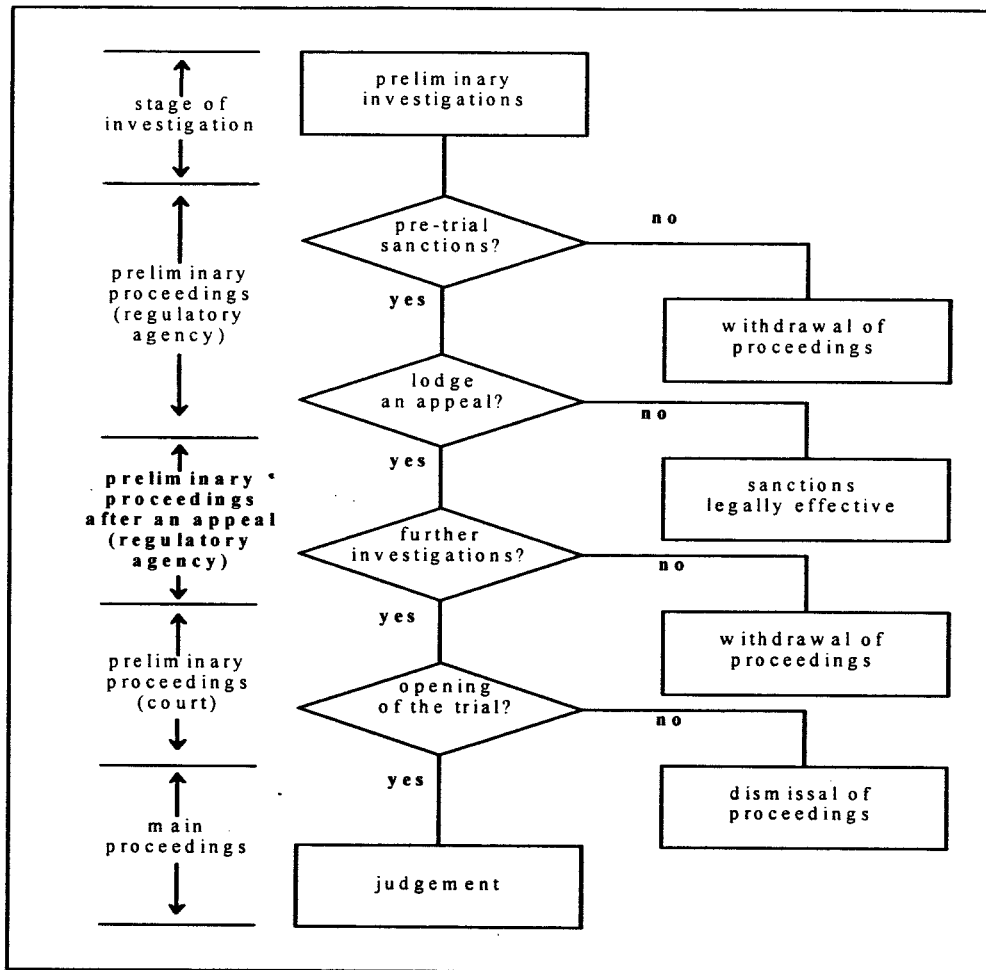


Figure 3: Pre-trial sanctions and the possibility to abandon proceedings after an appeal

It's entirely up to the agency whether or not to further investigate the facts. In particular, the agency bases its decision on its assessment of success and the costs of an additional investigation. This is in contrast to the German Law, where cost consideration are not allowed and illegal.¹⁰ Here, we assume that if the agency decides to withdraw the pre-trial sanction, the proceedings are abandoned.

¹⁰ See Göhler (1992, p.600f) and Deutscher Bundestag (1968, p.16).

3. The Game-Theoretic Analysis

We now model the procedural rules set out in the previous section in multi-stage games. After introducing the basic notations, we then analyse the interactions between the parties involved in the process of law enforcement.

Individuals are prohibited to behave in a specified manner. However, each individual may decide not to comply with the law. If an individual does not comply with the rules, he obtains a private benefit but is exposed to a monetary sanction. The maximum sanction corresponds to the total amount of his wealth. All individuals have identical wealth. If an individual complies with the rules, his private benefit is normalised to zero. All individuals are risk neutral. We use the following notation:

b = private benefit of an individual when he does not comply with the law,
 $b \geq 0$,

$f(b)$ = density function of private benefits b , $f(\bullet)$ continuous on $[0, \infty)$,

$F(b)$ = cumulative density function of $f(\bullet)$,

x = decision of an individual whether to comply, ($x = 0$), or not to comply,
($x = 1$), with the law,

w = wealth of an individual, $w > 0$.

3.1. Strict separation between prosecution and punishment

An individual's behaviour is not directly observable. A regulatory agency is responsible for detection of offences. To investigate individuals' behaviour, the agency has a fixed enforcement budget. We assume that investigative activities completely reveal an individual's behaviour. Let

E = agency's budget per individual for investigations, $E > 0$,

c_F = costs for investigations, $c_F > 0$,

p = probability of investigations, $p \in [0, 1]$,

We assume that the information obtained by the agency during its investigation is verifiable and can be used in court. Since this information completely informs the agency about an individual's behaviour, the court bases its final decision on the result of the agency's investigation. Thus, if illegal behaviour has taken place, court imposes the maximal possible sanction w .¹¹ If, alternatively, investigation reveals compliance with the law, the individual has to bear no sanction.

¹¹ The assumption that court imposes the maximum possible sanction is justified by the principle of maximum deterrence of Baron/Besanko (1984).

The sequence of actions between the regulatory agency and an individual is as follows:

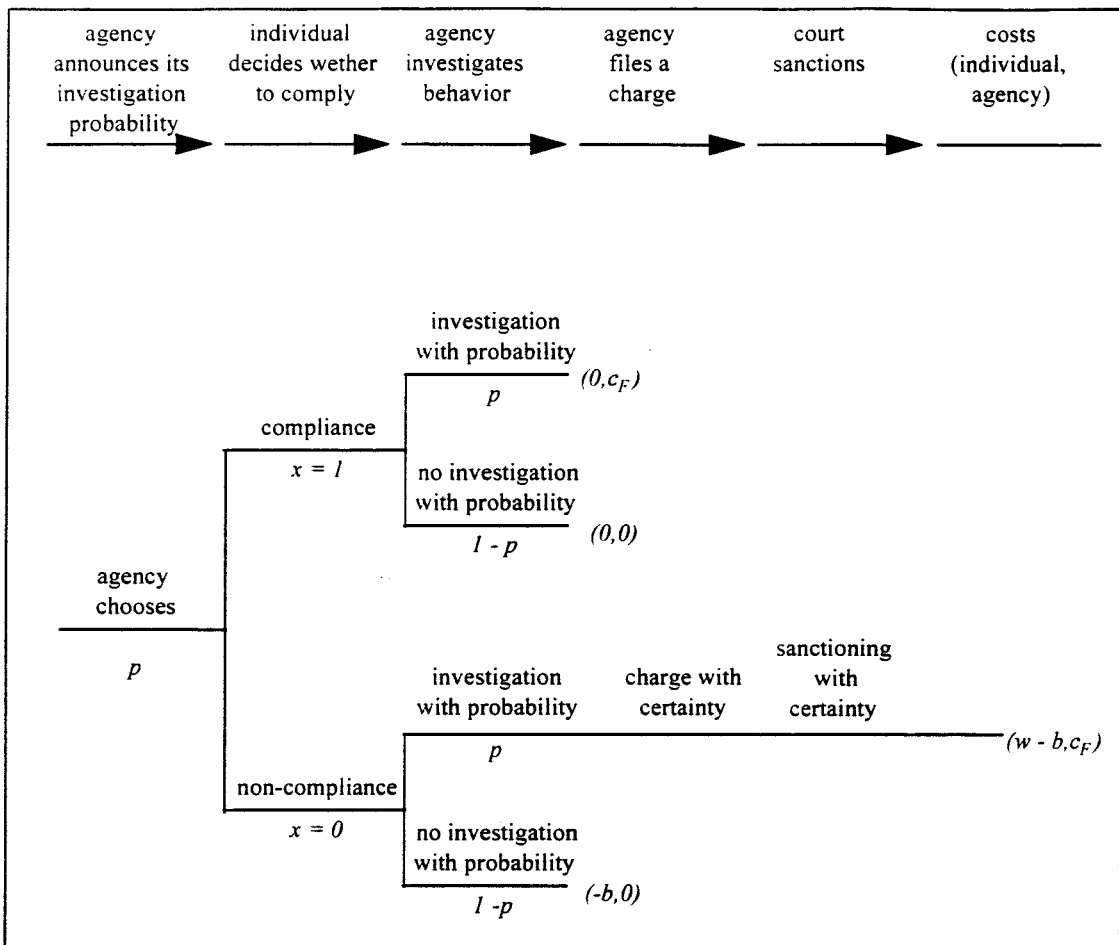


Figure 4: Interactions and extensive game-form

1. The regulatory agency decides with probability $p \in [0, 1]$ whether to investigate an individual's behaviour.
2. On the basis of this information, each individual decides whether to comply with the law. This behaviour is not directly observable for the agency.
3. The agency investigates an individual's behaviour as announced at stage 1. If its investigation reveals non-compliance, the agency files a charge.
4. The court sanctions the individual and imposes the maximum possible sanction.¹²

¹² In the following analysis, no administration cost e.g. of the court system are considered. This assumption is merely done for simplifying and does not change the qualitative statements of this paper.

The regulatory agency and the individuals are the only strategic players in this game. The court only plays a passive role. An individual's strategy is his decision $x \in \{0,1\}$ whether to comply with the law. A strategy for the agency is the probability $p \in [0,1]$ to investigate an individual's behaviour.

To analyse this model, consider first the behaviour of an individual with private benefit $b \in [0, \infty)$. For a given investigation probability $p \in [0,1]$ he decides not to comply with the law if the benefit from the offence exceeds the expected sanction. Since an investigation completely reveals his behaviour, an offender knows that the agency files a charge, and that he will be sanctioned at court, if the agency investigates his behaviour. Risk-neutrality implies that an individual decides not to comply, iff

$$b > wp.$$

According to the distribution of private benefits, the rate of compliance then is given by

$$F(wp).$$

The agency maximises the rate of compliance if it uses its entire budget for investigative activities. Hence, the optimal probability of investigation $p^* \in (0,1)$ is given by

$$E = c_F p^*$$

Result 1: *If the structure of procedural rules is determined by strict separation of prosecution and punishment, the maximal rate of compliance is given by*

$$F\left(w \frac{E}{c_F}\right).$$

According to this result, the rate of compliance is higher the higher the individuals' wealth (and, therefore, the maximal possible sanction) and is higher the higher the enforcement budget the agency has available. Moreover, the rate of compliance is decreasing in investigation costs.

3.2. Possibility of pre-trial sanctions in preliminary proceedings

According to this structure of procedural rules, see section 2, the regulatory agency uses preliminary investigations to keep enforcement costs low. Preliminary investigations imply that an individual's behaviour is observed with error. In particular, we assume that the agency receives one of the following three possible signals when making a preliminary investigation: insufficient evidence ($i = 0$), sufficient evidence ($i = 1$) or strong evidence ($i = 2$) for an illegal behaviour. We use the following additional notation:

$$c_p = \text{costs for preliminary investigations, } 0 < c_p < c_F,$$

p_V = probability of preliminary investigations, $p_V \in [0,1]$,

$\pi_i(C)$ = probability that the agency receives a signal i as the result of its preliminary investigations, given the individual complied with the law, $0 \leq \pi_i(C) \leq 1$, $\pi_0(C) + \pi_1(C) + \pi_2(C) = 1$.

$\pi_i(N)$ = probability that the agency receives a signal i as the result of its preliminary investigations, given the individual did not comply with the law, $0 \leq \pi_i(N) \leq 1$, $\pi_0(N) + \pi_1(N) + \pi_2(N) = 1$.

We assume that preliminary investigations are informative in the sense that the probabilities $\pi_i(C)$, $\pi_i(N)$, $i = 0, 1, 2$, satisfy the Monotone Likelihood Ratio Condition, i.e.

$$\frac{\pi_0(C)}{\pi_0(N)} > \frac{\pi_1(C)}{\pi_1(N)} > \frac{\pi_2(C)}{\pi_2(N)}.$$

This condition reflects the property that it is more likely that a preliminary investigation provides insufficient (strong) evidence for a non-complying behaviour when the individual is complying (non-complying) rather than when he is non-complying (complying). That is, $\pi_0(C) > \pi_0(N)$ and $\pi_2(C) < \pi_2(N)$.

The regulatory agency has the power to fine an individual if its preliminary investigation provides sufficient or strong evidence that he did not comply with the law. Let

f_i = (pre-trial) sanction imposed by the agency, if a preliminary investigation provides sufficient evidence ($i = 1$), resp. strong evidence ($i = 2$), for non-compliance, $f_i \in [0, w]$.

An individual who was fined by the agency has the right to lodge an appeal against the fine. If he makes use of his right, the regulatory agency is required to fully investigate the individual's behaviour. Full investigation is more costly for the agency than a preliminary investigation. Let

e = decision of an individual who was fined by the agency whether or not to lodge an appeal, $e = 0$, resp. $e = 1$.

c = additional costs for the agency to fully investigate an individual's behaviour, $c_F \geq c \geq c_F - c_p$.

The interactions between the regulatory agency and an individual then are as follows (see figure 5):

1. The regulatory agency decides with probability $p \in [0,1]$ whether to investigate an individual's behaviour. Moreover, the agency chooses a pair of (pre-trial) sanctions $(f_1, f_2) \in [0, w]^2$.

2. On the basis of this information, the individual decides whether to comply with the law. His behaviour is not directly observable.
3. The agency investigates an individual's behaviour as announced at stage 1.
4. As the result of its preliminary investigations, the agency receives a signal $i \in \{0,1,2\}$ about the individual's behaviour. If $i = 1$ or 2 , the individual has to bear the (pre-trial) sanction f_1 resp. f_2 .
5. The individual decides whether to lodge an appeal against the fine.
6. If he lodges an appeal, the agency is required to fully investigate the actual behavior of the individual.
7. If illegal behaviour has taken place, the court sanctions the offender with the maximum possible sanction. Otherwise, there will be no sanction.

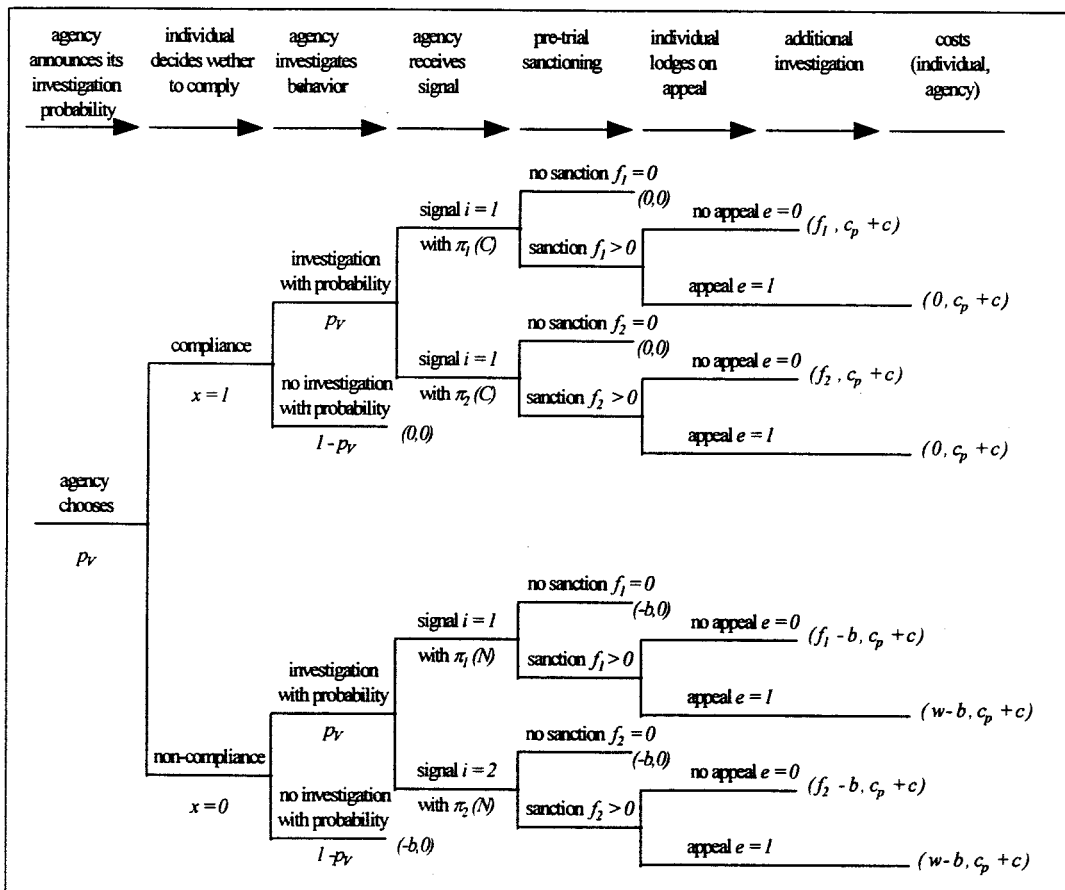


Figure 5: Interactions and extensive game-form

A strategy for the agency in this game is a policy (p, f_1, f_2) . It chooses its policy to maximise the rate of compliance given its enforcement budget. A strategy for an individual is a triple (x, e) , where x denotes his decision whether to comply with the law and e denotes his decision whether to lodge an appeal against a pre-trial sanction.

We use backwards induction to analyse this game: First, consider an individual's decision whether to lodge an appeal. Two cases are possible:

1. If he complied with the law, an additional investigation would reveal his legal behaviour. Hence, he will always bring the case into court, $e^* = 1$.
2. If he did not comply with the law, an additional investigation would prove his offence. Since the maximal sanction imposed by court is not lower than that the pre-trial sanction imposed by the agency, he will never lodge an appeal, i.e. $e^* = 0$.

Second, consider an individual's decision whether or not to comply with the law. For a given policy (p, f_1, f_2) he will choose to comply if his private benefit is lower than the expected sanction $E[f(\bullet)]$ for an offence. That is,

$$b < E[f(p, f_1, f_2)] := p[\pi_1(N)f_1 + \pi_2(N)f_2].$$

Third, consider the agency's problem. It has to choose a policy (p, f_1, f_2) in order to maximise the rate of compliance subject to its enforcement budget E . Taking into account the random error due to its preliminary investigations and the individuals' decisions, the agency can expect the following probabilities τ for an appeal:

$$\tau = \begin{cases} 1 - \pi_0(C) & f_1 > 0, f_2 > 0 \\ 1 - \pi_0(C) - \pi_1(C) & f_1 > 0, f_2 = 0 \\ \pi_1(C) & f_1 = 0, f_2 > 0 \\ 0 & f_1 = 0, f_2 = 0 \end{cases}$$

Hence, the agency's problem reads as:

$$\begin{aligned} &\text{Choose } (p, f_1, f_2) \text{ to maximise } H(E[f(p, f_1, f_2)]) \text{ subject to} \\ &p[c_p + \tau H(E[f(p, f_1, f_2)])] \leq E \end{aligned}$$

To analyse this problem, note first that it is optimal for the agency to impose sanctions which are either zero or equal to the maximal permissible sanction w . This follows from an argument similar to the one in Becker (1968). Hence, four different pairs of sanctions (f_1, f_2) are possible: $f_1 \in \{0, w\}$ and $f_2 \in \{0, w\}$. If the agency sets $f_1 = f_2 = 0$, the rate of compliance is zero which cannot be optimal. Moreover, $f_1 = w$ but $f_2 = 0$ cannot be a solution to its problem according to the Monotone Likelihood Ratio Condition: It is more likely that if a preliminary investigation provides strong evidence for non-compliance the individual is actually non-complying¹³. As a consequence of this argumentation it follows that the optimal policy consists either of a pair of sanctions $(0,$

¹³ Note that the Monotone Likelihood Ratio Condition ensures that $\pi_0(N) < \pi_0(C)$ and $\pi_2(N) > \pi_2(C)$.

w) or (w, w) . Let p_0^* , resp. p_w^* , denote the optimal probability of preliminary investigations, that is p_0^* , resp. p_w^* , satisfy the equations

$$p_0^* \left[c_p + \pi_2(C) F \left(E \left[f(p_0^*, 0, w) \right] \right) c \right] = E$$

resp.

$$p_w^* \left[c_p + (1 - \pi_0(C)) F \left(E \left[f(p_w^*, w, w) \right] \right) c \right] = E.$$

Result 2: *If the structure of procedural rules is determined by possible pre-trial sanctions in preliminary proceedings, the maximal rate of compliance is given by*

$$\max \left\{ F \left(wE \frac{\pi_2(N)}{c_p + \pi_2(C) F(\bullet) c} \right), F \left(wE \frac{\pi_1(N) + \pi_2(N)}{c_p + (\pi_1(C) + \pi_2(C)) F(\bullet) c} \right) \right\}.$$

According to this result, the optimal enforcement policy is characterised as follows: If the costs for preliminary investigations are low, the agency will sanction an individual only if its investigations provide strong evidence for non-compliance:¹⁴ Since only individuals lodge an appeal who behaved legally, the agency can reduce the rate of objections and save on expected costs for further investigations, if it chooses a pair of sanctions $(0, w)$. Low costs for preliminary investigations then imply that the resulting decrease in the rate of compliance can be outweighed by increased investigatory activities at the preliminary stage.

Moreover, the optimal enforcement policy of the agency depends on the reliability of its preliminary investigations: The higher the errors the lower the information about the actual behavior of an individual. Hence, the agency prefers a system of sanctions (w, w) which already sanctions an individual if preliminary investigations provide sufficient evidence for non-compliance.¹⁵

3. Pre-trial sanctions and the possibility to abandon proceedings after an appeal

So far, we assumed that the case is decided by court and the regulatory agency is required to fully investigate the actual behaviour of a suspected offender if this individual lodges an appeal. We analyse now a legal procedure which allows the

¹⁴ The Monotone Likelihood Ratio Condition ensures that $\frac{\pi_2(N)}{\pi_2(C)} > \frac{\pi_1(N) + \pi_2(N)}{\pi_1(C) + \pi_2(C)}$.

¹⁵ If $\pi_1(N)$ and $\pi_2(N)$ tend to $\pi_1(C)$ and $\pi_2(C)$, the second term exceeds the first term in Result 3.

regulatory agency to abandon proceedings if an individual lodges an appeal against a pre-trial sanction. Let

m_i = probability that the regulatory agency abandons proceedings, if an individual lodges an appeal and preliminary investigation provides sufficient ($i = 1$), resp. strong ($i = 2$), evidence for non-compliance.

We modify the sequence of actions in subsection 3.2 and replace step 6 by

6.'If an individual lodges an appeal, the regulatory agency reconsiders its decision and decides whether or not to press charges of the individual.

Note that in this set-up the agency abandons proceedings only for cost-benefit reasons: On the one hand, using resources for additional investigations implies a lower frequency of preliminary investigations. On the other hand, further investigations imply the incentives of an individual to comply with the law are higher. In sum, the agency decides not to press charges in court if and only if the costs are higher than the expected benefits of further investigations. Its decision will be based on its assessment whether or not the individual is actually an offender. This assessment is determined by the degree of evidence, that is, by the signal the agency received as a result of its preliminary investigations.

Result 3: *If the structure of procedural rules is determined by pre-trial sanctions and if the regulatory agency has the possibility to abandon proceedings after an appeal, its optimal decision is given as follows:*

- *If a preliminary investigation provides strong evidence for an illegal behavior ($i = 2$), the agency never drops the case, $m_2^* = 1$. Instead, the agency fully investigates the individual's behaviour.*
- *If a preliminary investigation provides sufficient evidence for an illegal behavior ($i = 1$), the agency may drop the case, $m_1^* \leq 1$. The decision whether or not to abandon proceedings depends on the costs and on the reliability of the results obtained during the preliminary investigations.*

A formal proof of this result is given in the appendix. The intuition behind this result is as follows. Suppose that the regulatory agency wants to increase the probability of abandoned proceedings. To keep the rate of compliance constant, the agency then has to increase the probability of preliminary investigations. In sum, this has the following consequences for its enforcement costs:

- The costs for preliminary investigations increase due a higher probability of those activities.
- The costs for further investigations are also affected: On the on hand, increasing the probability of abandoned proceedings implies lower costs. On the other hand, more individuals will comply with the law - due to the higher probability of preliminary investigations - and, hence, the probability for an appeal increases. Whether or not

the overall costs for further investigations are positively or negatively affected depends on the agency's assessment of the actual behaviour of a suspected offender:

- If its preliminary investigation provides strong evidence for a non-complying behaviour, it is more likely that the individual actually behaved illegally.¹⁶ To ensure that the overall rate of compliance keeps constant, it is then necessary to increase the probability of preliminary investigations more than to reduce the probability of abandoned proceedings. However, since the probability for strong evidence is small if an individual behaved legally - only these individuals will lodge an appeal - the rate of objections increases, and, therefore, the expected costs for further investigations. Together with the increased costs for preliminary investigations a reduction of the probability of abandoned proceedings leads to higher overall enforcement costs.
- If, however, preliminary investigations provides sufficient evidence for a non-complying behaviour, the expected costs for further investigations will decrease: According to the Monotone Likelihood Ratio Condition, it is relatively more likely that a preliminary investigation provides sufficient rather than strong evidence if the individual complies with the law.¹⁷ But then a reduction of the probability of abandoned proceedings implies a smaller increase in the probability of preliminary investigations in order to keep the overall rate of compliance constant. Hence, the rate of objections decreases. Whether the reduction in the expected costs for further investigations is greater than the increased costs for preliminary investigations depends on institutional conditions: If the costs for preliminary investigations are sufficiently low, a lower probability of abandoned proceedings is beneficial and the agency can increase the rate of compliance. This is also true if the probability is high that a complying behaviour leads to insufficient evidence: The expected costs for additional further investigations are low because the increase in the rate of objections is small.

4. The Optimal Design of Procedural Rules

First, we compare the legal procedure with a strict separation between prosecution and punishment and the legal procedure with the possibility of pre-trial sanctions in preliminary proceedings. According to result 1 and result 2, the rate of compliance in the first case is lower than the one in the second case iff

$$\frac{1}{c_E} < \max \left\{ \left(\frac{\pi_2(N)}{c_p + \pi_2(C)F(\bullet)c} \right), \left(\frac{\pi_1(N) + \pi_2(N)}{c_p + (\pi_1(C) + \pi_2(C))F(\bullet)c} \right) \right\},$$

¹⁶ This follows from the Monotone Likelihood Ratio Condition: $\pi_2(N) > \pi_2(C)$.

¹⁷ That is, $\frac{\pi_1(C)}{\pi_1(N)} > \frac{\pi_2(C)}{\pi_2(N)}$.

which is satisfied iff

$$c < \max \left\{ \left(\frac{\pi_2(N)c_E - c_p}{\pi_2(C)F(\bullet)} \right), \left(\frac{(\pi_1(N) + \pi_2(N))c_E - c_p}{(\pi_1(C) + \pi_2(C))F(\bullet)} \right) \right\}.$$

Result 4: *The legal procedure which is determined by pre-trial sanctions in preliminary proceedings leads to a higher rate of compliance as the legal procedure which is determined by strict separation of prosecution and punishment if one of the following conditions holds:*

- *Most of the findings obtained in course of a preliminary investigation can be used at court such that the additional costs for the agency to fully investigate an individual's behaviour are low.*
- *The rate of compliance is low due to institutional conditions. This is the case if, for example, the agent's enforcement budget is low, the maximal possible sanction is low, or the individuals' private benefits from illegal behaviour are high.¹⁸*
- *Preliminary investigations screen complying and non-complying individuals in the following sense: The probability is low that a preliminary investigation provides insufficient evidence for an illegal behaviour if the individual complies with the law.¹⁹*

Two remarks are worth noting. First, the two legal procedures lead to the same rate of compliance if there is no uncertainty in preliminary investigations, i.e. $\pi_0(C) = 1$ and $\pi_2(N) = 1$ and if the costs are identical, i.e. $c_p = c_f$. Second, note that if the legal procedure with a strict separation between prosecution and punishment involves some kind of selection mechanism, that is preliminary investigations by the agency prior to (further) full investigation, this procedure always leads to a lower rate of compliance than the procedure with the possibility of pre-trial sanctions in preliminary sanctions: Due to its incomplete information about individuals' behaviour, the agency can use pre-trial sanctions to screen individuals according to their decision whether or not to lodge an appeal.

Consider now the legal procedure which gives the agency the possibility to abandon proceedings after an appeal and the legal procedure without this possibility. Of course,

¹⁸ All three factors imply that $F(\bullet)$ is low.

¹⁹ That is, $\pi_1(C)$ and $\pi_1(C) + \pi_2(C)$ are small.

the first procedure is always better than the second one: To abandon proceedings may lead to a higher rate of compliance, see result 3 and, the regulatory agency may decide not to use its possibility. Given that the agency is interested in minimising the number of offences, the rate of compliance in case of a legal procedure which allows to abandon proceedings is at least as high as the rate of compliance in case of a legal procedure without this possibility.

From an economic point of view, it might therefore be socially beneficial to allow for cost considerations by the regulatory agency during the proceedings: If the agency anticipates that pressing charges into court may not prove illegal behavior, it might be optimal to abandon proceedings and to reallocate the financial resources necessary for further investigations to the use of preliminary investigations. The agency bases its decision on the information about the actual behavior of an individual obtained during its preliminary investigations as well as on the information obtained by the fact that the suspected offender makes use of his right to lodge an appeal. Since it is more likely that a non-complying individual admits his offence than an individual who behaved legally, the agency should reconsider its pre-trial sanction on the basis of this information.

5. Concluding Remarks

Our results on the optimal design of procedural rules are derived in a game-theoretic framework. In particular, we made several assumptions on the behaviour of the parties involved in the law enforcement process. In the following, we will discuss these assumption and the limitations of our results for public policies.

We assumed that the individuals rationally decide whether or not to comply with the law. This approach follows the seminal article by Becker (1968) but implies that we ignored other factors which might be important for an individual's decision. For example, we assumed that individuals are perfectly informed about the enforcement activities by the regulatory agency. However, they may not know the probability of apprehension, the magnitude of the sanctions, or both. Further, they may not even know the structure of legal procedures in use.

We have ignored several other aspects that are relevant when deciding on the optimal structure of law enforcement. We assumed that the regulatory agency can commit to its enforcement policy such that individuals can base their decision on this information. In the absence of this commitment ability, the following problem may arise. Suppose that the individuals decide on their behaviour as if the agency's announcement would be credible. But then the agency has an incentive not to investigate the individuals' behaviour and to save on enforcement costs. However, if this behaviour of the agency is foreseen by the individuals, their incentives to commit the offence increase. On remedy to this credibility problem may be to delegate law enforcement activities to private parties.²⁰

²⁰ See Melumad/Mookherjee (1989) and Besanko/Spulber (1989).

In modelling public enforcement, we followed Posner (1972) and assumed that the regulatory agency will act in the public good. In the context of our model, its goal is assumed to be to enforce the law such that the number of offences is minimal. Of course, one may argue that officials at public authority might lack the incentive to pursue enforcement rigorously, since their compensation does not turn on the success of litigation. Thus, the problem of moral hazard due to public enforcement may considerably limit our results.

Appendix: Proof of Result 3

To prove this result, it is sufficient to consider the two possible policies $(0, w)$ and (w, w) , see Result 2. Note, that the analysis in case of procedural rules without the agency's possibility to drop the case requires $m_1 = m_2 = 1$.

1. Case: Let $(p_0^*, 0, w)$ be the optimal policy, given $m_2 = 1$. Then the rate of compliance is equal to

$$F(p_0^* \pi_2(N)w),$$

where p_0^* satisfies the budget constraint. Now suppose the agency has the possibility to drop the case. Suppose that $m_2 < 1$. Then the expected sanction for an offender is

$$p \pi_2(N) m_2 w$$

if the agency chooses a probability $p \in (0, 1)$ for preliminary investigations. To ensure an identical rate of compliance, the agency then has to choose

$$p = \frac{p_0^*}{m_2}.$$

This requires $m_2 > p_0^*$. Suppose that this inequality is satisfied. But then the following argument shows that the agency's budget constraint is violated:

$$\begin{aligned} & \frac{p_0^*}{m_2} [c_p + \pi_2(C)F(\bullet)cm_2] \\ &= p_0^* \left[\frac{c_p}{m_2} + \pi_2(C)F(\bullet)c \right] > E. \end{aligned}$$

Hence, $m_2 < 1$ cannot be optimal under a policy $(0, w)$.

2. Case: Let (p_w^*, w, w) be the optimal policy, given $m_1 = m_2 = 1$. Then the rate of compliance is equal to

$$F(p_w^*(1 - \pi_0(N))w)$$

and p_w^* satisfies the corresponding budget constraint. Now suppose the agency chooses $m_1 = 1$, $m_2 < 1$.²¹ Then the expected sanction for non-compliance is

$$p[\pi_1(N)w + \pi_2(N)m_2w].$$

A rate of compliance equal to $F(p_w^*(1 - \pi_0(N))w)$ then requires a probability p equal to

$$\frac{p_w^*(1 - \pi_0(N))}{\pi_1(N) + \pi_2(N)m_2} := Ap_w^*.$$

Suppose that m_2 is chosen such that p is less than one. But then this policy implies expected enforcement cost which exceeds the agency's enforcement budget:

$$p[c_p + F(\bullet)(\pi_1(C) + \pi_2(C)m_2)c] > E$$

$$\text{iff } c_p(A - 1) + cF(\bullet)(A - 1)\pi_1(C) > cF(\bullet)\pi_2(C)(1 - Am_2)$$

which is satisfied since $c_p \geq 0$ and $(A - 1)\pi_1(C) > (1 - Am_2)\pi_2(C)$ according to the Monotone Likelihood Ratio Condition. Hence, $m_1 = 1$ and $m_2 < 1$ is not optimal.

Second, consider the case in which $m_1 < 1$ and $m_2 = 1$.²² Then an offender has to expect a sanction

$$p[\pi_1(N)m_1w + \pi_2(N)w].$$

To achieve a rate of compliance equal to $F(p_w^*(1 - \pi_0(N))w)$, the probability of a preliminary investigation p has to satisfy

$$p = \frac{p_w^*(1 - \pi_0(N))}{\pi_1(N)m_1 + \pi_2(N)} := Bp_w^*$$

Let m_1 be chosen such that $p \leq 1$. Then the agency can achieve this rate of compliance with less enforcement cost, i.e.

²¹ The following argumentation is similar for $m_1 < 1$.

²² The following argumentation is similar for $m_2 < 1$.

$$p[c_p + F(\bullet)(\pi_1(C)m_1 + \pi_2(C))c] < E$$

$$\text{iff } c_p(B-1) + cF(\bullet)B(\pi_1(C)m_1 + \pi_2(C)) < cF(\bullet)(1 - \pi_0(C))$$

which is satisfied, for example, if c_p is low²³ $B[\pi_1(C)m_1 + \pi_2(C)] < 1 - \pi_0(C)$ or if the probability is high that a preliminary investigation provides insufficient evidence for an offender, if the individual actually is complying with the law.

Literature

- Adreano, R. and J. Siegfried (1980. eds.): *The Economics of Crime*, New York: Wiley.
- Baron, D. and D. Besanko (1984): Regulation, Asymmetric Information and Auditing, *Rand Journal of Economics* 15, pp. 447-470.
- Becker, G. (1968): Crime and Punishment: An economic approach, *Journal of Political Economy* 76, pp. 169-217.
- Becker, G. and W. Landes (1974, eds.): *Essays in the Economics of Crime and Punishment*, New York: Columbia Univ. Press.
- Besanko, D. and D. F. Spulber (1989): Delegated Law Enforcement and Non-cooperative Behavior, *Journal of Law, Economic, and Organization* 5 (1), pp. 25-52.
- Easterbrook, F. H. (1982): Ways of Criticizing the Court, *Harvard Law Review* 95 (4), pp. 802-832.
- Ehrlicher, I. (1973): Participation in Illegitimate Activities: A Theoretical and Empirical Investigation, *Journal of Political Economy* 81, pp. 521-565.
- Göhler, E. (1980): *Gesetz über Ordnungswidrigkeiten, Kommentar*, München: Bech'sche Verlagsbuchhandlung.
- Grossman; G. M. and M. L. Katz (1983): Plea Bargaining and Social Welfare, *American Economic Review* 73, pp. 749-757.
- Heinecke, J. (1978, ed.): *Economic Models of Criminal Behavior*, Amsterdam: North-Holland.
- Kobayashi, B. and J. Lott (1992): Low-Probability-High-Penalty Enforcement Strategies and the Efficient Operation of the Plea-Bargaining System, *International Review of Law and Economics* 12, pp. 69-77.
- Melumad, N. and D. Mookherjee (1989): Delegation as Commitment: The Case of Income-Tax Audits, *Rand Journal of Economics* 20, pp. 139-163.

²³ Note that $B[\pi_1(C)m_1 + \pi_2(C)] < 1 - \pi_0(C)$ iff $\pi_1(N)\pi_2(C) < \pi_2(N)\pi_1(C)$.

Pyle, D. (1983): *The Economics of Crime and Law Enforcement*, New York: St. Martin's.

Roxin, C. (1985): *Strafverfahrensrecht: Ein Studienlehrbuch*, München: Beck.

**Forschungspapiere
der Wissenschaftlichen Hochschule für Unternehmensführung (WHU)
- Otto-Beisheim-Hochschule -**

Lfd. Nr.	Autor	Titel
1	Weber, Jürgen	Theoretische Herleitung eines Controlling in Software-Unternehmen (Juni 1991)
2	Heinzl, Armin	Spinning off the Information Systems Support Function (Juni 1991)
3	Setzer, Ralf	Ergebnisse einer Befragung zur Beschaffungsplanung für zentrale Rechnersysteme (August 1991)
4.	Pfähler, Wilhelm Lambert, Peter	Die Messung von Progressionswirkungen (Oktober 1991)
5.	Pfähler, Wilhelm Lambert, Peter	Income Tax Progression and Redistributive Effect: The Influence of Changes in the Pre-Tax Income Distribution
6.	Pfähler, Wilhelm Leder, Thomas	Operative Synergie - von der Theorie zur Unternehmenspraxis (z.Zt. nicht erhältlich, wird überarbeitet)
7.	Wiese, Harald	Network Effects and Learning Effects in a Heterogeneous Dyopoly (Dezember 1991)
8.	Heinzl, Armin Stoffel, Karl	Formen, Motive und Risiken der Auslagerung der betrieblichen Datenverarbeitung (Januar 1992)
9.	Bungenstock, C. Holzwarth, J. Weber, Jürgen	Wegfallkosten als Informationsbasis strategischer Entscheidungen (Januar 1992)
10.	Lehner, Franz	Messung der Software-Dokumentationsqualität (August 1992)
11.	Heinzl, Armin Sinß, Michael	Zwischenbetriebliche Kooperationen zur kollektiven Entwicklung von Anwendungssystemen (August 1992)
12.	Heinzl, Armin	Die Ausgliederung der betrieblichen Datenverarbeitung
13.	Lehner, Franz	Expertensysteme zur Unterstützung der strukturorganisatorischen Gestaltung von Unternehmen
14.	Lehner, Franz	Brauchen wir eine Theorie der Wirtschaftsinformatik?
15.	Lehner, Franz, Setzer, Ralf Hofmann, Hubert	Wartung und Pflege von Wissensbanken

16. Müller, Wolfgang
Klein, Sebastian Grundzüge einer verhaltensorientierten Preistheorie im Dienstleistungsmarketing
17. Lehner, Franz Considerations on Information System Strategies Based on an Empirical Study
18. Lehner, Franz
Hofmann, Hubert
Setzer, Ralf Maintenance of Knowledge Based Systems
19. Lehner, Franz
Sikora, Hermann Wartung objektorientierter Softwaresysteme
20. Lehner, Franz
Röckelein, Wolfg. Anwendung der Erfolgsfaktoren-Analyse zur Diagnose der betrieblichen Informationsverarbeitung
21. Lehner, Franz Gedanken und Notizen zur Entwicklung von Informatik-Strategien
22. Albach, Horst La Economia de la Empresa Como Ciencia
23. Müller, Wolfgang Konzeptionelle Grundlagen des Integrativen Dienstleistungsmarketing
24. Weber, Jürgen
Hamprecht, Markus Stand und Anwendungsperspektiven des Controlling in Verbänden und ähnlichen Non-Profit-Organisationen (März 1994)
25. Weber Jürgen
Kummer, Sebastian
Großklaus, Armin
Nippel, Harald
Warnke, Dorothee Methodik zur Generierung von Logistik-Kennzahlen (Juni 1994)
26. Kummer, Sebastian Controlling Logistics in the German Automotive Industry (Juni 1994)
27. Weber, Jürgen Zur Bildung und Strukturierung spezieller Betriebswirtschaftslehren (August 1994)
28. Weber, Jürgen
Kaminski, Arndt Zum Promotionsverhalten in der deutschsprachigen Betriebswirtschaftslehre (Oktober 1994)
29. Rösler, Frank Target Costing für komplexe Produkte Ein Diskussionsbeitrag zur Anwendungsproblematik des Zielkostenmanagements (März 1995)

30. Weber, Jürgen
Brettel, Malte
Großklaus, Armin
Hamprecht, Markus
Rösch, Barbara E.
Schäffer, Utz
Grundgedanken zur Entwicklung einer Theorie der Unternehmensführung (Mai 1995)
31. Weber, Jürgen
Kostenrechnung-(s)-Dynamik - Einflüsse hoher unternehmensex- und -interner Veränderungen auf die Gestaltung der Kostenrechnung (Mai 1995)
32. Weber, Jürgen
Selektives Rechnungswesen (Mai 1995)
33. Weber, Jürgen
Controlling versus New Public Management als alternative oder sich ergänzende Konzepte der Umgestaltung öffentlicher Institutionen? (März 1996)
34. Weber, Jürgen
Goeldel, Hanns
Schäffer, Utz
Zur Gestaltung der strategischen und operativen Planung (April 1996)
35. Weber, Jürgen
Brettel, Malte
Schäffer, Utz
Gedanken zur Unternehmensführung (April 1996)
36. Jost, Peter-J.
Crime, Coordination, and Punishment: An Economic Analysis (Mai 1996)
37. Jost, Peter-J.
A Positive Economic Analysis of Law Enforcement (September 1996)