COMPETITION LAW COMPLIANCE PROGRAMS AS INTERNAL SIGNALING DEVICES
Daniel Herold*

ABSTRACT
Cartel profitability depends on expected fines imposed by an authority. A manager informed about cartel profitability can use compliance programs as signals to prevent an uninformed employee from anticompetitive behavior. Signals can be (i) direct investments in compliance programs or (ii) indirect investments in personal commitment to compliance (tone-at-the-top). In a separating equilibrium, compliance investments coordinate agent's behavior efficiently for the firm: Cartelize if it pays off and compete otherwise. The authority can deter collusion without errors by increasing fines. Cartels that hurt consumers and the firm can only emerge outside of separating equilibria. Separating equilibria are more likely to exist if investment costs are not too high and in case (ii) by increasing profit-related bonuses. We analyze personal cartel fines in a repeated version of the game. While personal punishments for managers can hinder coordination on law conform behavior, punishing employees deters collusion.

Keywords: Cartel; Compliance; Bayesian Game; Competition Law

preliminary version – please do not quote or circulate

* Chair for Industrial Organization, Regulation and Antitrust
Justus-Liebig-University Giessen
Licher Straße 62
D-35394 Giessen
email daniel.herold@wirtschaft.uni-giessen.de
phone +49-641-9922055
fax +49-641-9922059
web http://www.uni-giessen.de/fbz/fb02/fb/professuren/vwl/goetz/kontakt/mitarbeiter/daniel-herold-m-sc
1. Introduction

Violations of antitrust laws can be very expensive for firms. The highest cartel fine for a single firm until now was 715 Mio. € in the Car Glass case. In Europe fines have drastically risen since 2000 with an additional sharp increase starting in 2005.\(^1\) Anecdotal evidence for this can be seen for example in the US and Germany, where 2014 marks the year of the highest total fines ever imposed.\(^2\) These higher fines can be an indication of higher cartel activity, though, this could also be a hint that (expected) negative consequences for firms rose due to a higher detection probability and/or higher fines. Besides a cartel's negative impact on welfare, these fines can have substantial consequences for the undertakings involved in the infringement which can be seen for example in the case of the German rail cartel: As a result of the cartel, ThyssenKrupp shut down its railway equipment subsidiary.\(^3\)

One way for a firm to avoid cartel activity is to install a competition law compliance program (CP). According to the OFT (2010: 10-11), CPs basically involve four stages: risk identification, risk assessment, risk mitigation and a review step. With the latter being a control device, the target of the first three steps is to spot possible threats (risk identification), rank them according to their overall risk potential (risk assessment) and to reduce those threats (risk mitigation). According to Murphy and Kolasky (2012) one major risk factor is that employees underestimate the risk of detection by competition authorities. To reduce this uncertainty and the lack of information, firms can, e.g., install training programs for their employees (Paha 2014). Here, an internal or external trainer stresses the importance of law abiding behavior, the threat of detection and the negative consequences for the firms. Another measure is to create an internal code of conduct or ethics code to emphasize the firm's commitment for compliance with (antitrust) laws.

There is a major credibility problem with cartel activity that arises in the context of compliance measures. It is a matter of fact that in a cartel, firms generate higher profits. So why should an employee obey the law when a trainer or a written document recommends him to do so? Neglecting fines, being in a (stable) cartel typically pays off. Some evidence for this claim can be found for example in Connor and Bolotova (2006). A firm cannot explicitly communicate or directly contract cartel activity since this would be a violation of the law.\(^4\) If the firm cannot

---

For Germany, see: http://www.bundeskartellamt.de/EN/Banoncartels/banoncartels_node.html
4 A firm can indirectly influence the propensity to collude of its employees by adjusting their incentive contracts (see
credibly communicate that the employee should engage in collusive activity, communicating law compliance might also not be credible. Therefore, besides their original meaning, we interpret the aforementioned compliance measures as signals. For example, offering training programs can be interpreted as a more costly signal than creating a code of ethics.

This paper addresses the question on the effectiveness of CPs on competition law compliance by interpreting the investment costs of the programs as signals in a manager-employee relationship. Taking fines into account, a cartel can be profitable or not, depending on the overall level of fines and the probability of detection. Since fines are typically calculated on the basis of the firm as a whole⁵, the employee might not know the actual level of expected fines, i.e., whether a cartel pays off. However, he has to decide whether to engage in collusive activity. To send a signal, a better informed manager can make different levels of compliance-investments.

Direct investments in CPs (e.g., training programs for employees) are made on a firm level and therefore reduce total profits. The manager can also make a personal investments in compliance. We call this an indirect investment since it does not directly reduce firm's profits. This concept is called tone-at-the-top and can be understood as a firm's upper level hierarchy's dedication to and communication of law conform behavior and is described as a crucial factor of CPs (OFT 2010: 36-37, International Chamber of Commerce 2013: 4, Schwartz, Dunfee and Kline 2005, Paternoster and Simpson 1996).⁶ To the best of our knowledge, this is the first paper to formally address the tone-at-the-top in a theoretical model with typical, neo-classical assumptions. One result of the model is that making a high indirect investment in compliance via tone-at-the-top can be a rational, equilibrium strategy of the manager to credibly signal that a cartel does not pay off and to coordinate on a (compliant) competitive outcome. By analyzing their coordination function, this paper also contributes to the discussion on whether CPs and corporate codices in general are only tools of public relation (Stevens 2007) and for reducing fines (US sentencing guidelines)⁷ or whether they are really promoting firms’ law compliant behavior.

We solve a non-repeated and a repeated coordination game in which a separating perfect Bayesian Nash equilibrium (PBE) can be reached by signaling. We adopt the basic ideas of Signaling (Spence 1972), while the non-repeated game is technically comparable to Kreps and

---

⁵ http://ec.europa.eu/competition/cartels/overview/factsheet_fines_en.pdf

⁶ The tone-at-the-top captures any sort of corporate crime. Although we focus on cartels here, the idea can be generalized to many sorts of corporate crime like cooking the books or violating environmental laws. For more information about tone-at-the-top and the general role of leadership on the coordination of subordinates, see Amernic, Craig and Tourish 2010, Collier and Esteban 2007 and d’Adda, Darai and Weber 2014.

Wilson (1982). Therefore, the paper is related to the literature of communication (see Riley 2001 and Farrel and Rabin 1996 for an overview of signaling and for communication in general, respectively). We will call the employer/manager the principal and the employee the agent throughout the analysis, since we examine a delegation problem. The manager can for example be a member of the board of directors who has an interest in maximizing firm value (Fershtman and Judd 1987). In the model, the employee is, e.g., a sales director or manager who is responsible for determining the actual pricing or quantity decision on the goods market. To this end, the setting is strongly related to the Principal-agent literature which examines internal firm structure in oligopoly settings (Sklivas 1987, Scharfstein 1988, Katz 1991, Schmidt 1997 and Aggarwal and Samwick 1999). There is another theoretical paper by Angelucci and Han (2010) which is closely related to our analysis. They examine CPs as internal monitoring devices in a three-tier (authority-)principal-agent setting. We add another facet to the discussion, namely, the coordination function of CPs. In our model the principal's information (or type) is unobservable to the agent. Furthermore, we focus on two levels of a firm's hierarchy and assume incentive contracts to be exogenously given.

We show that separating PBE exist when (direct and/or indirect) investment costs in compliance are not too high. In a separating PBE, the agent colludes only if it pays off and competes otherwise. That means that, for example, when an authority changes the fining guidelines to incorporate higher fines making a cartel unprofitable, a firm correctly switches to competitive market behavior. The *tone-at-the-top* approach is analyzed in a non-repeated version of the game and it is shown that it is cheaper for the firm as a whole when the manager makes a high indirect investment. However, the manager will have to be compensated for this costly signal. This can for example be done by increasing profit-related bonus payments. Therefore, we add another aspect to the literature of strategic delegation and collusion (For example, Fershtman, Judd and Kalai (1991), Spagnolo (2000, 2005), Aubert (2009), Han (2011)): Offering higher bonuses may promote compliance and, again, aligns the firm's interest with those of the manager (Grossman and Hart 1983). It is often discussed that adding managerial penalties can improve cartel deterrence (Kokkinaki 2013, Buccirossi and Spagnolo 2005).

In a repeated version of the game we analyze the impact of personal fines (penalties of the authority or damage claims) for the manager and for the employee on the existence of separating PBE and the emergence of cartels. By introducing punishments, collusion becomes less attractive since future payoffs in case of detection decrease. For farsighted managers this leads to a situation where competition is the preferred outcome independent of whether a cartel pays off or not. This seems to be a good situation from a welfare perspective. However, this implies that there is a
pooling PBE. In this case a main driver of market behavior is the agent’s prior of the threat of the authority. Depending on this prior an unprofitable cartel might be established that hurts both the consumers and the firm. However, the range of priors which lead to collusive behavior shrinks if sanctions are introduced for the employee. To avoid cartel activity, it is more reasonable to punish the employee or to raise firm-level fines than to sanction the manager who primarily has a coordination function in the firm.

The paper is structured as follows. Chapter 2 covers the non-repeated version of the model. Chapter 3 presents an extension to a repeated game where personal punishments are analyzed. Chapter 4 concludes.

2. The basic model

The set of players is \( P' = \{A, P\} \) with \( A \) being the employee/agent and \( P \) being the manager/principal. Both players are risk-neutral, so delegation takes place because of the lack of skill or knowledge (Laffont and Martimort 2001: 12). The agent can choose an action \( s_A \in S_A = \{C, K\} \) with \( C \) being competitive behavior and \( K \) being cartelization. For the manager, we can distinguish between two approaches, a direct and an indirect investment-strategy. Define the low and high direct investment choices by \( d \in \{L, H\} \) and the low and high indirect investment choices by \( i \in \{l, h\} \), respectively. The principal's strategies are tuples of direct and indirect investments \( (d, i) \), with \( s_P = (d, i) \in S_P = \{(L, l), (L, h), (H, l), (H, h)\} \) being the strategy set. Strategy \( (d, i) \) induces investment costs \( (I_d, i) \in \mathbb{R}^2 \). A choice \( s_P = (L, h) \) for example means that the principal makes a low direct investment in compliance and a high indirect investment by incurring personal costs (\textit{tone-at-the-top}) which generates overall investment costs in compliance \( (I_l, i_h) \).

The CP investment-strategies require some discussion. A CP can involve different levels of investment (see Götz, Herold and Paha 2014 for an overview of different measures). For the purpose of signaling, the costs of different approaches are of major importance. The cheapest way to 'invest' in compliance would be to tell the employees not to violate competition laws at some meeting, by printed booklets, via e-mail or in a written code of conduct since the costs of those measures can be negligible. On the other hand, some compliance measures can be very expensive. A firm can for example invest in expensive training programs, establish regular compliance meetings or set up an independent compliance department. There are labor costs for the employees in the newly established department, potential cost for hiring external experts for the training session as

---

8 We do not focus on mixed strategies throughout the paper.
well as the foregone working effort of the employees when attending the courses or the meetings. If the firm decides to further install an internal screening device in a way described in Angelucci and Han (2010) or Herold (2014), this can be even more expensive. In addition to that, this can lead to shrinking efforts because the employees might feel observed and distrusted (Falk and Kosfeld 2006).

The measures described above involve costs incurred by the firm. In addition to or instead of those direct costs there can be indirect costs in terms of disutility incurred by the manager. A manager can make personal investments in compliance efforts a lá tone-at-the-top by serving as a role model. This can be done for example by attending ethical training sessions for managers as described in Schwartz, Dunfee and Kline (2005). As the daily tasks of a manager will have to be done anyway, attending the courses requires extra working time. Other examples for those measures would be that the manager is always present in the training session and communicates the compliance codices face-to-face or in separate compliance speeches to show his commitment. Depending on the size of the firm, this process can be very time consuming and, therefore, very costly.

The difference between direct and indirect costs can be seen as an interpretation of the tone-at-the-top issue. When a manager spares some time dedicated to compliance efforts, this can be seen as a tone-at-the-top approach. In contrast to that, there is the issue of a cheap vs. an expensive signal. A simple e-Mail stressing out the importance of law-conform can be interpreted as a cheap signal; ethics training for managers or an independent compliance department are expensive signals. The following table gives an overview of different measures and summarizes the above discussion.

<table>
<thead>
<tr>
<th>Level of investment</th>
<th>Bearer of the cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>firm</td>
</tr>
<tr>
<td>low</td>
<td>- upload code of conduct/instructions about antitrust-law conform behavior</td>
</tr>
<tr>
<td></td>
<td>- posters with instructions</td>
</tr>
<tr>
<td></td>
<td>- regular antitrust law trainings for employees</td>
</tr>
<tr>
<td></td>
<td>- Compliance</td>
</tr>
</tbody>
</table>
Firm's profits in a cartel $\pi_K$ are higher than in a competitive state $\pi_C$. Assume that cartelizing behavior of the agent always leads to a cartel. However, the cartel might be profitable or unprofitable, depending on the state of the authority which is either dangerous or innocuous. Therefore, we can define the 'type' of the Manager $\theta$ (or his firm) as either safe $S$ or endangered $D$. Depending on $\theta \in \Theta = \{S, D\}$ the expected fine is $F_\theta$. Assume now that in a safe state, a cartel pays off while in a dangerous state it does not:

$$\pi_K - F_S > \pi_C \land \pi_K - F_D < \pi_C$$ (1)

Note that for the basic model in (1), we do not distinguish between detection probabilities and fines. In the repeated game, we will assume that expected fines are $\rho_\theta F_\theta$. These firm-level fines can also cover private damage claims as well. The difference between the states can for example be explained by a industry inquiry in the industry where the firm is active. This might drive up detection probabilities and make the cartel unprofitable. Another reason could be changes in antitrust laws that increase the potential sanctions or the detection probability. The introduction of leniency programs could be seen as an example for the latter (Miller 2009). While the agent does not know that, it is reasonable to assume that the principal as a manager who determines the overall course of the firm is aware of the threat generated by the authorities.

The timing of the game is as follows. In period 1, the principal chooses compliance activity $s_p \in S_p$, in period 2 the agent chooses $s_a \in S_a$. In period 3 the authority screens the market and

9 If there is uncertainty about whether a functioning cartel will be created (see Harrington and Chang 2009, Herold 2014), the profits can be seen as expected values. Let $\kappa > 0$ be the probability that the cartel will be set up if the employee decides to collude. In this case, $\kappa \pi_K + (1 - \kappa) \pi_C > \pi_C$ holds. Together with assumption (1), the results will still hold.

10 We assume that the principal perfectly knows the authority's state, i.e., his type. If one wants to relax this assumption, one could extend the model in a similar way Austen-Smith (1994) did. He assumed that the sender (here, the principal) could acquire the relevant information with some cost while the receiver (the agent) does not have a chance to observe whether the sender chose to stay uninformed.

11 We will argue below that the authority can adjust the laws in a way such that a cartel becomes unprofitable. Although an authority cannot directly influence private damage claims it can nonetheless make it easier for harmed consumers to sue the firms (see, for example, the directive on antitrust damages actions of the European Commission from 2014).
imposes an expected fine of $F_\theta$.\footnote{Note that due to simplified notation, we left out that the detection probability is $\rho_\theta$ and the fine in case of detection is $F_\theta.$} After that, utilities are realized.

Both players derive utility from the firm's profits. The wage of the principal is determined by an incentive contract which consists of profit-related bonuses as described in Murphy (1999, 2001). The is also true for the agent. Incentivizing the agent with contracts which offer higher bonuses when some parameters related to profits increase can be seen in reality, although it is rare due to the difficulties in designing the contracts (Frenzen et al. 2008). We could also argue that the chances of replacement or job loss due to bankruptcy are lower when profits are higher (see Stephan 2006: 14). This also generates a positive connection between profits and the utility of the agent. Moreover, for CEOs, Jenter and Lewellen (2014) show that bad stock price performance increases the chance of CEO turnover. Hence, depending on the level of the hierarchy and the size of the firm, this assumption is reasonable. Assume that $u_i(\pi, \cdot)$ with $\partial u_i(\pi)/\partial \pi > 0$ $\forall \ i \in P$ with $u_A: S_A \times S_P \rightarrow \mathbb{R}$ and $u_P: S_A \times S_P \times \Theta \rightarrow \mathbb{R}$. Furthermore assume a linear profit related bonus scheme where $\beta$ constitutes percentage bonuses on wages based on the profit.\footnote{The results also hold with the general assumption that both players' utilities increase in profits. The assumption of a specific, linear contract is made to make the results clearer.} To simplify notation, both players share the same bonus parameter. For the agent, is is sufficient that $\beta > 0$ to derive the results. Only the conditions for the existence of a separating PBE concerning the principal are really affected by $\beta$ as shown below. Profits $\pi$ itself are determined by the market behavior of the agent as well as by the behavior of the authority.

2.1 Solving the basic model

Before deriving the results of the basic game, we first define the solution concept. A perfect Bayesian Equilibrium (PBE) is defined as follows:\footnote{The definition is taken from Fudenberg and Tirole (1991: 325-326)}

In a Signaling game, the strategy profile $\sigma^*$ and posterior beliefs $\mu(\theta|s_P)$ form a PBE if
\[ \sigma^*_{\rho}(s_p \mid \theta) \in \arg\max_{s_r} \mathbb{E}_P\left[s_p, \sigma^*_{\theta}, \theta \right] \forall \theta \in \Theta \]

\[ \sigma^*_{\theta}(s_A \mid \theta) \in \arg\max_{s_A} \sum_{\theta \in \Theta} \mu(\theta) \mathbb{E}_P\left(s_p, s_A, \theta \right) \forall s_p \in S_P \]

\[ \mu(\theta \mid s_p) = \frac{p(\theta) \sigma^*_{\rho}(s_p \mid \theta)}{\sum_{\theta' \in \Theta} p(\theta') \sigma^*_{\rho}(s_p \mid \theta')} \text{ if } \sum_{\theta' \in \Theta} p(\theta') \sigma^*_{\rho}(s_p \mid \theta') > 0 \]

and \( \mu(\theta \mid a_p) \) is any probability distribution on \( \Theta \)

\[ \text{if } \sum_{\theta' \in \Theta} p(\theta') \sigma^*_{\rho}(s_p \mid \theta') = 0 \]

is satisfied. The first line in (2) is the optimality condition of the principal given the agent's best response. The second line captures the agent's optimal behavior given principal's behavior and posterior beliefs. The last two lines capture Bayesian updating of the prior after observing the respective actions of the principal. In case of a probability-0 event, i.e., if the agent observes an action of the principal which is not optimal, any probability distribution is possible.

**Lemma 1:** In a pooling PBE, there is a value of the prior \( p_{\text{ind}} \) for which the agent is indifferent between collusion and competition. For \( p \in [0, p_{\text{ind}}] \), the agent will collude and for \( p \in [p_{\text{ind}}, 1] \), the agent will compete.

Proof: In a pooling equilibrium both types of principals choose a low investment. Since \( I_H > I_L \) and \( i_h > i_l \), the principal will always prefer \( L \) over \( H \), i.e., \( s_p = (L, l) \). If this is the case, the agent has no chance to draw any useful information from observing the principal's action. This leads to a situation where posterior beliefs equal prior beliefs, \( \mu = p \). Given the prior, the agent will maximize expected utility by comparing expected utility for \( s_A = C \) with \( s_A = K \):

\[ E(u_A(s_p, C)) > E(u_A(s_p, K)) \]  

(3)

We see that compliance investments cancel out and condition (3) reduces to:

\[ \pi_C > \pi_K - p(F_D - F_S) - F_S \]  

(4)

The RHS of (4) contains a certain gain \( \pi_K - F_S \) in case of collusion, however, in case of a dangerous authority, there are additional expected fines \( F_D - F_S \). The LHS depicts the certain profit from competitive behavior. Define \( p_{\text{ind}} \) as the value of the prior for which the agent is indifferent between collusion and competition:

\[ p_{\text{ind}} = \frac{\pi_K - F_S - \pi_C}{F_D - F_S} \in [0, 1] \]  

(5)

Note that assumption (1) ensures that \( p_{\text{ind}} \in [0, 1] \) is given since \( \pi_K - F_S > \pi_C \) and \( \pi_K - \pi_C < F_D \). For
\( p \in [0, p_{\text{ind}}], \) the RHS of (4) is larger than the LHS and the agent will prefer collusion. For \( p \in [p_{\text{ind}}, 1] \) the reverse is true. ■

**Lemma 2:** When a separating PBE exists, the employee will want to obey (break) the law in a dangerous (safe) state.

Proof: For \( \theta = D \), the employee’s payoff is \( u_A(s, s_A|\theta = D) \). According to the definition of the PBE, \( \sigma_A \) maximizes \( u_A \) given \( s \neq (L, l) \) as the best response of the manager in a dangerous state. Note that a safe-state principal would never make any high investment (Proposition 1). Competitive behavior (obeying the law) is preferred to collusion if the following condition holds:

\[
\begin{align*}
&u_A(H, C) > u_A(H, K) \\
\Leftrightarrow &\quad \pi_C - I_H > \pi_K - F_D - I_H
\end{align*}
\]

(6)

Note that by assumption \( \partial u_A(\pi)/\partial \pi > 0 \) holds. Since in a separating PBE signaling is credible it follows \( \mu(\theta = D|s_M \neq (L, l)) = 1 \), hence, the employee knows that the firm is exposed to a dangerous authority and there is no uncertainty anymore involved in (6). By assumption (1), a cartel does not pay off in this case. Therefore, we have \( \sigma^*_A(s_M \neq (L, l), \mu) = C \). Note that for \( \theta = S \), the same argument holds with low investment cost \( (I_L, i_l) \) and \( \mu(\theta = S|s_M = (L, l)) = 1 \) in a separating PBE. By assumption (1), a cartel pays off in a safe state. It follows that \( \sigma^*_A((L, l), \mu) = K \). ■

**Proposition 1:** A separating PBE exists iff the benefits from compliance in a safe state are higher than investment-costs.

Proof: As shown in Lemma 1 the agent will collude for \( p \in [0, p_{\text{ind}}] \) and compete if \( p \in [p_{\text{ind}}, 1] \). Hence, the agent will engage in unprofitable collusion for \( \theta = D \) and for priors \( p < p_{\text{ind}} \) and refrain from profitable collusion for \( \theta = S \) and for priors \( p > p_{\text{ind}} \). Since the value of the prior is known, we will now show that a \( \theta = S \)-type principal will never choose a high investment and a \( \theta = D \)-type principal will prefer any high investment to induce competition if investment costs are not too high. One consequence is that only \( \theta = D \)-type principals make any high investments in compliance.

For \( \theta = S \) and \( p \in [p_{\text{ind}}, 1] \), the principal knows that the agent will refuse to collude although a cartel would be profitable. As shown in Lemma 2, the agent will compete if he knew that the true state was \( \theta = S \). Hence, the agent will correctly update his prior if the principal has no incentive to induce competitive behavior by making a high investment-decision for \( \theta = S \). The conditions (incentive constraints) for the existence of a separating PBE in this case are:
The conditions in (7) is always satisfied. By assumption (1), safe state collusion always pays off which implies that cartel profits and, therefore, by \( \partial u_p(\pi) / \partial \pi > 0 \), also utilities are higher. Every investment costs \( I_H > I_L \) and \( i_h > i_l \) incurred to induce an unprofitable competitive outcome would further reduce utility.

For \( \theta = D \) and \( p \in [0, p_{\text{ind}}] \), the agent would engage in unprofitable collusion. Inducing competition with any high investment strategy \( s_P \neq (L, l) \) pays off iff at least one of the following conditions is satisfied:

\[
\begin{align*}
&u_p((L, h), C, D) > u_p((L, l), K, D) \\
&\Rightarrow \beta(\pi_c - (\pi_k - F_D)) > i_h - i_l \\
&\quad (8)
\end{align*}
\]

\[
\begin{align*}
&u_p((H, l), C, D) > u_p((L, l), K, D) \\
&\Rightarrow \pi_c - (\pi_k - F_D) > I_H - I_L \\
&\quad (9)
\end{align*}
\]

\[
\begin{align*}
&u_p((H, h), C, D) > u_p((L, l), K, D) \\
&\Rightarrow \beta(\pi_c - (\pi_k - F_D)) > \beta(I_H - I_L) + i_h - i_l \\
&\quad (10)
\end{align*}
\]

All three conditions capture the fact that additional investment costs in direct \( (I_H - I_L) \) or indirect \( (i_h - i_l) \) compliance measures should not be too high relative to the gains from compliance, i.e., either \( \pi_c - (\pi_k - F_D) > 0 \) or \( \beta(\pi_c - (\pi_k - F_D)) > 0 \) according to assumption (1). The difference between direct CP investments and indirect (tone-at-the-top) investments is that the latter leave firm’s profit unchanged. The consequence is that for \( s_p = (L, h) \) and \( s_p = (H, h) \) increasing the bonus parameter \( \beta \) makes it more likely that the respective incentive condition is satisfied. Obviously, if (6) or (7) are satisfied, (8) will be satisfied as well. This implies that \( s_p = (H, h) \) is dominated.

Given Lemma 1 and Lemma 2, it follows that for \( \theta = D \land p \in [0, p_{\text{ind}}] \), the principal’s best response is \( \sigma^p(C, D) = (L, h) \) if (8) is satisfied and if \( u_p((L, h), \cdot) > u_p((H, l), \cdot) \) holds. If (9) is satisfied and \( u_p((H, l), \cdot) > u_p((L, h), \cdot) \) holds, \( \sigma^p(C, D) = (H, l) \) will be the principal’s best response. For \( \theta = S \land p \in [p_{\text{ind}}, 1] \), the principal chooses a low investment \( \sigma^p(C, D) = (L, l) \) since this induces \( \sigma^*(L, l, \mu) = K \) by Lemma 1. ■
It is often argued that an effective CP has to be 'backed up' by management dedication (OFT 2010). In the model above, this result will not occur. However, one could think of cost-synergies, i.e., assume that for \( s_p=(H,h) \) costs of \((I_{h},i_{h})<i_{h}\) arise. That means that by making high direct and indirect investments in CPs, the costs for each measure is smaller then they would be if they were introduced alone. In this case, it is necessary that a high indirect investment reduces the costs for the direct investment and vice versa. A high indirect investment might reduce direct costs since, as described above, it involves extra managerial effort/working time. One could think of the manager being a 'compliance-expert' giving speeches during regular compliance meetings or at compliance training sessions so that no external person has to be hired for this purpose. For the case of high direct investments reducing the costs for tone-at-the-top, one could think of a compliance department making the principal's communication more efficient and less time consuming. Hence, it becomes easier for the principal to give speeches or to talk to specific subordinates which in the end reduces his investment-costs.

**Proposition 2:** If there are cost-synergies between high direct and indirect investments, \((H,h)\) is the principal's optimal strategy iff costs saving of implementing a high investment are higher than the extra cost incurred relative to the low investment-decision.

Proof: First, it is necessary that (10) holds which in turn requires that also (8) and (9) are satisfied. Therefore, a separating PBE exists in this case. For \( s_p=(H,h) \) to be the equilibrium best response, it is required that \((H,h)>=(H,l)\) and \((H,h)>=(L,h)\). First, \((H,h)>=(H,l)\) iff

\[
u_p((H,h), C, D) > u_p((H,l), C, D) \geq u_p((L,l), K, D) \iff \beta(I_{h} - I'_{h}) > i'_{h} - i_{l}
\]

(11)

Is satisfied. Constraint (11) captures that the investment costs for high direct compliance measures can be reduced by adding high indirect compliance effort. This cost-savings increase wages by \(\beta(I_{h} - I'_{h})\). This extra wage payments have to overcompensate additional indirect costs by moving from a low indirect investment to a (cheaper) high indirect investment \(i_{h} - i_{l}\). Second, \((H,h)>=(L,h)\) iff

\[
u_p((H,h), C, D) > u_p((L,h), C, D) \geq u_p((L,l), K, D) \iff i_{h} - i'_{h} > \beta(I'_{h} - I_{L})
\]

(12)

holds. Condition (12) captures the fact that cost-synergies realized for the indirect investments \(i_{h} - i'_{h}\) have to overcompensate the negative impact of additional direct investment costs on manager's wages \(\beta(I'_{h} - I_{L})\).

2.2 Results of the basic model
We have shown that if the agent's prior is in a range such that he unprofitably colludes or competes, the principal's best response is to make a high or low investment decision, respectively. A separating PBE exists if investment costs in compliance are not too high, i.e., they must be lower than the gains from compliance. The case of dangerous state (unprofitable) collusion is called *hubris* in the compliance literature (Murphy and Kolasky 2012: 63). However, to credibly signal that competition is the preferred alternative the principal will have to send a signal that is perceived as being high. This means that simply writing down compliance codices will not promote ethical behavior in any way which has been mentioned in the Business ethics literature before (see, for example, Stevens 2007: 607). We add to the literature that incurring high personal costs in a *tone-at-the-top* approach can be an equilibrium strategy for a rational manager without any preference for morality or other deviations from standard neo-classical assumptions. The explanation is that if he knows that his agent will make a mistake, a high personal investment of the principal will help to coordinate on an equilibrium in which both players are better off, namely, compliance with the laws (competition) if a cartel does not pay off. If the principal would not make a high investment for \( p \in [1, p_{\text{ind}}] \) the agent inferred that the true state is safe and would not draw any useful information. In both situations, a cartel will arise which is inferior for both players for a dangerous state and for \( p \in [1, p_{\text{ind}}] \).

The model also shows that credible signaling can be promoted by increasing profit related wages. Increasing profit related bonus payments compensates the principal for high indirect compliance investments he has to incur to send a costly signal via management dedication (*tone-at-the-top*). While direct investments appear on a firm-level and reduce profits, the *tone-at-the-top* is a personal investment creating disutility for the principal. When cartels are not profitable, sending this costly and credible signal leads to coordination on a law-conform market outcome preferred by the firm as a whole, depending on the principal's level of costs he has to be compensated in terms of higher bonuses. In a broader context, this result is in line with traditional principal-agent literature which states that by the right contracts, the incentives of a manager can be aligned with those of the firm (see for example Grossman and Hart 1983). However, it is to some extent not consistent with the finding that variable bonuses promote collusive behavior (Aubert 2009, Herold 2014). The point made here is that the manager does not simply have the incentive to engage in illegal activities but also to promote compliant behavior when the cartel does not pay off. It might not only be costly to take an illegal action. If it is costly to resolve uncertainty, ensuring a law conform course of the firm requires manager's compensation for the costs he has to incur to coordinate on compliance with the law.

When strong enough cost-synergies arise between direct and indirect investments,
combining high direct and indirect investments can be optimal. This requires that additional investment by switching from a low to high direct (indirect) investment is overcompensated by a cost-reduction for the high indirect (direct) investment due to cost-synergies. This synergies can arise because (extra) managerial effort can reduce direct investment-costs when, e.g., the principal himself can act as a compliance expert in compliance meetings or training sessions which makes hiring an external expert unnecessary. On the other hand, by having a compliance department (high direct investment) can make it easier for the principal to communicate with his employees. Whether this argument is plausible strongly depends on the size of the firm. In a small firm, costs for hiring external experts can be relatively high, hence, cost savings can be high when the manager sacrifices personal time. However, the manager incurs personal cost which can be substantial depending on his opportunity cost and the perceived disutility. In a large firm, we can expect that hiring external experts is not that expensive compared to high opportunity costs of a manager whose sacrifice of working time will be more costly. This is especially true if managerial wages are higher in a large enterprise. Moving away from the model, another aspect is that the employees have to perceive the investments in compliance as really being high to conclude that collusion is unprofitable. This process can be easier and more unambiguous if there are two sources of high investments (signals) than just one.

3. The repeated model

In the discussion about optimal cartel deterrence it is often argued that corporate fines per se are insufficient to prevent cartel conduct and should be complemented by managerial sanctions (Kokkinaki 2013). One of the key insights of the Economics of Crime literature is that punishments are required to deter individuals from corporate crime (Eide, Rubin and Shepherd 2006). In the realm of antitrust law violations, punishments can be manifold. Members of the board of directors can be individually liable if corporate breaches of the laws occur (Schwartz, Dunfee and Kline 2005). Firms might also fire those employees involved in anticompetitive actions (Hüschelrath, Leheyda and Beschorner 2011). Also, the debate is still ongoing whether managers should be held liable via criminal law or even go to prison for collusive behavior (Buccirossi and Spagnolo 2005). We try to capture these managerial punishments in a dynamic model where the continuation-payoff in case of detection is reduced depending on the severity of the punishments. Job loss and the negative impact on a manager's reputation for being a cartelist can reduce the manager's future opportunities on the job market. This is a dynamic phenomenon. We incorporate these penalties into a repeated analysis of the basic model of section 2.
Assume that the principal and the agent are involved in an infinitely repeated game with the basic structure as the model presented in section 2. In every period $t$, the agent can decide whether to collude or to compete after observing the investment decision of the principal. We stick to the case of firms' compliance direct investments here and leave out the tone-at-the-top. We assume that the discount factors are common knowledge and high enough for a cartel to be stable for all other firms in the industry, so the decision of the firm under consideration can be analyzed without having to take into account other firms. Furthermore, we assume that the principal and the agent share the same discount factor $\delta \in (0,1)$ to simplify the analysis. Both the principal and the agent are risk-neutral and want to maximize the expected stream of wages. In period $t=0$, nature chooses the state $\theta \in \{S,D\}$ of the authority. After that the principal makes his investment decision in compliance $I \in \{L,H\}$ and the agent chooses whether to compete or to collude, $S_a=\{C,K\}$. The principal's investment and the agent strategic choice are repeated in every period from $t=1$ to infinity.

The investment-decision cannot be reversed, i.e., the principal chooses a path of investments in compliance. This assumption can be motivated, for example, by the fact that once a compliance department is installed, it cannot simply be removed. This simplifies the analysis in a way such that the principal focuses on stationary strategies in equilibrium. Then the agent chooses whether to compete $C$ or to collude $K$. If the agent chooses to collude, the authority will detect the cartel with probability $\rho_0$ with $\rho_S<\rho_D$. In case of detection a fine $F_\theta$ with $F_S<F_D$ will be imposed in the period of detection. Fines might differ between the states since, e.g., we observe renewals of fining guidelines from time to time which can, in the end, involve an increase of total fines. A closer look at the EU cartel statistics reveal that the fines per convicted cartel drastically rose from 1990-1994 (about 34 Mio. €) to 2010-2014 (about 290 Mio. €). Connor and Lande (2006) argue that for the US and the EU the calculation of fines should be revised again since they would still be too low to be deterrent. Hence, the debate is ongoing and there might still be changes to come.

Define $V_C$ and $V_K$ as the payoffs in competition and collusion, respectively and $V_\theta$ as the continuation payoff in case of detection. Because of they share the same discount factor, these present values apply for both players, however, we are going to include a punishment-parameter for the principal and the agent below. Hence, we can formalize the payoffs as follows:

15 The latter two assumptions make the model analytically much more tractable since otherwise one would have to consider expectations about future changes of the competition authorities' conduct and both players' optimal response connected to it. To relax this assumptions, one could adopt the approach described in Fershtman and Pakes (2012).
16 By assuming that $F_S=F_D$, the agent could not perfectly infer the true state of nature if signaling fails to give rise to a separating PBE. In this case, the agent would update his prior according to Bayes' Law in every period and the expected utility-stream of each strategy would change.
\[ V_C = \beta \left( (\pi_C - I_l) + \delta (\pi_C - I_l) + \delta^2 (\pi_C - I_l) + \ldots \right) = \frac{\beta}{1 - \delta} (\pi_C - I_l), \quad I \in \{L, H\} \] (13)

\[ V_K = \beta \left( \rho_0 (\pi_K - I_l - F_0) + (1 - \rho_0) (\pi_K - I_l) \right) + \delta (\rho_0 V_E + (1 - \rho_0) V_K) \]

\[ \Rightarrow V_K = \frac{\beta (\pi_K - I_l - \rho_0 F_0) + \rho_0 \delta \beta V_E}{1 - \delta (1 - \rho_0)}, \quad I \in \{L, H\} \] (14)

Note that \( \beta \) cancels out in the following analysis.\(^{18}\) In the upcoming section, we will adjust \( V_E \) to different scenarios to analyze different punishment regimes, e.g., whether the principal will be fired, sued and what happens to the bonus-payment.

A crucial point here is whether expected fines are per se deterrent. This effects the continuation payoff in case of detection, \( V_E \). When they are non-deterrent, we can stick to the notation proposed in Aubert, Rey and Kovacic (2006).\(^{19}\) They state that a profitable cartel will always be 'rebuilt' after detection. When fines are deterrent, the firm will stick to the competitive solution. However, this crucially depends on assumption (1), since for \( \theta = D \), fines are deterrent, while for \( \theta = S \), they are non-deterrent. The agent is in general not aware of the true state. If the agent thought the true state was \( \theta = S \), he would try to collude again in every period. However, for \( F_S < F_D \) this is not a problem because the agent can infer the true state in case of detection. In a separating PBE, the cartel will be rebuilt only if the true state is \( \theta = S \), while for \( \theta = D \), the agent will comply with the law. This will be shown in Lemma 3.

**Lemma 3**: In a separating PBE, in a dangerous (safe) state the agent will compete (collude) in all periods.

Proof: The agent will choose to collude if \( V_C < \mu V_K (\theta = D) + (1 - \mu) V_K (\theta = S) \) and compete otherwise. Here, \( \mu = \text{prob} (\theta = D | I_l, F_0) \) is the agent's posterior belief after observing the principal's investment decision \( I_l \) and, if there was collusion in the previous period, the fine \( F_0 \). Assume the agent knows the true state. In this case, assumption (1) prescribes that collusion does not pay off for \( \theta = D \) and is profitable for \( \theta = S \). Therefore, the (stationary) strategy maximizing continuation payoffs \( V_E \) is \( \sigma_\alpha = C \) for all \( t = 1 \) to infinity and \( \theta = D \) and \( \sigma_\alpha = K \) for \( t = 1 \) to infinity \( \theta = S \). Hence, we know that the agent will

---

\(^{18}\) In this notation, \( V_E \) is the parameter that measures the full continuation payoff the players are entitled to. Note that, for the precise continuation-payoff, we would need \( V_E = \beta X \) where \( X \) constitutes the continuation payoff in the game and a scrap value if a player is fired. We multiply \( V_E \) by \( \beta \) rather than using \( \beta X \) to get rid of \( \beta \) in the following analysis because it has no qualitative effect.

\(^{19}\) For \( \beta = 1 \) and \( V_i = (\pi_C - \rho F)/(1 - \delta) \), expression (13) is similar to the present value of collusion proposed in Aubert, Rey and Kovacic (2006).
compete (collude) in a dangerous (safe) state in all periods iff

\[
\beta \frac{\pi_C - I_L}{1 - \delta} > \frac{\beta (\pi_K - \rho_D F_D - I_L) + \delta \rho_D \beta \frac{\pi_C - I_L}{1 - \delta}}{1 - \delta (1 - \rho_D)} = \pi_C > \pi_K - \rho_D F_D
\]

\wedge \beta \frac{\pi_C - I_L}{1 - \delta} \leq \frac{\beta (\pi_K - \rho_S F_S - I_L) + \delta \rho_S \beta \frac{\pi_C - I_L}{1 - \delta}}{1 - \delta (1 - \rho_S)} = \pi_C < \pi_K - \rho_S F_S
\]

is satisfied which is true by assumption (1).\(^{20}\) □

For the principal in a separating PBE, we can analyze different punishments regimes by examining the different continuation payoffs \(V_E\). According to Lemma 3, continuation payoffs are \(V_E = (\pi_C - I_L) / (1 - \delta) \equiv V_{E,D}\) for \(\theta = D\) and \(V_E = (\pi_K - \rho_S F_S - I_L) / (1 - \delta) \equiv V_{E,S}\) for \(\theta = S\) without punishments and \(V_E < V_{E,D}\) for \(\theta = D\) and \(V_E < V_{E,S}\) for \(\theta = S\) with punishments. As argued above, those punishments could involve removal, fines, damage claims and a weaker position on the job market. To analyze different punishment regimes, we introduce a parameter \(\gamma \in [0,1]\) which depicts the share of continuation payoffs the principal is left with after a breach is detected. Hence, \(1 - \gamma\) can be interpreted as a punishment parameter. For \(\gamma = 0\), we have the regime with very high punishments and for \(\gamma = 1\) there are no punishments except the direct reduction in bonuses induced by the fines.

To examine separating PBE, a closer look at those cases where the agent would mistakenly engage in unprofitable collusion or competition without proper signaling is necessary. This happens if \(\theta = S\) and \(p \in [p_{ind}, 1]\) or if \(\theta = D\) and \(p \in [0, p_{ind}]\), i.e., the agent refrains from profitable collusion and is involved in an unprofitable cartel, respectively. Here, \(p_{ind}\) denotes the value of the prior for which the agent is indifferent between collusion and compliance.\(^{21}\) The agent’s prior \(p_{ind}\) will be analyzed in more detail in Proposition 5. Hence, we can specify the range where separating PBE exist:

\[
\pi_C - I_H \leq \pi_K - \rho_D F_D - I_L + \gamma \delta \rho_D \frac{\pi_C - I_L}{1 - \delta}, \quad \pi_C - \rho_S F_S - I_L + \gamma \delta \rho_S \frac{\pi_K - \rho_S F_S - I_L}{1 - \delta}
\]

In (16) is the payoff by inducing competition with a high investment \((\pi_C - I_H) / (1 - \delta)\) has to be in a

---

\(^{20}\) Including fines for the agent remains to be done here.

\(^{21}\) Outside of a separating PBE this could also involve the posterior beliefs as long as cartel activity was not detected.

Since we want to derive the conditions under which a separating PBE exists and the principal can only invest in signaling in \(t = 0\), we do not have to consider posterior beliefs here. \(p_{ind}\) satisfies \(V_C = p V_C(\theta = D) + (1 - p) V_C(\theta = S)\), hence, \(p_{ind} = (V_C(\theta = S) - V_C) / (V_C(\theta = S) - V_C(\theta = D))\).
certain interval. The lower bound of this interval is fixed by the present value of collusion in the
dangerous state while the upper bound constitutes the present value of collusion in a safe state. Just
as in described in section 2, inducing competition must only be profitable for the principal in a
dangerous state. In a safe state, the principal must prefer collusion. Otherwise, every type of the
principal would always prefer the same outcome and the agent will not believe any signal. Hence,
all types of principals would prefer a low investment if present values of competition with a high
investments are not in the interval specified in (16). Additional reward for breaches are excluded
here, i.e., the highest possible continuation is generated by the respective market payoff.

When punishments become more severe ($\Delta \gamma < 0$), the existence of separating PBE becomes
less likely for two reasons, (i) the upper bound of (16), $V_{K,S}$, shrinks and (ii) the size of the of the
interval of (16) becomes smaller when expected continuation payoffs corrected for the detection
probabilities are higher in a dangerous state. This will be shown in the following two Propositions.

**Proposition 3:** More severe fines decrease the upper bound of $[V_{K,D}, V_{K,S}]$.

Proof: According to (16),

$$V_{K,S} = \frac{\pi_K - \rho_S F_S - I_L + \gamma \delta \rho_S}{1 - \delta (1 - \rho)}$$

Obviously, $\partial V_{K,S}/\partial \gamma > 0$ iff $\pi_K - \rho_S F_S > I_L$ which must hold since otherwise investing in compliance
would never be rational. Hence, more severe punishments ($\Delta \gamma < 0$) decrease the lower bound and can
prevent the existence of a separating PBE. ■

**Proposition 4:** The interval $[V_{K,D}, V_{K,S}]$ becomes larger if expected continuation payoffs
$V_{E,K,\theta}$, adjusted by the discount factor $\delta$ and the detection probabilities $\rho_{\theta}$ are higher in $\theta=S$
than for $\theta=D$.

Proof: The size of the interval in (16) is determined by

$$V_{K,S} - V_{K,D} = \frac{\pi_K - \rho_S F_S - I_L + \delta \rho_S \gamma V_{E,S}}{1 - \delta (1 - \rho)} - \frac{\pi_K - \rho_D F_D - I_L + \delta \rho_D \gamma V_{E,D}}{1 - \delta (1 - \rho_D)}$$

with
Note that \( \tilde{V}_{E,S} = \frac{\pi_K - \rho_S F_S - I_L}{1 - \delta} \) and \( \tilde{V}_{E,D} = \frac{\pi_C - I_L}{1 - \delta} \) by Lemma 3. In (19), it is obvious that \( \pi_K - \rho_S F_S - I_L > \pi_C - I_L \) by assumption (1). This higher value of (expected) firm profits in \( \theta=S \) is offset by a higher probability of detection \( \rho_D > \rho_S \). This effect makes the lower bound increase more strongly than the upper bound (increases RHS of (19)). Hence, when condition (19) is satisfied, increasing fines (\( \Delta \gamma < 0 \)) makes the existence of a separating PBE less likely.

Propositions 3 and 4 show that by increasing fines (i) the upper bound of the relevant interval \( V_{K,S} \) for the existence of a separating PBE decreases and (ii) the size of the interval \( V_{K,S} - V_{K,D} \) shrinks if the upper bound decreases more strongly than the lower bound. To analyze the impact of the punishments, the figure 1 is illuminating:

![Figure 1: Interval of (16) with \( V_C(\delta) \) in green, \( \tilde{V}_{K,S}(\delta,g) \) in yellow and \( \tilde{V}_{K,D}(\delta,g) \) in red. There exist separating PBE if the \( \tilde{V}_{K,S} > V_C > \tilde{V}_{K,D} \), i.e., when the yellow plane is visible. In the orange areas, the red plane is above the green plane (\( V_{K,D} > V_C \)). Parameter values are \( \pi_K = 100, \pi_S = 120, \rho_S = 0.1, \rho_D = 0.3, F_S = 20, F_D = 50, I_L = 0 \) and \( I_H = 5 \).](image)

The plot depicts the graph of the three functions for the present values in (16) as functions of (\( \delta, \gamma \))
where continuation payoffs $V_E$ are multiplied by $\gamma$. Here, the green plane captures the present value of compliance with high compliance investment ($(π_c - I_h)/(1 - δ)$), while the red and the yellow planes show low investment decisions in $θ=D$ and $θ=S$, respectively. Note that a separating PBE exists iff the yellow plane is above the green plane and the green plane is above the red plane. We used a lower opacity for the yellow and the green graphs to better visualize those areas, where the red plane lies above the green plane since the yellow plane is always above the red plane ($ρ_s < ρ_D$ and $F_s < F_D$). Hence, in the orange area, there do not exist separating PBE since the lower bound of (16) is violated, i.e., collusion always pays off. In the green area, there also do not exist separating PBE since the upper bound of (16) is violated, i.e., collusion never pays off.

Starting from $γ=0$, relaxing punishments ($Δγ>0$) generally makes the area with separating PBE become smaller in this example when punishments become less severe, i.e., (19) is violated in many points. Furthermore, we see that for a farsighted manager (high $δ$), a punishment (low $γ$) there is no separating PBE. The reason is that collusion becomes less attractive since in case of detection the principal is left with only a small fraction of $V_E$, $θ$. In this case, the principal will always prefer competition. Since the agent knows that, he will not believe any of his signals and coordination breaks down. If the principal is rather myopic, collusion is always the preferred outcome and coordination breaks down, too. This is why we observe separating PBE only for intermediate values of $δ$ if punishments are harsh.

To ensure the existence separating PBE for farsighted principals, rather low punishment regimes are necessary. In figure 1, we see that the yellow plane is visible for high values of $δ$ for approximately $γ \in [0.8, 0.9]$. The reason is that for farsighted agents, future payoffs are important. These are in higher in a safe state cartel if punishments are not too high. Otherwise, competition becomes more attractive again, destroying the separating PBE. However, punishments should not be too soft, since otherwise a dangerous state cartel becomes more attractive than competition which again leads to pooling equilibrium. When the principal is myopic, it is impossible to reach a separating PBE. Collusion is always the preferred outcome since he can realize short run gains. The principal does not care about future payoffs so punishments are irrelevant.

Until now, we have only considered personal punishments for the principal. However, one could also impose fines on the agent since he is the one who in the end took the illegal action. To analyze the impact of personal fines for the agent, include a parameter $γ_A \in [0,1]$ with $1-γ_A$ being agent's punishments. The agent engages in unprofitable collusion outside a separating PBE for
$p \in [0, p_{\text{ind}}]$, i.e., when he underestimates the probability of detection. By decreasing the threshold probability $p_{\text{ind}}$, it is less likely that the agent engages in profitable and unprofitable collusion. Hence, if $\partial p_{\text{ind}}/\partial \gamma > 0$ personal punishments for the agent effectively deter collusion.

**Proposition 5:** An increase in personal punishments decreases the probability that the agent engages in unprofitable collusion if $V_C \in [V_{K,D}, V_{K,S}]$.

With $p = \text{prob}(\theta = D)$, the agent is indifferent between collusion and competition in period $t$ iff:

$$V_C = p V_{K,D} + (1 - p) V_{K,S}$$

$$\Rightarrow p_{\text{ind}} = \frac{V_{K,S} - V_C}{V_{K,S} - V_{K,D}}$$

(20)

Note that if there was no detection in $t-1$, then there is an indifferent value of posterior beliefs $\mu_{\text{ind}}$ satisfying (20). Next, we examine how $p_{\text{ind}}$ changes in $\gamma_A$. Since $V_{E,\theta}$ is premultiplied by $\gamma_A$, we know that $V_{K,\theta}$ are functions of $\gamma$. Hence, $p_{\text{ind}}$ increases in $\gamma_A$ iff:

$$\frac{\partial p_{\text{ind}}}{\partial \gamma} = \frac{\partial V_{K,S}}{\partial \gamma} - \frac{\partial V_{K,D}}{\partial \gamma} \Rightarrow 0 > \frac{V_{K,S} - V_C}{V_{K,S} - V_{K,D}}$$

(21)

For (21), $(V_{K,S} - V_C)/(V_{K,S} - V_{K,D}) = p_{\text{ind}}$ according to (20). Furthermore, $p_{\text{ind}} \in [0,1]$ holds for $V_{K,D} < V_C < V_{K,S}$ for any $I_t$. Note that the latter is very similar to the condition for the existence of a separating PBE (16), though, for any level of compliance investments. Therefore, (21) is satisfied for $p_{\text{ind}} \in [0,1]$ iff

$$\frac{\partial V_{K,S}}{\partial \gamma_A} - \frac{\partial V_{K,D}}{\partial \gamma_A} \Rightarrow 0 > \frac{V_{K,D}}{V_{K,S}}$$

(22)

It is obvious that $\partial V_{K,\theta}/\partial \gamma > 0$ for all $\theta$ as in the case of the principal (16). Therefore, condition (22) is always satisfied. It follows that for $V_C \in [V_{K,D}, V_{K,S}] \forall I_t$, increasing the agent's fine $1 - \gamma$ decreases $p_{\text{ind}}$ by $\partial p_{\text{ind}}/\partial \gamma > 0$ and makes collusion less likely. ■

The repeated model shows that adding personal fines makes collusion less attractive for the principal and the agent. However, punishing the principal might disturb efficient coordination by violating the conditions for the existence of separating PBE: If collusion is never profitable for the

---

22 The intervals would be different for the principal and the agent for different discount factors.
principal (for example because of high personal fines), compliance investments will not be credible. The principal will always prefer to make a high investment, could he induce competition. However, the agent knows that this message is not informative (the principal will never prefer collusion) and will therefore act according to his prior. This gives rise to potentially very harmful equilibria: For $p \in [0, p_{\text{ind}}]$, the agent will collude and harm consumers and for $\theta = D$ he will also harm the firm. This is comparable to Akerlof's lemon problem: Both types of principals prefer compliant behavior. That means that both types would make a high investment in a CP. Since the agent knows that for $\theta = S$ and $\theta = D$, we would observe high investments, he cannot infer any information from this. The principal knows that and therefore chooses a low investment, independent of his type. The result is that we only observe low investments and one could argue that the 'market' for efficient coordination breaks down (Riley 2001: 436).

On the other hand, personal punishments for the agent can really deter collusion. By increasing fines for an uninformed agent, the range of priors which lead to a collusive outcome shrinks and cartels become less likely. This is only true when $V_C \in [V_{K,D}, V_{K,S}]$ which implies that $p_{\text{ind}} \in [0, 1]$. When dangerous state fines and personal punishments are insufficient to be deterrent, i.e., $V_{K,S} > V_{K,D} > V_C$, $p_{\text{ind}} > 1$ and the agent will always collude. Increasing personal punishments ($\Delta \gamma_A < 0$) can make this situation less likely. We can conclude that personal punishments for the agent can indeed complement firm-level fines to effectively deter collusive conduct while personal punishments for the can negatively influence his coordination function in the firm.

5. Conclusion

The paper presented an analysis of compliance programs as internal signaling devices. An employee who can decide whether to collude does not know whether a cartel pays off for the firm as a whole. The uncertainty about the profitability of collusive behavior exists because the level of fines and punishments imposed by the competition authority are unknown to the employee. There is a manager who is perfectly informed about expected fines and knows whether a cartel pays off. To solve the arising coordination problem, the manager can invest in expensive compliance measures to signal whether collusion or competition is more profitable in expectation.

In a separating PBE, the manager will make a high investment in compliance programs if the employee would otherwise engage in unprofitable collusion, i.e., every high investment credibly signals that cartels are unprofitable. Hence, by observing the high investment the employee will compete. By making a low investment, the manager signals that collusion pays off and the
employee will collude.

In the non-repeated version of the model, we also incorporate personal investments into the analysis. This can be seen as an attempt to understand the concept of the so called tone-at-the-top. In the literature, this concept is described as management dedication to firms' ethical and compliant behavior and it is seen as a crucial part of compliance programs (OFT 2010). We can show that personal investments a la tone-at-the-top are substitutes to high direct investments in compliance programs by the firm. Since the manager alone incurs those personal, indirect costs, tone-at-the-top can be cheaper for the firm as a whole. However, the manager has to be compensated for the investment-costs. This can for example be done by providing the manager with higher, profit-related bonuses. Therefore, we add another aspect to the literature of strategic delegation and collusion (e.g., Fershtman, Judd and Kalai 1991, Spagnolo 2000, 2005, Aubert 2009, Han 2011). Providing the manager with higher bonuses need not only fosters collusion but can also promote compliance with competition laws.

It is often argued that high investments in CPs have to be complemented by management dedication (OFT 2010). When strong enough cost-synergies arise between direct and indirect investments, making high direct and indirect investments can result in equilibrium. In the analysis, this argument is solely based on investment-costs. In reality, the employees have to perceive the investments in compliance as really being high to conclude that collusion is unprofitable. This process can be easier and more unambiguous if there are two sources of high investments (signals) than just one.

Throughout the model we search for cases where separating PBE exist. From a welfare perspective, we argue that the existence of separating PBE is preferred because they ensure the 'correct' coordination on the market outcome preferred by the firm. When the authority is able to provide the right incentives by setting deterrent fines, it generates an environment where collusion is unprofitable. In this case, the manager will make a high investment in compliance and the result will be a compliant (competitive). In combination with higher cartel fines, this could be part of the explanation why there are a lot more firms investing in CPs in recent years (see for example Götz, Paha and Herold 2014). Outside of a separating PBE, the manager will never make high compliance investments. Hence, the employee is unable to draw any useful information from the investment-decisions of the manager and will compete or collude depending on the value of his prior-probability about the threat of the authority which determines cartel profitability. This can lead to the establishment of unprofitable cartels which harm both the firms and the society. Furthermore,
the authority is only able to effectively control the firm's competitive behavior in a separating PBE since otherwise an uninformed employee alone is in the end responsible for determining market behavior.

We present an infinitely repeated version of the model to incorporate personal punishment regimes for managers and employees (sales people, sales managers) into the analysis. The analysis of individual punishments enriches the debate on whether and how managers should be liable when breaches of competition law occur (Kokkinaki 2013: 29). Punishments in this case can also include all kinds of sanctions (official fines, damage claims by third parties or the firm, imprisonment, release and a worse position on the job market). We can see that adding personal fines for the manager can hinder coordination on a firm's law compliant market behavior. Personal fines result in a misalignment of the manager's incentives with those of the firm. In case of the examined coordination problem, employee's mistakes that arise because of uncertainty can lead to situations where this misalignment can also lead to outcomes which also harm society, i.e., unprofitable cartels. By making collusion less attractive for the manager with high punishments, the employee knows that the manager never prefers collusion. This especially holds for farsighted managers since they value long-run competitive profits more than high cartel profits with the possibility of incurring also severe punishments. The result is that the coordination problem will not be solved.

Introducing personal punishments for the employee can indeed deter collusion by shrinking the range of priors which lead to collusive behavior. This can also make expensive signaling unnecessary. Training programs play a more crucial role in this case since the agent has to know the true personal consequences of collusive conduct. These programs can influence the agent's prior and in the end help to deter collusion. Therefore, we argue that – from a viewpoint of a firm's internal coordination – personal fines for managers are inferior to firm-level fines when it comes to effectively deter collusive conduct. Complementing firm-level fines with punishments for the employees, however, seems to a more reasonable tool for deterrence.

REFERENCES


Aubert, C. (2009), 'Managerial Effort Incentives and Market Collusion', TSE working paper 09-127.


Murphy, K. J. (2001), 'Performance standards in incentive contracts', *Journal of Accounting and
Economics, Vol. 30 (3), 245-278.


