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A PRINCIPAL-AGENT MODEL OF COMPETITION LAW COMPLIANCE

Daniel Herold*

ABSTRACT

This paper analyzes firm owners' incentives to implement Competition Law Compliance Programs as imperfect monitoring devices in a principal-agent setup and the interaction effects with bonus contracts. The manager chooses working effort and has the option to cartelize. The model reveals a non-monotonic relationship between profit targets and incentives to collude. Contrary to intuition, it might be the case that low instead of high profit targets facilitate collusion. This result is driven by the threat of detection and punishment. A Compliance Program deters the agent from misbehavior and enhances effort as long as the agent did not engage in collusive activity. Additionally, the owner can use the Program as an insurance against fines.

Keywords: Cartel; Compliance; Principal-agent; Competition Law

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1. INTRODUCTION

A look at EU and US cartel statistics reveal that a growing level of fines were imposed to violations of competition law during the last 10 years.¹ These fines can have substantial consequences for a firm which can be seen for example in the German rail cartel: In mid 2012 a fine of 103 Mio€ was imposed to Thyssen Krupp.² In March 2014, the firm announced to shut down its railway division. The firm states the negative impact of the cartel as one reason for the shutdown.³ For a firm, one way to avoid breaches of competition law is to set up a Competition Law Compliance Program (CLCP). Here, 'Compliance means respecting the law. In the competition field, it means business proactively respecting competition rules'.⁴ The question arises whether and how these programs really influence the economic behavior of the decision makers responsible for engaging in collusive arrangements.

To work on this question, first it has to be clarified who is responsible for the breach and second why the breach occurred. There are indications that some cartels are formed as a thought-out project of top level management. This is the case for example in the Vitamins cartel.⁵ Some cases suggest that it is not the top-level but a medium or higher level of the hierarchy. This can be seen for example in the Methionine-case. The European Commission (EC) describes that at the first documented meeting the divisional managers participated.⁶ Other examples of cartels initiated by higher level hierarchy include the cases of Graphite electrodes, where the meetings involved the Sales Directors.⁷ Although it is possible that the information available to the EC are incomplete – perhaps there were unknown meetings on the highest levels of the firms – this observation suggests that larger, international cartels prosecuted by the EU are formed by a higher level of a firm's hierarchy. The Office of Fair Trading (OFT 2010) describes that drivers of non-compliant behavior that can be influenced by CLCPs are uncertainty about the law, errors of employees and single agents acting against the law (*'rogue employees'*). Although these can also be reasons for misbehavior, it is not a satisfactory explanation that in large, international firms the decision makers are participating in collusive agreements because they were insufficiently informed about

1 See <http://ec.europa.eu/competition/cartels/statistics/statistics.pdf> and <http://www.justice.gov/atr/public/division-update/2012/criminal-program.html>. Note that the highest fine for a company was 450 Mio€ (see LIBOR/EURIBOR-case http://europa.eu/rapid/press-release_IP-13-1208_en.htm)

2 see: http://www.bundeskartellamt.de/SharedDocs/Entscheidung/DE/Fallberichte/Kartellverbot/2012/B12-11-11.pdf?__blob=publicationFile&v=4

3 see: http://www.thyssenkrupp.com/en/presse/art_detail.html&eid=TKBase_1394478471449_993583327

4 This definition is taken from the European Commission (DG Comp), see <http://ec.europa.eu/competition/antitrust/compliance/>.

5 see European Commission, Decision COMP/E-1/37.512, page 16, paragraph 160

6 see EC Case C.37.519, page 6, paragraph 83

7 see EC Case COMP/E-1/36.490 page 10, paragraph 44

competition law. However, many of those large firms have installed CLCPs. One example is Akzo Nobel⁸. Planned misbehavior of managers generates a potential discrepancy between the incentives of the firm and its shareholders on one side and its managers on the other.

Although some countries like the UK offer fine reductions for firms having a CLCP installed, fine reductions alone cannot explain the existence of CLCPs. There are firms with CLCPs in place in countries without offering fine reductions.⁹ In this paper the incentives of a firm to invest in a CLCP are examined without fine reductions granted for the mere existence of a program. The findings can be useful to enhance the understanding of the effectiveness of CLCPs and to enrich the current debate on fine reductions.

There are already some approaches to explain the existence of a CLCP. The first and – to the best of the knowledge of the author – the only paper that investigates incentives for Compliance-Programs in a fully fledged theoretical framework on a firm level is Beckenstein and Gabel (1986). They choose a neoclassical model of a firm that faces an authority that fines corporate misbehavior. One result of Beckenstein and Gabel (1986) is that centralizing decision making in the firm can reduce the probability of a breach of competition law. Since their model analyzes CLCPs on an aggregate firm level, a further examination of the centralization argument and on the effectiveness of this programs inside the firm can add useful insights about the topic. Since a CLCP is located explicitly inside the firm, it seems necessary to take a closer look at the decision makers. Laffont and Martimort (2001: 12) point out that it is necessary for a firm to have a certain amount of decentralization because of the shareholder's lack of skills or knowledge. In the language of principal-agent theory, the principal delegates a task to the agent because the agent can do it better – this is in the nature of the diversification of labor.

Therefore, this paper analyzes a theoretical principal-agent model to analyze CLCPs. A related approach was chosen by Angelucci and Han (2010). They examine how optimal fining-strategies of the authority should be designed and how CLCPs incentivize the different players. Therefore, they propose a three-tier-model with a strategic authority, a shareholder (principal) and a manager (agent) where the agent can receive a constant gain from engaging in collusion. In contrast, the

8 Note that Akzo Nobel was involved in many EU cartel cases including rubber chemicals (COMP/F/38.443), sodium chlorate (COMP/38.695) and hydrogen peroxide (COMP/F/38.620). The firm's Compliance manual can be found at: http://www.akzonobel.com/system/images/AkzoNobel_Competition_Law_Compliance_Manual_tcm9-16085.pdf

9 Currently, there are debates about this topic going on in several European Countries. For example, the German Federal Cartel Office does not deem fine reduction necessary if a CLCP is installed (see the activity report of the German Federal Cartel Office 2011-2012).

model proposed here offers a different perspective. The mechanisms of a CLCP inside the firm, i.e. between the shareholder and the manager, are examined. The interplay of different payment-schemes, working-effort and the incentives to cartelize play a major role in the analysis. Just as the model of Angelucci and Han (2010), this model can also be generalized to many kinds of corporate crime that can be committed by the agent and that expose the firm to fines.

Another, major difference between the model of Angelucci and Han (2010) and the model described here is that managerial effort is included. A look at documented cartel cases reveals that cartelization and managerial effort are substitutable to some extent. For example in the Zinc phosphate cartel market shares and customers were allocated and prices were fixed when the cartel was established.¹⁰ Capturing or defending market shares and acquiring new customers can be seen as managerial effort. Schmidt (1997), who examines managerial effort that leads to reductions in costs, indicates that the pressure to exert effort might be highest in a very competitive oligopolistic environment (with a substantial chance for bankruptcy in case of higher production costs). Markets in cartel cases like the aforementioned Vitamins-cartel and the collusive agreement for Citric-Acids were characterized by intense competition before the cartels were formed (see Grout and Sonderegger 2005: 63; see also Harrington (2006) for detailed case-studies). It can be assumed that managers try to escape increased working effort that comes along with competitive pressure. For this reason it is necessary to incorporate effort into the analysis.

Reduced effort of managers in a cartel generates a source of conflict inside and between firms. This conflict was already examined in Aubert (2009). She analyzes the relation between agent's effort and the incentives to collude in a model where the agent has the possibility to collude, to compete or to deviate. By collusion, the agent has less effort to exert to meet a certain profit benchmark. The implementation of contracts with high profit targets¹¹ increase the incentives to be in a collusive state because in a cartel it is easier to achieve a profit target above a certain threshold. Additionally, the manager prefers to work less. Another result of Aubert's (2009) model is that to avoid collusion the firm might have to sacrifice internal efficiency by softening profit targets. The model presented here investigates what happens if a CLCP is in place. One result is that the principal can still install high profit targets by investing in a CLCP because the agent can be deterred by an internal detection in combination with punishments.

10 see EC Case COMP/E-1/37.027, page 7, paragraph 65

11 The terms *profit target* and *profit thresholds* will be used synonymously throughout the paper.

In standard models of principal-agent theory, a principal delegates a task to the agent. The agent can exert effort to influence the value of the objective function of the principal through different channels. This effort leads to disutility for the agent which might result in suboptimal (inefficient) outcomes. To overcome this problem, different mechanisms were proposed, for example implementing profit or output targets (see for example Laffont and Martimort 2001). When examining firms with respect to their market conduct, it turns out that these profit targets might facilitate collusion in different settings. For example, Spagnolo (2005) shows that typical compensation schemes including profit-related bonuses and bonus-caps foster collusive behavior. Spagnolo (2000) examines stock-related compensations and shows that stock-related bonus-payments facilitate collusion.

The basic idea of the model presented here is as follows. A shareholder (principal) delegates a manager (agent) to run his firm¹². Both are risk neutral, rational (expected) utility-maximizers. To influence firms' profits the agent can exert effort which is unobservable to the principal. Prominent examples for the analysis of the resulting moral hazard problem are Holmström (1979) and Grossman and Hart (1983). Also the contributions of Sharfstein (1988: 149) and Schmidt (1997) are comparable to the model proposed here. They analyze effort incentives explicitly in market contexts and assume that the agent's effort can decrease production costs. In the model proposed here, the agent is paid according to a remuneration scheme containing a fixed part and a variable, profit-related bonus-payment. For the determination of this variable part, the realized profit is compared to a profit target. When profits exceed the target, the agent receives a bonus. If the target is not met, the agent will only receive the fixed wage. In addition to exerting effort, the agent can also try to engage in collusion which is illegal. This basic framework is comparable to the assumptions made in many models that try to investigate incentives to collude in a principal-agent setup (see for example Fershtman and Judd 1987, Katz 1991, Aggarwal and Samwick 1999, Fershtman, Judd and Kalai 1991 and Sklivas 1987). The choice for collusive behavior will not always result in the set up of a cartel.¹³ This fact is depicted in a probability of cartel formation when the agent chooses a collusive action. In a cartel, the agent obtains a profit level which is independent of effort levels. The competitive environment of the firm is exogenous. This approach is comparable to Schmidt (1997), who investigates the incentives of increased competition on managerial incentives to exert effort. The idea is related to the model proposed here, since the agent can – on his behalf – escape

12 It is also possible to think of the situation as a manager (principal) delegating a task to a lower level-employee (agent), who is (i) paid according to some bonus scheme and (ii) has the autonomy to unobservably exert different effort-levels and has a chance to collude.

13 The formation process of a cartel is not explicitly modelled here. For systematic approaches see for example Selten (1973), D'Aspremont et al. (1983), Prokop (1999) and Paha (2013a, 2013b).

the “pressure” of competition and of high efforts by joining a cartel. Profits are subject to a stochastic shock $\varepsilon \sim \text{No}(0, \sigma^2)$ which can arise from demand-fluctuations. This is comparable but not similar to the approach of Spagnolo (2005) based on Rotemberg and Saloner (1986) and will be discussed in the model-section below in more detail. If the principal decides to set up a CLCP, he will be able to find evidence of the agent's illegal activity. There is a competition authority that detects and fines collusive conduct with a certain probability. If an attempt to collude is detected internally before the investigation of the competition authority takes place, the firm will not be fined. This assumption is driven by leniency policies in competition law of large industrialized areas like the EU and the US. For example, European law provides full amnesty for the first informant, even if he is the ringleader (see Aubert, Rey and Kovacic 2006). If the internal monitoring does not reveal the misconduct but the authority does, this will result in a fine charged to the shareholder. If the attempt to behave collusively is detected either by the authority or by internal revision, the agent will be fined.¹⁴ Therefore, the agent chooses (i) his optimal effort level and (ii) the optimal market conduct, while the principal decides on (I) the optimal remuneration scheme, (II) whether or not to install a CLCP. Agent's punishment takes the form of reductions in wages: The bonus will not be granted and the fixed wage will be reduced. To justify this assumption a look at liability-regimes is necessary. Shavell (1997) describes that when it comes to harm of third parties, wage-reductions and dismissal are possible sanctions. However, the employer's ability to impose sanctions is limited.¹⁵ In many legislations, employees can further be fined by the authorities. Fines against individuals including jail sentences are possible under current United States law (see Buccirosi and Spagnolo 2005). In the EU fines can only be imposed to firms, although in some countries such as the UK jail sentences are possible (see Wils 2007: 37). In Germany, individual monetary fines are possible.¹⁶ Additionally, actions for damages against individuals can be seen as another pecuniary loss the agent might incur when he breaches the law.

The model shows that a CLCP as an (imperfect) monitoring device can ensure compliant behavior even when high profit targets are implemented. The agents' incentives to save on effort can be counteracted by CLCPs in combination with punishments. If profit targets are too high, i.e. if they

14 Hüschelrath, Leheyda and Beschoner (2011) mention that, in their investigation for Switzerland, detected misbehavior often leads to removal of the respective employee. This is also communicated for example in the Compliance-Manuals of AkzoNobel (see above)

15 In Shavell's (1997) model of corporate liability, a lower level of wages will be payed when an accident occurred. Shavell's *accident* is comparable to collusive conduct in the model described here.

16 See fining guidelines of the German Federal Cartel Office:
http://www.bundeskartellamt.de/SharedDocs/Publikation/DE/Leitlinien/Bekanntmachung%20-%20Bu%C3%9Fgeldleitlinien-Juni%202013.pdf;jsessionid=F87ADB70712ED744650945ACBF787B95.1_cid378?__blob=publicationFile&v=5

are achievable only in a cartel, the agent will be encouraged to collude. However, the model shows that there is a non-monotonic relationship between profit targets and the incentives to collude. Since lowering the profit targets increases expected bonus payment also in a cartel, lowering the profit target fosters both collusion and compliance. It will be shown that in the state of unsuccessful cartel formation the agent will exert less effort due to the possibility of detection. This lower effort level will result in lower profits. If these profits in the state of unsuccessful cartel formation are high enough to be rewarded a bonus-payment, the agent's incentive to collude is fostered again: The agent knows that if cartel formation fails he will still have the chance to receive a bonus. The net effect is ambiguous. It is possible that low profit targets might drive the agent towards collusion more strongly than high profit targets do. Apart from providing incentives for law conform behavior, a CLCP is a device for insuring the principal against misbehavior of the agent. If illegal conduct of the agent is detected internally, the principal can apply for leniency. Documented cartel cases in the EU show that firms involved in cartels often are larger enterprises. For example in the Vitamins-cartel the cartelists were subunits of large, diversified companies. As explained below in more detail, cartel fines can be calculated on the basis of the whole company. It follows that fines imposed to the firm can be many times larger than the profits contributed by the subdivision engaged in collusive-activity. This influences the incentives of the principal: If the profits generated by the agent are small relative to whole profits of the firm (which can be the case when the firm consists of many divisions), cartel profits are smaller than the expected fines and the principal will prefer not to collude. In this case, CLCPs are important monitoring devices to prevent breaches. However, even if the principal prefers collusion, he might want to invest in a CLCP because of the resulting insurance-effect.

The paper is structured as follows: Section 2 provides a description of the model. The solution of the model is presented in section 3. Section 4 concludes.

2. THE MODEL

At the first stage of the model, the principal decides whether to set up a CLCP ($C=1$), or not ($C=0$). In addition he offers a remuneration scheme $(\underline{w}, \underline{\pi}, a)$, where $\underline{w} \in \mathbb{R}$ is the fixed wage, $\underline{\pi} \in \mathbb{R}$ the profit target and $a \in [0,1]$ the percentage share of profits exceeding the profit target the agent will receive. The payment scheme will be described below in more detail. It follows that the action-set of the principal is a 4-tuple $a_P = (C, \underline{w}, \underline{\pi}, a)$. There are two different actions the agent can take, the collusion-decision $K \in \{0,1\}$ and the effort-level $e \in \mathbb{R}^+$. Here, choosing $K=1$ is an attempt to collude and $K=0$ is

competitive behavior. Therefore, the action-set of the agent is $a_A=(e,K)$. It is necessary to introduce a state-variable $R \in \{0,1\}$ indicating the existence of a functioning collusive agreement. Effort is unobservable to the principal, while collusive activity can be detected when a CLCP is installed. The decision for collusive conduct $K=1$ leads to a functional cartel ($R=1$) with probability κ . That there is a chance for unsuccessful cartel formation despite it is in the interest of the firms is also proposed by Harrington and Chang (2009: 1403). There might be for example some final distrust between the managers trying to collude which introduces uncertainty into the process. In the model proposed here, there are no decision makers of other firms included, so the analysis of stable cartel formation is not explicitly modeled. Therefore, κ also captures the aspect that there might be other firms who stop the cartel from being formed. This is clearly a simplification. However, the purpose of the model is to analyze the internal functioning of a CLCP which necessitates to exclude most of the external problems that might arise.¹⁷ Note that since even the unsuccessful attempt to set up a cartel, i.e. choosing $K=1$ with the result of $R=0$, is deemed illegal (see Nordlander and Harrison 2012: 11 for an example). After market conduct is chosen and realized (which is only observable to the agent), the agent chooses his optimal effort-level e . Then the internal revision of the CLCP, if in place, investigates the firm. The state variable $D \in \{0,1\}$ indicates whether misconduct of the manager is internally detected ($D=1$) or not ($D=0$). The detection probability is denoted by $\psi \in [0,1]$. For some intuition about the limits of monitoring in a CLCP, see Wils (2013: 62). After the internal monitoring took place, the competition authority screens the industry and, in case of $K=1$, the probability that the collusive conduct is detected by the authority is exogenously given by ρ . In case of detection the fine charged to the shareholder is F , so the expected value of the fine is ρF . In case of $K=1$, internal or external detection by the authority cause termination of bonus-payments and the agent is left with a share $b \in [0,1]$ of the fixed wage. As argued above, depending on the jurisdiction, this might be due to individual punishments, actions for damages or a feature of the working contract.¹⁸ The agent's outside option is not to work for the principal at all, leaving him with a utility-level of zero. The timing of the model can be summarized as follows:

1. The principal chooses whether to implement a CLCP, $C \in \{0,1\}$, and offers a take-it-or-leave-it contract $(\underline{w}, \underline{z}, a)$ to the agent.
2. The agent chooses market conduct $K \in \{0,1\}$.
3. The cartel is realized ($R=1$) with probability κ .
4. The agent chooses his effort-level e .

¹⁷ For a principal-agent model analyzing stability issues between firms, see for example Han (2012).

¹⁸ If the latter is true, the parameter b is another strategy-variable of the principal. This will not have any qualitative impacts on the results of the model.

5. Profits are realized.
6. If a CLCP is in place ($C=1$) and the agent tried to collude ($K=1$), the collusive agreement is detected internally ($D=1$) with probability ψ .
7. If $D=0$, the Competition authority screens the market and detects $K=1$ with probability ρ .
8. Utilities are realized.

Next, the objective-function of the agent will be examined in more detail. Agent's utility is increasing in wages w and decreasing in effort e which is real-valued and $e \in [0, \infty)$. Effort can be interpreted as “market”-effort that influences profits directly (Aubert 2009) or indirectly by “cost”-effort (Sharfstein 1988, Schmidt 1997). The properties of the utility function with respect to e are not straightforward because of realized market conduct, as will be shown later. The utility function is assumed to be twice continuously differentiable for the whole range of \mathbb{R}^+ in w . Just as in Aubert (2009) and in Angelucci and Han (2010), the agent is assumed to be risk-neutral which implies that $\partial u / \partial w > 0$ and $\partial^2 u / \partial w^2 = 0$. Some authors, including Spagnolo (1999, 2000, 2005) and Paha (2013a), argue that managers have an incentive for income-smoothing which would result in a concave utility in wages. The latter implies risk-aversion. The model is only static, therefore income-smoothing over time is not an issue here. However, both risk-aversion and a dynamic framework would be reasonable extensions. By attempting to collude ($K=1$) profits and agents' wages are subject to sources of uncertainty: The realization-probability of the cartel κ , the internal detection probability ψ and the external detection probability ρ .

The remuneration scheme of the agent can be formalized as follows:

$$w(\pi) = \begin{cases} \underline{w} + a(\pi - \underline{\pi}), & \pi \geq \underline{\pi} \\ \underline{w}, & \pi < \underline{\pi} \end{cases} \quad (1)$$

It can be seen that the agent is paid according to a fixed wage $\underline{w} > 0$ and a variable part $a(\pi - \underline{\pi})$ with $a \in [0, 1]$. Here, $\underline{\pi}$ is a profit target and π is realized profit. A comparable scheme was also chosen by Spagnolo (2005) which is empirically supported by Murphy (1999).¹⁹ The model is restricted to a linear bonus scheme with $a \geq 0$. This assumption is justified on documented observations by Murphy (2001: 250-251) who describes a typical incentive contract based on a study of 177 firms.

Profits can be increased by exerting effort, so π is a function of e . As argued above, in a cartel

¹⁹ It is stated in Murphy (2001) that bonus-payments are typically capped. Right now, this cap is not modelled. In the model as it is described in this version of the paper (especially with a risk-neutral agent), a cap would influence the results only if it is very restrictive (i.e. below the bonus realized in a cartel). It could also be the case, that the agent receives a bonus depending on the overall profits and not on the distance between profits and the threshold.

profits are constant. Based on standard competition models like Cournot and Bertrand it is further reasonable to assume that cartel profits are higher than competitive profits. Since many market parameters can be volatile in reality, profits are also subject to a stochastic component $\varepsilon \sim \text{No}(0, \sigma^2)$, which is independent of the different market states (i.e. if a cartel is realized or not).²⁰ The influence of profit shocks on collusion is for example examined in Paha (2013a). The distribution of ε is common knowledge but the realization is only observable to the agent.²¹ It follows that wages cannot be conditioned on realizations of ε in the contract.

One crucial point of this model is that the agent has to exert less effort if he is engaged in a collusive agreement. The rationale for this assumption is as follows: From an IO-perspective a manager can basically increase profits by means of effort by (i) acquiring new customers (increase quantities sold), or (ii) increase customer's willingness to pay and therefore prices by marketing campaigns or he can (iii) decrease costs. In general, (i) and (ii) are actions that run counter to a cartel-agreement. As explained above, for example in the Methionine case market shares, prices and customers were allocated in the cartel.²² Since (iii) might lead to a higher asymmetry between firms, cost-reductions will also be discouraged by the cartel. To formalize this argument, define a cartel profit level $\pi_K > 0$. For the sake of simplicity assume that the agent does not have to exert any effort to achieve π_K when he has chosen the market conduct of a cartel and the cartel was formed, i.e. in case of $K=1$ and $R=1$.²³ Recall that any form of illegal communication between firms representatives, is already seen as participation in an illegal agreement, i.e. with $K=1$ the agent is exposed to punishments. If the agent decides not to collude ($K=0$) the firm remains in a competitive state where increasing effort always leads to higher profits.

Agent's utility in general can be expressed as $u_A: w, e \rightarrow \mathbb{R}$. Note that (total) wages depend on the following variables: Effort e , the cartel-decision $K \in \{0, 1\}$, the success of the collusive agreement $R \in \{0, 1\}$ and internal detection $D \in \{0, 1\}$. The latter is only possible if a CLCP is installed ($C=1$). In addition to that, the parameters recorded in the employment-contract influence his wages, i.e. the

20 This shock can result from a variance of demand (see for example Green and Porter 1984, Rotemberg and Saloner 1986, Haltiwanger and Harrington 1991, Kandori 1991 or Besanko et al. 2010). Case studies show that demand-shocks influence cartel-stability and -formation (see Grout and Sonderegger 2005 and Levenstein and Suslow 2011).

21 Note that it does not need to be directly observable. The agent knows his choices of K and e and therefore he knows what profits should have been realized without the shock. The Principal does not know anything but $\varepsilon \sim \text{No}(0, \sigma^2)$. Therefore, he cannot deduce with certainty from observed profit to the actions chosen by the agent.

22 Harrington and Skrzypacz (2011) provide a detailed analysis on how a cartel contract can be established and on how it works economically to stabilize the cartel based on the Lysine case. However, they examine (truthful) reporting of the cartel-firms.

23 One could also think of a situation where there is some basic level of effort \underline{e} . The cartel profit can be achieved with \underline{e} , but outside the cartel effort $e > \underline{e}$ is necessary to achieve any profits. In the model \underline{e} is normalized to zero.

fixed wage \underline{w} , the profit target $\underline{\pi}$ and the bonus parameter $a \in [0,1]$. If the agent's misbehavior $K=1$ is internally or externally detected, he will lose the bonus payment and receive a share of his fixed wage $b\underline{w}$. Therefore, the expected utility function of the agent is $E[u_A(e, K, R, C, D, \underline{w}, \underline{\pi}, a, b)]$.

Principal's utility is a function of total profits $u_P: G \rightarrow \mathbb{R}$. The principal is assumed to be risk-neutral. Since the agent is risk-neutral as well, the reason for delegation can be special knowledge or skills of the agent. For the results, it is necessary to assume that u_P is increasing in G . It is important, though, to note that the profits used for the calculation of the agents' bonuses can be different from those attributed to the principal. Assume that the fine only occurs in the utility of the principal. The rationale for this is that (i) the principal is the owner of a much larger company with the agent running only a minor part. Punishments in this case might be much higher than profits generated by the agent. In the EU, enterprises can be liable for a breach of competition law with up to 10% of their total annual turnover (see Buccirosi and Spagnolo 2005: 5). This means that if there was a local division involved in a cartel it might be the case that the whole firm would have to pay 10% of their worldwide revenues as fines.²⁴ Another argument could be that (ii) there is a time-lag between the realization of the profits that account for the bonuses of the manager and the realization of total profits for the shareholder. Since the model is static, this cannot be modeled here in more detail. Therefore it is assumed that total profits G consist of the profits of other divisions of the principal's company g and of the profits realized by the agent π . Profits π depict the interaction between the principal and the agent and so π is always related to this profits in the model. By this assumption, total profits can be expressed as follows:

$$E(G) = \begin{cases} g + E[\pi_0] - \underline{w} - a(\pi_0 - \underline{\pi}), & (K=C=0) \vee (K=0, C=1) \\ g + E[\pi_1] - \underline{w} - a(\pi_1 - \underline{\pi}) - \rho F, & (K=1, R=C=0) \vee (K=1, R=0, C=1, D=0) \\ g + E[\pi_1] - \underline{w} - a(\pi_1 - \underline{\pi}), & (K=1, R=0, C=D=1) \\ g + E[\pi_K] - \underline{w} - a(\pi_K - \underline{\pi}) - \rho F, & (K=R=1, C=0) \vee (K=R=C=1, D=0) \\ g + E[\pi_K] - \underline{w} - a(\pi_K - \underline{\pi}), & (K=R=C=D=1) \end{cases} \quad (2)$$

There are basically five different cases to consider, which will be explained in the order of (2). Also, any legal opportunities to reduce corporate fines by the mere existence of a CLCP in the firm are left out here, so the firm (i.e. the principal) will be punished with ρF in expectation in case of external detection. Also, define π_j with $j \in \{0,1,K\}$ as the cases of no cartel, unsuccessful cartel-activity and successful cartel-activity, respectively. These three values will be analyzed in section 3. Now the different cases for $E[G]$ in (2) can be highlighted:

²⁴ This can also be seen in national legislations. For Germany this is regulated in §81, 4 GWB. This argument is also mentioned in Angelucci and Han (2010: 13, footnote 22)

- I. The agent is not involved in any collusive activity ($K=0$). The principal did or did not invest in a CLCP ($C=1$ or $C=0$). In this case, the principal will get the profit of the other divisions, g , plus the expected value of profits in the competitive state, $E[\pi_0]$. He will have to compensate the agent according to the parameters fixed in the working contract, \underline{w} and $\underline{\pi}$.
- II. The agent tries to collude ($K=1$) but the attempt fails ($R=0$). However, the attempt is not detected either because no CLCP was in place ($C=0$) or because the monitoring was not successful ($C=1, D=0$). In this case, the principal will receive the expected profit $E[\pi_1]$ and pays the agent according to the working contract. In addition to that, there is the danger of being detected by the competition authority leading to an expected fine of ρF . It will be shown later that this is the worst situation for the principal because profits are lower than in any other state and there is the threat of fines.
- III. The unsuccessful attempt to collude of the agent ($K=1, R=0$) is detected internally by the CLCP ($C=D=1$). In this case the principal will not be exposed to fines because of leniency.²⁵ In the model it is always optimal for the principal to apply for leniency when he has evidence of the agent's illegal activity. Holding back information only bears the risk of external detection and fines.
- IV. The agent's attempt to collude was successful ($K=R=1$). The collusive activity is not detected either because there is no CLCP ($C=0$) or the monitoring-process introduced by the CLCP was not successful ($C=1, D=0$). As mentioned in (II), the principal is exposed to potential sanctions of the competition-authority. However, in this case he will receive the expected cartel-profit $E[\pi_k]$.
- V. The agent's attempt to collude was successful ($K=R=1$) and the CLCP detects the cartel internally ($C=D=1$). The principal will not be exposed to fines. In addition to that, he receives high cartel profits.

Note that there appear no costs of a CLCP in the model. In the following analysis it should be considered that there are costs in reality; however this costs do not change the basic results.²⁶ By assuming that installing a CLCP requires some fixed costs, these have to be compared with the potential gains from installing a CLCP.

One of the results derived in section 3 is that the situation described in (V.) can be optimal for the

²⁵ If the principal can adjust punishments b , he will only have to pay wages of $b\underline{w}$. This holds for V., as well.

²⁶ Falk and Kosfeld (2006) use experiments to show that there are also indirect costs of profit targets and monitoring in principal-agent setups. Agents might be less willing to exert effort when they feel being treated as untrustworthy by the principal. Taking this into account would impose a negative impact of $C=1$ on effort.

principal and it involves having a CLCP. In this case, the CLCP works as an insurance: On the one hand, the principal is interested in realizing the highest possible profits. On the other hand, this involves a breach of competition law. This breach comes along with potentially severe punishments. To avoid these punishments, the principal has the incentive to detect misbehavior internally prior to any investigations of the authority. As argued at the beginning of section 3.2, whether the principal prefers collusion can be driven by the relation between profits contributed by the agent and total profits of the principal's company. So it might be optimal for the principal to offer a contract that has a higher chance to induce collusive activity and to install a CLCP as an insurance against the consequences.

3. SOLVING THE MODEL

3.1 OPTIMAL EFFORT-LEVELS

Finding a solution to the model requires that the principal and the agent maximize their expected utilities:

$$\max_{a_i} \left\{ E(u_i(a_A, a_P, b, D, R)) \right\}, i \in \{A, P\} \quad (3)$$

This is done recursively, i.e. by first determining the optimal effort-level of the agent. Profits are realized according to $\pi(e, K, R, \varepsilon) = \pi(e, K, R) + \varepsilon$. Since $\varepsilon \sim \text{No}(0, \sigma^2)$ it follows that $E(\pi) = E(\pi(e, K, R))$. Determining the optimal effort level requires analyzing three different situations arising from the collusion process of the prior stages. According to stages 1. to 3., agent's expected utility is:

$$E[u_A(e, K, R, D)] = \begin{cases} E[u(\underline{w} + a(\pi(e, \epsilon) - \underline{\pi}), c(e))], & K=0 \\ E[u(\underline{w} + a(\pi(e, \epsilon) - \underline{\pi}), c(e), D)], & K=1, R=0 \\ E[u(\underline{w} + a(\pi_K(\epsilon) - \underline{\pi}), c(e), D)], & K=R=1 \end{cases} \quad (4)$$

Agent's expected utility is a function of effort e , the attempt to collude $K \in \{0, 1\}$ and the two state-variables (i) whether the cartel is realized $R \in \{0, 1\}$ and (ii) whether potential misbehavior is detected internally $D \in \{0, 1\}$. From this setup it follows that there are three different cases:

- I. The agent does not attempt to collude ($K=0$). In this case, he will receive a fixed wage \underline{w} plus a bonus-payment $a(\cdot)$ depending on profits, the realization of the shocks and the profit target. There are also costs of effort $c(e)$.
- II. The agent's attempt to collude ($K=1$) is not successful ($R=0$). In this case, total wages depend on fixed wages, bonus-payments and the costs of effort. In addition to that, there is a chance of being internally or externally detected.
- III. The agent's attempt to collude ($K=1$) is successful ($R=1$). As before, total wages depend on fixed wages and the profit target relative to (constant) cartel profits. Exerting effort is not

necessary. Again, there is the risk of detection.

Finding the optimal effort-level requires solving the problem:

$$\max_e \{E[u_A(e, K, R, D)]\} \quad (5)$$

For the analysis, the following properties are assumed to solve (5):

(A-I) The utility function is additively separable in the gain from wages and the costs of effort:

$$u_A = u(w) - c(e).^{27}$$

(A-II) Convex costs: $dc/de > 0$, $d^2c/de^2 > 0$.

(A-III) A linear bonus scheme with $a \in [0, 1]$.²⁸

(A-IV) Effort increases profits with diminishing returns: $d\pi/de > 0$ and $d^2\pi/de^2 \leq 0$.

(A-V) Utility is linear in wages: $\partial u_A / \partial w > 0$ and $\partial^2 u_A / \partial w^2 = 0$.

(A-VI) the profit level in a realized cartel, $\pi(e, 1, 1) \equiv \pi_K$, is irrespective of effort, so $d\pi_K/de = 0$.

One also has to make some assumptions about the behavior of the utility and effort-cost functions for $\pi(e) = \underline{\pi}$ to rule out corner-solutions. More details can be found in the Appendix. The agents' incentives to exert effort are different in case of $K=0$ and $K=1$. There will be different optimal effort-levels if the cartel is realized, since the agent observes whether a cartel has been formed before he chooses his optimal effort. First, consider the case when he does not try to engage in collusion ($K=0$ -case). In this case, the following maximization problem arises:

$$\max_e \{u_A(e, K=0) = u(\underline{w} + a E[(\pi(e, \epsilon) - \underline{\pi})]) - c(e)\} \quad (6)$$

The result is an effort level e that maximizes utility in case of the agent not trying to engage in collusion. Define the solution of (6) as e_0 . In the appendix it is shown that there is a unique optimum effort level solving problem (6).

The optimal effort-level in case of a successful attempt to collude ($K=R=1$ -case) is the solution to the following maximization-problem:

$$\begin{aligned} \max_e \{u_A(e, K=1, R=1) = (1-\psi)(1-\rho)u(\underline{w} + a(E[\pi_K(\epsilon)] - \underline{\pi})) \\ + (\psi - \psi\rho + \rho)u(b\underline{w}) - c(e)\} \end{aligned} \quad (7)$$

Define the solution of (7) as e_K . Note that $e_K=0$ since cartel-profit π_K is constant. If agent's misbehavior is detected, he will receive a reduced value of fixed wages and no bonus-payment at

27 Note that due to (A-I), the function u from now on only depicts the “income-part” of the agent's utility since effort-costs are separated.

28 This assumption is not crucial. However, it simplifies the analysis. See Ferstman, Judd and Kalai (1991) for properties of compensation functions.

all. Since the bonus is the only channel through which the agent can gain additional utility from effort, any effort in this case would be wasted. A more detailed analysis can be found in the Appendix.

The last case for determining the agent's optimal effort is the case of an unsuccessful attempt to collude ($K=1, R=0$). Define the optimal effort in this case as e_1 . The agent will work less compared to the situation of $K=0$ since his expected (marginal) utility is deflated by the probabilities of detection. Since $e_1 > 0$ the agent will exert more effort than in a cartel. The derivation of this result can be found in the Appendix. It follows that $e_0 > e_1 > e_K = 0$ for $\rho > 0$ or $\psi > 0$. For the agent, this case of unsuccessful collusion can be seen as the worst case, because (i) the (constant) cartel-profits could not be realized, so he will again have to exert effort and (ii) he would be better off by having chosen $K=0$, because in this case there would be no danger of being punished.

3.2 INCENTIVE-COMPATIBILITY

Before turning to the incentive compatibility-constraint (ICC) of the agent it is useful to examine the preferences of the principal. It is obvious that if the principal does not prefer collusion, he will want to deter the agent from misbehavior. However, even a collusion-preferring principal might have an incentive to install a CLCP because he can insure himself against a punishment. The relation between the profits generated by the agent and the expected punishment determine whether the principal prefers collusive activity of the agent or not. Recall that the punishment F can be up to 10% of the total turnover of the whole firm according to legal frameworks like in the EU. Therefore, define G as the sum of all profits generated by the subunits of the principal's firm. fines F are a function of total profits G . The latter consist of the profits generated by other segments, g , of the principal's firm and the expected profits generated by the agent in the different states, $E[\pi_j]$, $j \in \{0, 1, K\}$. Here, π_0 and π_1 are the “indirect” profits as a function of the optimal effort-levels e_0 and e_1 , respectively, determined in 3.1. It was shown that $e_1 < e_0$ from which it follows that $E[\pi_1] < E[\pi_0]$. As argued above, it holds that $E[\pi_1] < E[\pi_0] < E[\pi_K]$. For the principal to prefer collusion it is necessary that the expected value of cartel-profits $E[\pi_K]$ is higher than the expected fine $\rho F(G)$. So there are basically two factors that can make the principal prefer collusion: (i) the agent generates a substantial share of total profits or (ii) the detection-probability is small. It is important to note that an application for leniency of other firms involved in the cartel-agreement will lead to an external punishment by the authority. The impact of leniency programs on the detection of cartels is expected to be quite high (see Miller 2009). This is also captured in a higher value of ρ since other

firms applying for leniency are not explicitly modeled. Therefore, the most important factor promoting the principal's interest to be in a cartel would be a large share of profits generated by the agent relative to total profits G . It follows that the larger the enterprise becomes, the stronger the incentive to install a CLCP should be. Parker and Nielsen (2008: 28) and Abrantes-Metz and Sokol (2013: 3-4, 11) observe that in deed larger firms are more likely to have a CLCP. If the principal only receives the profits of the agent, $G=\pi(\cdot)-w(\cdot)$ holds and the principal will prefer collusion if $\pi_K-w(\pi_K)-\rho F > \pi(e_0, \cdot)-w(\pi(e_0))$.

By adjusting the contract parameters, the principal can influence the agents' choice of effort e and market behavior $K \in \{0,1\}$ through the incentive compatibility constraint. Since optimal effort-levels are closely related to the decision to participate in a collusive agreement, the factors that influence this choice are the “heart” of the incentive contract. Note that the participation constraint (PC) is fulfilled if the agent receives at least the utility of his outside option which is normalized to zero. So for any contract that has an expected wage of at least zero, the PC is (weakly) fulfilled. This constraint can be neglected because even a very small \underline{w} is enough to ensure the PC.²⁹ Concerning competition law compliance it is more important to analyze the incentive-compatibility of the contract. For the agent to prefer $K=0$ to $K=1$, the indirect utility from obeying the law has to exceed the indirect utility from engaging in collusive activity. Define v_0, v_1 and v_K as the indirect utilities when a cartel is not intended, not realized but intended and realized, respectively, i.e. $v_j \equiv u_A(e_j)$ with $j \in \{0,1,K\}$. Here, e_j are the optimal effort-levels determined in section 3.1. Therefore, the following ICC has to be satisfied for the agent to prefer compliance with the law:

$$\kappa v_K + (1-\kappa)v_1 \leq v_0 \quad (8)$$

For a better understanding of this ICC, define w_j as the "indirect" wage levels, i.e. those wages generated by the optimal effort-levels e_0, e_1 and e_K determined in 3.1. The ICC can be rearranged to:

$$v_1 + \kappa \left((1-\psi)(1-\rho)(u(w_K | \underline{\pi}) - u(w_1 | \underline{\pi})) + c(e_1) \right) \leq u(w_0 | \underline{\pi}) - c(e_0) \quad (9)$$

A detailed derivation of this result can be found in the Appendix. The LHS of (9) constitutes (i) a baseline utility level v_1 , which is the indirect utility when a collusive attempt is unsuccessful. This is the minimum utility the agent can receive by choosing $K=1$. The agent can realize (ii) an expected gain in utility from additional income realized in a successfully formed cartel, $\kappa(1-\psi)(1-\rho)(u(w_K) - u(w_1))$. Also, if the cartel is established, the agent can (iii) save effort costs in a cartel, $\kappa c(e_1)$. This factors drive the incentives of the agent to engage in collusion. If net utility from normal competition, $u(w_0) - c(e_0)$, is higher than the collusive-value just described, the agent will prefer to

29 This is comparable to Ferstman, Judd and Kalai (1997) where even a very small wage that is paid only if the utility target fixed in the working contract is met is enough to ensure participation.

obey the law.

One parameter the principal can change is the fixed wage \underline{w} . Recall that the agent is left with \underline{w} for $\pi(e, K) < \underline{\pi}$. Since agent's misbehavior will be punished by a reduction of fixed wage if $b < 1$, changes in \underline{w} affect the ICC. Note that the effort-levels can be directly influenced by the profit target $\underline{\pi}$ and the bonus parameter a . Given the choice of $K \in \{0, 1\}$, \underline{w} has no effect on effort. However, \underline{w} can affect the agent's decision whether to attempt to collude ($K=1$) or not ($K=0$). As there are different effort levels associated with K , \underline{w} has an indirect impact on effort levels.

Proposition 1: If a punishment is installed in terms of $b < 1$, any increase in the fixed wage \underline{w} decreases the incentive of the agent to collude.

The Proof can be found in the Appendix. Economically, the fixed wage \underline{w} is comparable to a transfer. However, the agent can keep the whole transfer with certainty only if he obeys the law. If he chooses to breach the law, the resulting lottery provides a reduced value $b\underline{w}$ in case of internal or external detection. When a breach occurred, the whole fixed wage is only paid if the agent's misbehavior is not detected. Therefore, in case of an increase $\Delta\underline{w} > 0$, the agent will certainly receive $\Delta\underline{w}$ only if he chooses $K=0$, while with $K=1$ he will only realize a share (stochastically and in terms of reductions by the fine) of $\Delta\underline{w}$. The resulting increase in opportunity cost of breaching the law make obeying the law more attractive for the agent.

For the analysis of the profit targets it is important to first look at the different levels they can be positioned at. It was shown that $e_0 > e_1 > e_K = 0$ – the highest effort will be carried out in a competitive state. It was also assumed that cartel-profits π_K are higher than competitive profits $\pi(e_0)$. Because of $e_0 > e_1$ it follows that $E[\pi_K] > E[\pi_0] > E[\pi_1]$. So in expectation, a cartel yields the highest profit levels and obeying the law is more profitable than an unsuccessful attempt to collude. The principal can always abstain from a profit target (comparable to $\underline{\pi} > E[\pi_K] > E[\pi_0] > E[\pi_1]$). However, if he wants to install an effective profit target, there are three different possibilities. Define the sets of the principals' feasible profit targets as follows:

1. No effective profit target: $\underline{\pi}_N := \{\underline{\pi} \mid \underline{\pi} > E[\pi_K] > E[\pi_0] > E[\pi_1]\}$
2. High profit target: $\underline{\pi}_H := \{\underline{\pi} \mid E[\pi_K] > \underline{\pi} > E[\pi_0] > E[\pi_1]\}$
3. Intermediate profit target: $\underline{\pi}_M := \{\underline{\pi} \mid E[\pi_K] > E[\pi_0] > \underline{\pi} > E[\pi_1]\}$
4. Low profit target: $\underline{\pi}_L := \{\underline{\pi} \mid E[\pi_K] > E[\pi_0] > E[\pi_1] > \underline{\pi}\}$.

This four cases will be examined in more detail in the following section. For the analysis, note that

risk-neutrality and $E[\varepsilon]=0$ make the shock disappear and therefore allow for a detailed analysis of this ICC.

1. No effective profit target ($\underline{\pi} > E[\pi_K] > E[\pi_0] > E[\pi_1]$)

For $\underline{\pi} \in \underline{\pi}_N$, the agent can never receive bonus-payments. Without bonus-payments the agent will not exert effort. Setting the primary tool for incentivizing the agent to exert effort or to engage in collusive activities aside is no reasonable solution, because the payoff of both parties can be improved by installing an effective profit target. The reason for is simple: Wages are constant over all states, so $u(w_K)=u(w_0)=u(w_1)=u(\underline{w})$. It can be seen in maximization-problem (6) that optimal effort levels are zero. Concerning the decision of $K \in \{0,1\}$, the ICC for no effective profit target can be stated as follows:

$$(\psi + \rho - \psi\rho)(u(\underline{w}) - u(b\underline{w})) \geq 0 \quad (10)$$

A detailed analysis on how to derive the ICCs for the different targets can be found in the Appendix. Inequality (10) basically states that the expected costs of an attempt to engage in collusion³⁰ have to be positive for compliance with the law to be optimal. If this is indeed the case, the agent will not breach the law. Without an effective profit target, the analysis is comparable to the one of the fixed wage \underline{w} . Without a punishment ($b=1$) the agent is indifferent between breaching the law or complying with it. However, for $b < 1$, ICC (10) is always met. The reason is that by choosing $K=1$ the agent is exposed to possible wage-reductions while not having the possibility to gain anything. If the principal can adjust b , he can deter the agent from collusive conduct with only slight punishments. As long as $\rho > 0$ he will not have to invest in monitoring. However, without proper incentives, profits $\pi(e=0)$ can be very low, so the firm would sacrifice legal profits while collusion could also be encouraged by utilizing profit-targets as explained below.

2. High profit target ($E[\pi_K] > \underline{\pi} > E[\pi_0] > E[\pi_1]$)

When $\underline{\pi} \in \underline{\pi}_H$ holds, the agent can only receive a bonus-payment if he is involved in a successfully formed cartel. If he complies with the law, he will only receive the fixed wage, so it follows that $u(w_0)=u(w_1)=u(\underline{w})$. As explained above, the incentives to exert effort are erased in these cases, so the agent will not exert effort. The optimal effort-level in the competitive states ($K=0$ and $K=1$, $R=0$) are zero, accordingly, and so are the effort costs, $c(e_0)=c(e_1)=0$. In a cartel, the optimal effort-level is zero anyway. Hence, with a high profit target in place, the agent will never exert effort. The ICC for the high profit target can be stated as follows:

30 Note that $(\psi + \rho - \psi\rho) = (1 - \psi)\rho + (1 - \rho)\psi + \psi\rho$, so the probability of being detected through any possible channel.

$$\kappa(1-\psi)(1-\rho)(u(w_K|\pi \in \pi_H) - u(\underline{w})) \leq (\psi + \rho - \psi\rho)(u(\underline{w}) - u(b\underline{w})) \quad (11)$$

The derivation of this result can be found in the Appendix. Inequality (11), again, states that if the expected costs of a collusive decision (RHS) exceed the expected gains from collusion (LHS), the agent will comply with the law. It is a feature of the case of a high profit target that the gain from collusion is $(w_K - w)$ and the loss is $(w - b\underline{w})$. This is because the agent cannot receive any bonuses outside a cartel which is what might be a strong incentive to engage in collusion. If there is no individual fine ($b=1$) the ICC will always be violated. The agent only benefits from engaging in collusion: In case of detection he will only lose his bonus, which he would not have received by complying with the law, anyway. Note that a high profit target like the one described might be problematic since it unambiguously reveals the incentive of the principal to engage in collusion. This might make the firm vulnerable in eventual court-decisions. Another drawback is that the agent will exert no effort at all, especially when the attempt to collude failed. Therefore, it can be an option to lower the profit target, even if the principal intends to engage in collusion.

3. Medium profit target ($E[\pi_K] > E[\pi_0] > \underline{\pi} > E[\pi_1]$)

For $\pi \in \pi_M$, the agent can receive a bonus-payment if he engaged in collusion and if he complied with the law. Only the optimal expected profits when the attempt to collude was not successful is not high enough to be granted a bonus, hence $u(w_1) = u(w)$ holds. As before, effort-costs are zero in this case, $c(e_1) = 0$. The ICC can be stated as follows:

$$\begin{aligned} \kappa(1-\psi)(1-\rho)(u(w_K|\pi \in \pi_M) - u(\underline{w})) - (\psi + \rho - \psi\rho)(u(\underline{w}) - u(b\underline{w})) \\ \leq u(w_0|\pi \in \pi_M) - u(\underline{w}) - c(e_0) \end{aligned} \quad (12)$$

As in the case of high profit targets, for collusion to be more attractive than complying with the law, the expected gain from collusion, $\kappa(1-\psi)(1-\rho)(u(w_K|\cdot) - u(\underline{w}))$, has to exceed the expected costs of collusion, $(\psi + \rho - \psi\rho)(u(\underline{w}) - u(b\underline{w}))$. With a medium profit target in place, this expected net gain from collusion has to further exceed the expected gain from complying with the law, i.e. choosing $K=0$, which constitutes the RHS. These consist of the utility gain $u(w_0|\cdot) - u(\underline{w})$ minus effort-costs. Note that ICC (12) is not necessarily less restrictive than ICC (11), since $\pi_M < \pi_H$ which generates higher bonus-payments for collusion. On the other hand, gains from compliance are increased, because positive bonuses are possible when choosing to comply with the law. It follows that there is a non-monotonicity in profit-thresholds and the incentives to collude which will be shown in Proposition 2 below.

4. Low profit target ($E[\pi_K] > E[\pi_0] > E[\pi_1] > \underline{\pi}$)

For $\underline{\pi} \in \underline{\pi}_L$, the ICC is:

$$\begin{aligned} & \kappa(1-\psi)(1-\rho)(u(w_K | \underline{\pi} \in \underline{\pi}_L) - u(\underline{w})) \\ & + (1-\kappa)((1-\psi)(1-\rho)(u(w(e_1) | \underline{\pi} \in \underline{\pi}_L) - u(\underline{w})) - c(e_0)) \\ & - (\psi + \rho - \psi\rho)(u(\underline{w}) - u(b \underline{w})) \leq u(w_0 | \underline{\pi} \in \underline{\pi}_L) - u(\underline{w}) - c(e_0) \end{aligned} \quad (13)$$

Also, all of the mechanisms described before hold as well: By choosing $K=1$, the agent can save on effort and has the chance to receive a high bonus. The latter effect is enhanced because the lowest target regime $\underline{\pi} \in \underline{\pi}_L$ is active. Additionally, the profit target is so low that the agent can also receive a bonus when the attempt to collude was not successful which is depicted in the second line. On the other hand, the certain bonus payment in a compliant state is also higher than in the other target regimes.

Proposition 2: A low profit target can provide a stronger incentive to collude than a medium profit target.

The proof can be found in the Appendix. The economic explanation is as follows: By introducing a lower profit target, the bonus-payments in a successfully formed cartel and in the competitive state increase. The former increases the gain of collusion and the latter the opportunity-cost of collusion. What is special to this case is that even if the attempt to collude failed ($K=1$ and $R=0$) the agent can still receive a bonus if his misbehavior stays undetected. This additional, expected gain will increase the incentive to collude again, if the profit target is lowered beyond the competitive profits-threshold. It follows that there is a non-monotonic relationship between profit targets and the incentive to engage in collusion: A high profit target encourages the agent to collude, while a medium profit target deters the agent. However, further lowering the profit target beyond the profit level the agent would contribute if the cartel was not formed, encourages the agent to collude again. The low target insures the agent against "bad luck" during cartel-formation.

From this non-monotonic relationship the question arises whether a high profit target promotes collusion more strongly than a low profit target. This is captured by Proposition 3.

Proposition 3: A low profit target provides stronger incentives to collude than a high profit target if higher expected bonuses in a cartel together with expected bonus payments net effort-costs in case of an unsuccessfully formed cartel in a low regime exceed high bonuses for compliance induced by a low regime.

The proof can be found in the Appendix. The reason is that both with high and low profit target, the agent can receive a bonus-payment if the cartel successfully formed. With a high target, the agent will not receive a bonus in normal competition (i.e. by choosing $K=0$) nor when cartel formation was unsuccessful (i.e. $K=1$ and $R=0$). In these two states the agent will realize the utility of his base wage, $u(\underline{w})$. With a low target, the agent can receive a bonus in both cases. Therefore, if the high and the low targets are compared, the additional utility from bonuses in relation to the utility from the base wage have to be compared. Additionally, the expected bonus payment is higher for the low profit target regime since $\underline{\pi}_L < \underline{\pi}_H$ holds by definition. So on the one hand, compliance is rewarded more strongly by choosing a low profit threshold. On the other hand, also collusion becomes more attractive by increasing the bonus payments and offering the chance to still receive a bonus payment despite cartel formation was not successful. The net effect is ambiguous and one result can be that low profit targets foster collusion more strongly than high profit targets.

Proposition 4: A medium profit target provides a stronger incentive to collude than a high profit-target if the net gain in bonus payments is lower than the expected loss generated by refraining from collusion for all $\underline{\pi} \in \underline{\pi}_M$.

The proof can be found in the Appendix. When the agent chooses to comply with the laws, he can gain a bonus payment in the medium regime. This is not the case for the high regime. Hence, this effect makes collusion less attractive in the medium regime. On the other hand, the expected gain from collusion is higher due to the higher bonus payments generated by the lower threshold $\underline{\pi}_M < \underline{\pi}_H$, therefore making collusion more attractive in the medium regime. If the latter effect is stronger, collusion is fostered more strongly in the medium target regime.

To sum up, there are different channels through which the principal can deter the agent from misbehavior. First, he can increase the fixed wage \underline{w} . However, this only deters the agent from misbehavior if there is a punishment in place in terms of $b < 1$. Second, he can adjust the profit target. By choosing no effective profit target ($\underline{\pi} > E[\pi_K] > E[\pi(e_0)] > E[\pi(e_1)]$) in addition to a punishment in terms of reducing the fixed wage in case of detection, the agent will be prevented from engaging in collusion because the agent has nothing to gain in a cartel. However, this situation is inefficient because the agent will not exert any effort. To overcome this problem, the principal has to lower the profit targets. Setting a high profit target ($E[\pi_K] > \underline{\pi} > E[\pi_0] > E[\pi_1]$) will drive the agent towards engaging in collusive activity since he can only achieve a bonus in a cartel or by a large

realization of ε . However, lowering the profit target does not necessarily decrease the agent's incentive to collude. With an intermediate profit target ($E[\pi_k] > E[\pi_0] > \underline{\pi} > E[\pi_1]$) in place, compliance is fostered by giving the agent the opportunity to receive a bonus payment if he complies with the law. However, the bonus payment in a cartel is also increased which makes collusion more favorable. Lowering the profit target even further to ($E[\pi_k] > E[\pi_0] > E[\pi_1] > \underline{\pi}$) enhances this effect. Besides increasing payoffs for compliance due to the lower profit target, it additionally gives the agent the chance to still receive a bonus even if cartel formation was not successful. This makes the attempt to collude even more attractive.

Throughout the analysis there are interactions between the different components of the contract-parameters. One point worth mentioning in this context is that the introduction of a CLCP in terms of a positive internal detection-probability unambiguously deters the agent from collusive-activities.

As stated in the analysis, the principals' preferences towards collusion primarily drive the level of profit targets and CLCP investments. Though it depends on the relation of π_k to $\pi(e_0)$ and ρF , it can clearly be stated that the case of an unsuccessful attempt is the worst case for the principal. Here, the agent would exert effort of e_1 which is smaller than e_0 as derived in section 3.1. It follows that an unsuccessful attempt to collude by the agent generates less profit and exposes the firm to fines. To avoid this situation installing a CLCP can be optimal to at least have the chance to apply for leniency.

4. CONCLUSION

The agent has the chance to reduce working effort and to increase profits of the firm by engaging in collusive activity. Increased profits result in bonus-payments to the agent if realized profits exceed a certain profit target fixed in the working contract. It was shown that to prevent cartel-activity of the agent, the principal can invest in a CLCP as a monitoring device. The threat of detection (internal or external) unambiguously deters the agent from misbehavior if punishments (eliminations of bonus-payments and reductions of the fixed wage) are induced.

The principal can incentivize the agent to exert effort by setting profit-targets. These targets also influence the agents' incentive to collude. If the target is so high that it is only achievable in a cartel, the incentive to collude is fostered, respectively. Contrary to the literature (Aubert 2009), we show that by introducing uncertainty about cartel formation as well as internal and external monitoring,

there exists a non-monotonic relationship between profit targets and the incentives to collude. Setting a high profit target which is only achievable in a cartel drives the agent towards engaging in collusive activity since, in expectation, he can only achieve a bonus in a cartel. However, lowering the profit target does not necessarily decrease the agent's incentive to collude. With an intermediate profit target which is below competitive profits but above profits that are generated when cartel formation was not successful, compliance is fostered by giving the agent the opportunity to receive a bonus payment if he complies with the law. However, the bonus payment in a cartel is also increased which makes collusion more favorable. Lowering the profit target to a level where the agent can always receive a bonus in expectation enhances this effect. Besides increasing payoffs for compliance due to the lower profit target, it additionally gives the agent the chance to receive a bonus even if cartel formation was not successful. This makes the attempt to collude even more attractive. Also, it was shown that CLCPs unambiguously promote law conform behavior. This shows that uncertainties lead to interaction effects between different parameters that generate a non-monotonic relationship between profit targets and the incentive to collude. Hence, in reality, firms have to be very careful when fixing the parameters of their working contracts if they want to promote law conform behavior.

The preferences of the principal towards collusion depend on the level of profits generated by the agent relative to overall profits of the principal's enterprise. Fines for an enterprise can be very large even if only a subdivision was involved in an infringement of competition law. Therefore, the model allows to make statements about the principal's payoff: If expected fines based on total profits of the enterprise are higher than the expected gain from collusion, the latter is not optimal. In this case, the principal can deter the agent from collusion. On the other hand, even a principal who prefers collusion might want to invest in a CLCP – he can insure himself against potential fines. If misconduct is detected internally before the authority started its investigation, the principal can apply for leniency and still realize the whole profit the agent has generated. Otherwise he will suffer from the fines. One conclusion of this result would be that large, differentiated firms tend to be more interested in CLCPs.

The results of the model reveal a possible implication on how CLCPs can work on a very basic level, without the need to introduce any reputation-effects, preferences for law-compliance or moral values. Although this factors certainly play a role in reality, it is not satisfactory to explain the existence of CLCPs only by means of these. In the approach proposed here, a CLCP is just a down-to-earth method for incentivizing the manager of a firm to exert effort in a proper way and to protect

the firm against high fines.

A major problem is that the principal might be the one who is responsible for collusion. According to the results of the model, this can be 'obscured' by installing a CLCP. The program, though, might only be a device for the principal to actually induce collusion more safely. Based on this argument it would be a misleading policy to reduce the fine for the mere existence of a CLCP. However, besides fines there could also be private damage claims which are not covered in the model. Especially in regimes with relatively low fines and high private damage claims like in the US, these might strongly influence the incentives of the principal when the firm cannot get rid of damage claims when applying for leniency.

A reasonable extension would be to study this issues in a dynamic framework. The principal might not want to report the misbehavior of the agent to stabilize the cartel agreement. It might still be optimal to search for evidence in this case since having information to reveal or even being the first firm to apply for leniency might be an optimal strategy.

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APPENDIX

Optimal Effort-levels

First, note that risk-neutrality allows that $E[u(w,e)] = u[E(w,e)]$. Since $\varepsilon \sim \text{No}(0, \sigma^2)$, the shock vanishes in expectation and the analysis can proceed without expectation-operators. This holds for all the three following cases.

1. Optimal effort-level without an attempt to collude (K=0-case)

Define the maximization problem in general:

$$\max_e \{u_A(w, \underline{w}, a, \pi(e), \underline{\pi}, c(e)) = u(w(\underline{w}, f(\pi(e), \underline{\pi}))) - c(e)\} \quad (14)$$

Where $f(\cdot)$ is a general compensation function. The FOC to problem (14) is:

$$\frac{\partial u}{\partial w} \frac{\partial w}{\partial a} \frac{\partial f}{\partial \pi} \frac{\partial \pi}{\partial e} = \frac{dc}{de} \quad (15)$$

It was assumed that $f(\cdot) = a(\pi - \underline{\pi})$. (15) can be therefore be expressed as:

$$\Leftrightarrow a(\pi(e) - \underline{\pi}) \frac{\partial u(\cdot)}{\partial \pi(\cdot)} \frac{\partial \pi(\cdot)}{\partial e} = \frac{dc(\cdot)}{de} \quad (16)$$

According to (A-III) to (A-V), the LHS is positive. Note, that the agent derives utility from income w which is a (linearly) increasing function of π . Therefore, assumption (A-V) implies $\partial u(\cdot)/\partial \pi > 0$. The RHS is positive because effort-costs are increasing in effort (A-II). One can easily see here that if the profit target is not met, optimal effort will be zero, since $f(\cdot) = a(\pi - \underline{\pi}) = 0$ for $w < \underline{w}$ as assumed in (1).

The solution of (14) constitutes a maximum if the SOC is negative (abstracting from corner-solutions). The SOC is:

$$\frac{\partial^2 u}{\partial w^2} \frac{\partial w}{\partial a} \frac{\partial f}{\partial \pi} \frac{\partial \pi}{\partial e} + \frac{\partial u}{\partial w} \frac{\partial^2 w}{\partial a^2} \frac{\partial f}{\partial \pi} \frac{\partial \pi}{\partial e} + \frac{\partial u}{\partial w} \frac{\partial w}{\partial a} \frac{\partial^2 f}{\partial \pi^2} \frac{\partial \pi}{\partial e} + \frac{\partial u}{\partial w} \frac{\partial w}{\partial a} \frac{\partial f}{\partial \pi} \frac{\partial^2 \pi}{\partial e^2} - \frac{d^2 c}{d e^2} \quad (17)$$

It is assumed that costs are convex (A-II), so $d^2 c / d e^2 > 0$. From the assumption of a linear bonus scheme (assumption A-III) it follows that $\partial^2 w(\cdot) / \partial a^2 = \partial^2 f(\cdot) / \partial \pi^2 = 0$. Risk-neutrality implies $\partial^2 u(\cdot) / \partial w^2 = 0$ and Assumption (A-IV) assures diminishing returns of effort, so $d^2 \pi / d e^2 \leq 0$. It follows that SOC (17) is negative and the solution to (6) in deed constitutes a maximum.

2. Optimal effort-level with an successful attempt to collude (K=R=1-case)

The maximization-problem in full length can be depicted as follows:

$$\begin{aligned} \max_e \{ & u_A(e, K=1, R=1) = (1-\psi)(1-\rho) \left(u(\underline{w} + f(\pi_K - \underline{\pi})) - c(e) \right) \\ & + (\psi \cdot \rho) \cdot (u(b \underline{w}) - c(e)) + (1-\rho) \psi \cdot (u(b \underline{w}) - c(e)) + (1-\psi) \rho \cdot (u(b \underline{w}) - c(e)) \} \end{aligned} \quad (18)$$

The first summand depicts this case of no detection. However, in case of detection, the agent will be punished, which is stated in the last three summands. In these cases, the agent receives only a share of his fixed wage but still bears effort-costs. Because of (A-VI), cartel profits are irrespective of effort, so the FOC of (18) is $-dc/de$, which is negative because of (A-II). Since $e \geq 0$ the optimal effort-level in a cartel is $e_K=0$.

3. Optimal effort-level with an unsuccessful attempt to collude $K=1, R=0$ -case

The maximization-problem can be formulated and rearranged:

$$\max_e \{ (1-\psi)(1-\rho) u(\underline{w} + a(\pi(e) - \underline{\pi})) + (\psi - \psi \rho + \rho) (u(b \underline{w})) - c(e) \} \quad (19)$$

The FOC of (19) is as follows:

$$\Leftrightarrow (1-\psi)(1-\rho) a(\pi(e) - \underline{\pi}) \frac{\partial u(\cdot)}{\partial \pi(\cdot)} \frac{\partial \pi(\cdot)}{\partial e} = \frac{dc(\cdot)}{de} \quad (20)$$

Compared to (16), it is obvious that the LHS of (19) is smaller leading to an optimal effort-level which is less than in the $K=0$ -case. Marginal utility of income is deflated because the function $u(w)$ is rotated downward by $(1-\psi)(1-\rho)$ with ψ and ρ being the internal and external detection-probabilities. However, the same explanations w.r.t. optimality apply here as well.

The ICC

The ICC can be stated as follows:

$$\kappa v_K + (1-\kappa) v_1 \leq v_0 \quad (21)$$

Here $v_j, j \in \{0, 1, K\}$ are the indirect utility levels based on the optimal effort levels e_j determined in 3.1, i.e. $v_j = u_A(\underline{w} + E[a(\pi_j(e_j, \varepsilon) - \underline{\pi})]) - c(e_j)$. Note that $E[\varepsilon]=0$ and $u_A = u(w) - c(e)$ due to assumption (A-I). Since the agent is assumed to be risk-neutral, v_0, v_1 and v_K can be stated as follows:

$$v_0 = u(\underline{w} + a(\pi(e_0) - \underline{\pi})) - c(e_0) \equiv u[w_0] - c(e_0) \quad (22)$$

$$\begin{aligned} v_1 = & (1-\psi)(1-\rho) \left(u(\underline{w} + a(\pi(e_1) - \underline{\pi})) - c(e_1) \right) \\ & + \psi(1-\rho) (u(b \underline{w}) - c(e_1)) + (1-\psi) \rho (u(b \underline{w}) - c(e_1)) + \psi \rho (u(b \underline{w}) - c(e_1)) \\ \equiv & (1-\psi)(1-\rho) u[w_1] - c(e_1) + (\psi + \rho - \psi \rho) u(b \underline{w}) \end{aligned} \quad (23)$$

$$\begin{aligned} v_K = & (1-\psi)(1-\rho) u(\underline{w} + a(\pi_K - \underline{\pi})) + \psi(1-\rho) u(b \underline{w}) + (1-\psi) \rho u(b \underline{w}) + \psi \rho u(b \underline{w}) \\ \equiv & (1-\psi)(1-\rho) u[w_K] + (\psi + \rho - \psi \rho) u(b \underline{w}) \end{aligned} \quad (24)$$

where

$$w_j \equiv \underline{w} + a(\pi_j(e_j) - \underline{\pi}) \quad (25)$$

Substitution of (23) to (25) in (22) yields the base-ICC:

$$\begin{aligned} & \kappa((1-\psi)(1-\rho)u[w_K] + (\psi+\rho-\psi\rho)b\underline{w}) + \\ & (1-\kappa)((1-\psi)(1-\rho)(u[w_1] - c(e_1)) + (\psi+\rho-\psi\rho)b\underline{w}) \leq u[w_0] - c(e_0) \end{aligned} \quad (26)$$

Expression (26) can be rearranged to:

$$v_1 + \kappa((1-\psi)(1-\rho)(u[w_K] - u[w_1]) + c_1) \leq u[w_0] - c(e_0) \quad (27)$$

Proof of Proposition 1

Define $w_j(\underline{w}, a(\underline{\pi})) \equiv \underline{w} + a(\pi_j(e_j) - \underline{\pi})$ for all $j \in \{0, 1, K\}$.

$$\begin{aligned} & (1-\kappa)((1-\psi)(1-\rho)u(w_1(\underline{w}, a(\pi_1 - \underline{\pi}))) + \kappa((1-\psi)(1-\rho)u(w_K(\underline{w}, a(\pi_1 - \underline{\pi}))) \\ & + (\psi+\rho-\psi\rho)u(b\underline{w}) - u(w_0(\underline{w}, a(\pi_1 - \underline{\pi})))) \leq (1-\kappa)c(e_1) - c(e_0) \end{aligned} \quad (28)$$

To examine how the ICC changes in \underline{w} , the LHS of (27) can be differentiated w.r.t. \underline{w} . If the expression is negative, the constraint is more likely to be met. For the result it is important to note that marginal income-changes lead to the same utility-changes for all $i \in \{0, 1, K\}$, so $du/dw_0 = du/dw_1 = du/dw_K = du/dw$. This holds for changes of wages in the fixed wage \underline{w} as well, which results in $\partial w_0 / \partial \underline{w} = \partial w_1 / \partial \underline{w} = \partial w_K / \partial \underline{w} = 1$. Therefore, differentiation of the LHS of (28) yields:

$$\frac{\partial u}{\partial w}((b-1)(\psi+\rho-\psi\rho)) \quad (29)$$

Marginal utility of income is always positive, so $\partial u / \partial w > 0$. Since $\psi, \rho \leq 1$, (29) is smaller than zero for $b < 1$. It is zero for $b = 1$. This proves Proposition 1.

Profit targets

Start with (26):

$$\begin{aligned} & \kappa((1-\psi)(1-\rho)u[w_K] + (\psi+\rho-\psi\rho)u(b\underline{w})) + \\ & (1-\kappa)((1-\psi)(1-\rho)(u[w_1] - c(e_1)) + (\psi+\rho-\psi\rho)u(b\underline{w})) \leq u[w_0] - c(e_0) \end{aligned} \quad (30)$$

No effective profit-target:

Substituting $u(w_K) = u(w_0) = u(w_1) = u(\underline{w})$ and $c(e_0) = c(e_1) = 0$ in (30) and rearranging yields:

$$\begin{aligned} & (\psi+\rho-\psi\rho)(u(b\underline{w}) - u(\underline{w})) \leq 0 \\ & \Leftrightarrow (\psi+\rho-\psi\rho)(u(\underline{w}) - u(b\underline{w})) \geq 0 \end{aligned} \quad (31)$$

High profit-target:

Substituting $u(w_0) = u(w_1) = u(\underline{w})$ and $c(e_0) = c(e_1) = 0$ in (30) and rearranging yields:

$$\begin{aligned} & \kappa(1-\psi)(1-\rho)(u(w_K) - u(\underline{w})) - (\psi+\rho-\psi\rho)(u(\underline{w}) - u(b\underline{w})) \\ & \Leftrightarrow \kappa(1-\psi)(1-\rho)(u(w_K) - u(\underline{w})) \leq (\psi+\rho-\psi\rho)(u(\underline{w}) - u(b\underline{w})) \end{aligned} \quad (32)$$

medium profit-target:

Substituting $u(w_1)=u(\underline{w})$ and $c(e_1)=0$ in (30) and rearranging yields:

$$\kappa(1-\psi)(1-\rho)(u(w_K)-u(\underline{w}))-(\psi+\rho-\psi\rho)(u(\underline{w})-u(b\underline{w}))\leq u(w_0)-u(\underline{w})-c(e_0) \quad (33)$$

Proof of Proposition 2: A low profit target can provide a stronger incentive to collude than a medium profit target.

To prove this proposition, first note that the low profit target $\underline{\pi}_L$ is below the profit-threshold generated by the optimal effort level when collusion was failed to be established, $\pi_K > \pi(e_0) > \pi(e_1) > \underline{\pi}_L$. The medium profit target $\underline{\pi}_M$ is below the profit generated by the optimal effort level for law compliant behavior and strictly higher than the profit generated by the optimal effort level when collusion failed, $\pi_K > \pi(e_0) > \underline{\pi}_M > \pi(e_1) > \underline{\pi}_L$. It is obvious that $\underline{\pi}_M > \underline{\pi}_L$. Since the agent is risk-neutral, his utility function takes the form $u(e, K) = \alpha + \beta w(e, K) - c(e)$, where α is the intercept and β the slope measuring marginal utility of wages. The ICCs for the low and medium profit target can be stated now:

$$\begin{aligned} \kappa \{ & (1-\psi)(1-\rho)(\alpha + \beta(\underline{w} + a(\pi_K - \underline{\pi}_L))) + \psi(1-\rho)(\alpha + \beta b\underline{w}) + (1-\psi)\rho(\alpha + \beta b\underline{w}) \\ & + \psi\rho(\alpha + \beta b\underline{w}) \} + (1-\kappa) \{ (1-\psi)(1-\rho)(\alpha + \beta(\underline{w} + a(\pi(e_1) - \underline{\pi}_L))) \\ & + \psi(1-\rho)(\alpha + \beta b\underline{w}) + (1-\psi)\rho(\alpha + \beta b\underline{w}) + \psi\rho(\alpha + \beta b\underline{w}) - c(e_1) \} \\ & \leq \alpha + \beta(\underline{w} + a(\pi(e_0) - \underline{\pi}_L)) - c(e_0) \end{aligned} \quad (34)$$

Expression (34) can be explained as follows. The first term in curly brackets, $\kappa\{\dots\}$, contains indirect utility in case that cartel formation was successful. It consists of four cases: No detection with probability $(1-\psi)(1-\rho)$, internal detection but not external detection with probability $\psi(1-\rho)$, external detection but not internal detection with probability $(1-\psi)\rho$ and both external and internal detection with probability $\psi\rho$. Note that only in the first case the agent will realize his full bonus-payment while in the latter three cases he will be left with a fraction b of the fixed wage \underline{w} . If the cartel is established, the bonus will be paid according to a percentage a of the difference between cartel profits π_K and the profit target $\underline{\pi}_L$. Further note that in the cartel case the agent will not exert effort, resulting in effort costs of zero. The second term in curly brackets, $(1-\kappa)\{\dots\}$, depicts indirect utility in case of unsuccessful cartel formation. The only difference to the case of successful cartel formation is when the illegal activity remains undiscovered. If the cartel was not formed but intended, the respective realized profit used for the calculation of profits is $\pi(e_1)$.

The next step is to formulate the ICC for the medium profit target $\underline{\pi}_M$:

$$\begin{aligned}
& \kappa \left[(1-\psi)(1-\rho)(\alpha + \beta(\underline{w} + a(\pi_K - \underline{\pi}_M))) + \psi(1-\rho)(\alpha + \beta b \underline{w}) + (1-\psi)\rho(\alpha + \beta b \underline{w}) \right. \\
& \quad \left. + \psi\rho(\alpha + \beta b \underline{w}) \right] + (1-\kappa) \left[(1-\psi)(1-\rho)(\alpha + \beta \underline{w}) \right. \\
& \quad \left. + \psi(1-\rho)(\alpha + \beta b \underline{w}) + (1-\psi)\rho(\alpha + \beta b \underline{w}) + \psi\rho(\alpha + \beta b \underline{w}) \right] \\
& \leq \alpha + \beta(\underline{w} + a(\pi(e_0) - \underline{\pi}_M)) - c(e_0)
\end{aligned} \tag{35}$$

There are two differences between the ICC of the low target (34) and the medium target (35). First, the threshold is now $\underline{\pi}_M$ which results in smaller bonuses. Second, there will be no bonus-payment possible if cartel formation failed, which can be seen in the second curly bracket $\kappa\{\dots\}$. Here, the agent will only receive his fixed wage if the breach of the law stays undetected.

Now, to show that the medium ICC can provide stronger incentives for law-conform behavior, add $\beta a \underline{\pi}_L$ in (34) and $\beta a \underline{\pi}_M$ in (35). Define the resulting expressions as (34') and (35'), respectively. Recall that both ICCs state that if expected indirect utility for collusive behavior (LHS) is smaller than expected indirect utility for law-conform behavior (RHS), the agent will prefer not to engage in collusive activity. To see which profit-threshold provides the strongest incentive to obey the law, one has to check which LHS of (34') and (35') is smaller. The smaller the LHS, the more likely it is that it is smaller than the RHS and the more likely it will result in law-conform behavior. To do so, subtract the LHS of (35') from the LHS of (34'). After some rearrangements, the following expression depicts that difference:

$$(1-\kappa) \left[(1-\psi)(1-\rho) a \beta (\pi(e_1) - \underline{\pi}_L) - c(e_1) \right] + (\kappa(1-\psi)(1-\rho) - 1) a \beta (\underline{\pi}_M - \underline{\pi}_L) \tag{36}$$

If expression (36) is positive, there is a non-monotonic relationship between the incentives to collude and the profit targets: A medium profit targets provides a weaker incentive to collude than a low profit target. Based on (36), we can formulate:

$$(1-\kappa) \left[(1-\psi)(1-\rho) a \beta (\pi(e_1) - \underline{\pi}_L) - c(e_1) \right] > (1-\kappa(1-\psi)(1-\rho)) a \beta (\underline{\pi}_M - \underline{\pi}_L) \tag{37}$$

Expression (37) captures the cost and gains from breaking the law for a low threshold compared to a medium threshold. The LHS of (37) states the gains the agent can realize: If cartel formation was not successful, the agent still can receive a bonus-payment $a(\pi(e_1) - \underline{\pi}_L)$, provided his illegal activities are not detected. If the evaluated bonuses are greater than the whole effort-costs, this term is positive. The RHS of (37) captures the expected costs of a collusive attempt. To understand the argument here, assume that there is a chance of successful and undetected cartel activity of $\kappa(1-\psi)/(1-\rho)=20\%$. That means that in 80% of the cases, the agent misses the 'safe harbor'-solution of obeying the law. In the comparison between the medium and the low profit target, this is exactly the distance between the medium and the low profit thresholds. If (37) is met, a medium profit target is more likely to produce law-compliant behavior than a low profit target.

Proof of Proposition 3

Rearranging the ICC for $\underline{\pi} \in \underline{\pi}_H$ yields:³¹

$$(\psi + \rho - \psi\rho)\beta \underline{w}(b-1) \leq -\kappa(1-\psi)(1-\rho)a\beta(\pi_K - \underline{\pi}_H) \quad (38)$$

The ICC for can be formulated as:

$$\begin{aligned} (\psi + \rho - \psi\rho)\beta \underline{w}(b-1) &\leq a\beta((\pi(e_0) - \underline{\pi}_L) - \kappa(1-\psi)(1-\rho)(\pi_K - \underline{\pi}_L)) \\ &\quad - (1-\kappa)(1-\psi)(1-\rho)(\pi(e_1) - \underline{\pi}_L) - c(e_0) + (1-\kappa)c(e_1) \end{aligned} \quad (39)$$

Again, we can compare both RHS of (39) and (38). If the RHS of (38) exceeds the one of (39), we know that compliance is fostered more strongly in the high regime, i.e., iff:

$$\begin{aligned} a\beta(\kappa(1-\psi)(1-\rho)(\underline{\pi}_H - \underline{\pi}_L) + (1-\kappa)(1-\psi)(1-\rho)(\pi(e_1) - \underline{\pi}_L) - (1-\kappa)c(e_1)) \\ \geq a\beta(\pi(e_0) - \underline{\pi}_L) - c(e_0) \end{aligned} \quad (40)$$

The LHS depicts (i) the higher bonuses generated by the lower profit thresholds for $\underline{\pi}_L$ compared to $\underline{\pi}_H$, (ii) bonus the agent can receive if a cartel formation was not successful and (iii) effort-cost in case of unsuccessful cartel formation. The RHS captures high bonuses in case of $\underline{\pi} \in \underline{\pi}_L$ net effort-costs. If the LHS exceeds the RHS, collusion is fostered for low profit target regimes more strongly than for high profit target regimes. Since $(1-\kappa)c(e_1) < c(e_0)$ for (40) to hold it is necessary that:

$$(1-\psi)(1-\rho)(\kappa \underline{\pi}_H + (1-\kappa)\pi(e_1)) > \pi(e_0) - (\psi + \rho - \psi\rho)\underline{\pi}_L \quad (41)$$

Proof of Proposition 4

Rearranging the ICC for $\underline{\pi} \in \underline{\pi}_H$ yields:

$$(\psi + \rho - \psi\rho)\beta \underline{w}(b-1) \leq -\kappa(1-\psi)(1-\rho)a\beta(\pi_K - \underline{\pi}_H) \quad (42)$$

The ICC for $\underline{\pi} \in \underline{\pi}_M$ can be written as:

$$(\psi + \rho - \psi\rho)\beta \underline{w}(b-1) \leq a\beta((\pi(e_0) - \underline{\pi}_M) - \kappa(1-\psi)(1-\rho)(\pi_K - \underline{\pi}_M)) - c(e_0) \quad (43)$$

Now, if the RHS of (42) exceeds the RHS of (43), compliance is fostered more strongly in a high target regime. This is true iff the following condition holds:

$$a\beta((\pi(e_0) - \underline{\pi}_M)) - c(e_0) < a\beta\kappa(1-\psi)(1-\rho)(\underline{\pi}_H - \underline{\pi}_M) \quad (44)$$

The LHS of (44) depicts the net bonus gains from compliance when a medium regime is in place, whereas the RHS captures the expected loss from not colluding for $\underline{\pi} \in \underline{\pi}_M$ compared to $\underline{\pi} \in \underline{\pi}_H$. If the RHS of (44) exceeds the LHS, a medium target regime fosters collusion more strongly than a high target regime.

³¹ Note that the net values are all negative here. However, this does not imply that the agent expects a negative payoff which would be inconsistent with the PC. Here, we rather look at the differences in the ICC for compliance.

Optimal effort at $\pi(e)=\underline{\pi}$.

Another problem is that the threshold depends on the optimal effort-level. This problem would require a constrained optimization on the first sight. This can be ruled out by assuming that (A1) $\underline{\pi} > \pi(0)$ holds or that (A2) expected marginal returns of effort is larger than marginal costs of effort at least at a very small positive effort-level (condition (48) below). Note that (A2) implies (A1).

First, recall that:

$$w(\pi) = \begin{cases} \underline{w} + a(\pi - \underline{\pi}), & \pi \geq \underline{\pi} \\ \underline{w}, & \pi < \underline{\pi} \end{cases} \quad (45)$$

The maximization problem then is as follows:

$$\max_e \{u(e) - c(e) : \pi(e) \geq \underline{\pi}\} \hat{=} \max_e \{u(\underline{w} + a(\pi(e) - \underline{\pi})) - c(e) : \pi(e) \geq \underline{\pi}\} \quad (46)$$

Now, set up the Lagrangian for the Kuhn-Tucker-type Problem (46): $Z(e, \lambda) := u(\underline{w} + a(\pi(e) - \underline{\pi})) - c(e) + \lambda(\pi(e) - \underline{\pi})$. The corresponding K-T conditions are:

$$\frac{\partial Z}{\partial e} = a \frac{\partial u}{\partial w} \frac{\partial \pi}{\partial e} - \frac{dc}{de} + \lambda \frac{\partial \pi}{\partial e} \leq 0, e \geq 0, e \frac{\partial Z}{\partial e} = 0 \quad (47)$$

$$\frac{\partial Z}{\partial \lambda} = \pi(e) - \underline{\pi} \geq 0, \lambda \geq 0, \lambda \frac{\partial Z}{\partial \lambda} = 0 \quad (48)$$

There are four possible regimes. Two of them are consistent with $e > 0$. It will be shown now that with a small assumption according to the slopes of the Kuhn-Tucker Conditions, i.e., (A2) explained above, there is only one regime to consider here.

The only reasonable solution-regime with $e \geq 0$ is $\lambda = 0$ with $\pi(e) \geq \underline{\pi}$. A regime with $\lambda \geq 0$ requires $\pi(e) = \underline{\pi}$ to hold, which is contradictory to $e \geq 0$: If $\pi(e) = \underline{\pi}$ holds, the agent's bonus will be zero. In this case, exerting effort does not pay off, so he could decrease e to lower $c(e)$ which would result in a higher utility-level. Therefore, a solution where the agent works just as much as to generate profits equaling the target but not exceeding them is ruled out.

The two regimes with $e = 0$ are (i) $\lambda = 0$ with $\pi(e) \geq \underline{\pi}$ and (ii) $\lambda \geq 0$ with $\pi(e) = \underline{\pi}$. Both of them are ruled out by assuming that (A1) $\underline{\pi} > \pi(0)$ holds. This would bypass the problem that it could be optimal not to work at all although the profit-target is extremely low by just assuming it away. Assumption (A1) is rather a consequence than an assumption. There is an assumption that covers the slopes in the range of $e \in [0, \varepsilon]$ with $\varepsilon > 0$ which implies that (A1) holds.³² The following inequality has to be

³² The cartel-case, i.e., the case in which the Agent does not have to exert effort to earn high profits, does not matter here because by assumption cartel profits are higher than competitive profits, i.e., $\pi_K > \pi(e) > \pi(0)$.

satisfied for $\underline{\pi} > \pi(0)$ to be optimal for the Principal (A2):

$$(1-\psi)(1-\rho) \frac{\partial u}{\partial w} \frac{\partial \pi(e')}{\partial e} > \frac{dc(e')}{de} \forall e' \geq \epsilon \quad (49)$$

(54) ensures that there is an optimal effort level $e^* > \epsilon > 0$ since at $e = \epsilon$ (hence, also at $e = 0$) (expected) marginal returns of effort are still positive. Obviously regime (i) with $e = 0$ and $\lambda = 0$ is already ruled out by this assumption which can be seen in the first Kuhn-Tucker Condition (47). For regime (ii), $\lambda \geq 0$ with $\pi(0) = \underline{\pi}$ has to hold. The bonus-threshold is determined by the principal who is deriving utility linearly (due to risk-neutrality) from profits. This implies that he prefers every increase in profit. The agent will agree with this higher target if his utility increases. Monotonicity of $\pi(e)$ in e ensures that c.p. profits are strictly higher with higher effort levels. Assumption (49) ensures that the agent will exert effort $e > \epsilon > 0$ iff at least $\underline{\pi} = 0$ holds. By increasing the target to $\underline{\pi} = \epsilon > 0$, the same profit level will be generated as with $\underline{\pi} = 0$; however, Agent's wages w' are higher in the latter case:

$$w' = \begin{cases} \underline{w} + a(\pi(e^*) - 0), & \underline{\pi} = 0 \\ \underline{w} + a(\pi(e^*) - \epsilon), & \underline{\pi} = \epsilon \end{cases} \quad (50)$$

Just as in Fershtman, Judd and Kalai (1991), the Principal would be better off by installing a target of $\underline{\pi} = \epsilon$, leaving the agent with a very small bonus.³³ By (49) this is still compatible with positive effort-levels. It follows that $\underline{\pi} = \pi(0)$ is dominated by $\underline{\pi} = \epsilon$ for the Principal which rules out the second regime with $e = 0$. The same analysis applies to the law-compliant regime of $K = 0$ since in this case $\psi = \rho = 0$ in (49). Hence, the agent will never exert just as much effort as to reach the profit target; either the optimal effort level will be positive with a positive expected bonus or he will not work at all.

33 Qualitatively, the result is different from Ferstman, Judd and Kalai (1991). In their model, the agent only receives a wage of ϵ in a stable cartel. However, this is all the agent will receive in their setup.