

Collusive behavior, managerial incentives and antitrust fines¹

Florence Thépot^a, Jacques Thépot^b

^a*School of Law, University of Glasgow,
5-9 The Square, Glasgow G12 8QQ, UK.*

E-mail: florence.thepot@glasgow.ac.uk.

^b*LARGE, Université de Strasbourg,
61, avenue de la Forêt Noire 67085 Strasbourg, France.*

E-mail: thepot@unistra.fr. (corresponding author)

September 12, 2018

¹We thank participants to the 11th CRESSE Conference (Rhodes, July 2016), to the LARGE research seminar (Strasbourg, March 2017) and to the Symposium on Imperfect Forms of Collusion (Stellenbosch, January, 2018) for their helpful feedback and comments on previous versions of this article. Usual disclaimers apply. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Abstract

Based on a price setting duopoly model, this paper argues that collusion on managerial incentive compensation may have the equivalent effect to collusion on prices. This paper also provides an analysis of the effect of different antitrust fines regimes in the context of a game between two companies each composed of two-level of decision making (the board of directors and the sales manager). The contribution of this paper is two-fold: it identifies "backstage arrangements" that may be used by companies in order to achieve monopoly outcome without entering into explicit price-fixing practices. It also highlights the inefficiency of fining regimes based on sales when companies have a multi-layer decision-making structure

JEL classification : K21, L13, L41. Keywords: duopoly, antitrust law, governance.

1 Introduction

Price collusion among competitors is regarded as one of the most serious violation of competition law and is homogeneously prosecuted across jurisdictions. Companies convicted for price-fixing cartel activity have been receiving increasingly higher fines, and individuals may face criminal sanctions in a number of countries, such as in the UK and in the US. Both in the EU and in the US, the mere exchange of pricing information between companies can constitute evidence that companies are coordinating their market conduct rather than behaving independently. As a result, any contact between companies relating to future prices may trigger a very strong presumption that the prohibition of cartels found in Article 101 TFEU in the EU, and in the Section 1 of the Sherman Act (US) has been breached.

The aim of this paper is to show that companies may be able to use a subtler range of collusive techniques, what we call "backstage arrangements" that have an effect equivalent to traditional price collusion. Collusion on "backstage parameters" such as the structure of remuneration affecting managerial incentives is an example of alternative collusive device that would typically attract less attention, or that would be less easily detectable by competition authorities.

This paper addresses the question of collusion over managerial compensation in a duopoly model of two two-tier companies: each company is composed of a board of directors ('upstream' level) and of a manager ('downstream' level).

Collusive agreements, or cartels, have been analyzed by the literature to understand how these may be formed and sustained, respectively corresponding to the participation constraint and the coalition incentive constraint in the models (cf. Laffont and Martimort, 1998). Each of both conditions (or constraints) is relevant to the study of the cartel problem, as discussed by several authors (see e.g. Jensen and Sorgard, 2016; Herold and Paha, 2016).

This paper focuses on the participation condition (behind cartel formation) which translates here into a choice of collusive behaviors that can be adopted at two levels, among the boards and the managers respectively. These upstream and downstream behaviors interact through the vertical structures of the firms.

A significant strand of literature considers the vertical structure of the firm in collusion in the perspective of cartel sustainability (i.e. the coalition incentive condition). In a repeated game context, some of these contributions analyze how suitable compensation packages may provide strong managerial incentives to sustain collusive agreements between oligopolistic firms. (Spagnolo et al., 2000, 2004, Joh, 1999). Incentive contracts to overcome the

agency problem in cartel contexts is also studied in Angelucci and Han (2015) and Herold (2017). There, the main question is whether some parameters of the manager, to whom is delegated the pricing decision-making, may help overcome the inherent incentive to deviate from the collusive outcome; as described in prisoner-dilemma game theory settings. For example, Spagnolo (2005) examines how preferences of the manager that maximizes its own utility may help the firm reach the coordinated outcome that the owner wishes to induce.

Our contribution departs from this literature as no horizontal deviation within the group of boards and the group of managers is allowed so that upstream and downstream incentive conditions are embedded into the behaviors of the parties. Our focus here is the vertical stability between boards and managers, as it derives from game equilibrium conditions. This assumption will be specifically discussed.

The aim of this paper is to identify the effect of antitrust enforcement regimes (with a focus on fines) on collusion that can take place at two different levels within the firm. As such, the paper also tackles the issue of optimality of sanctions depending on how fines are computed.

The core policy implication of the paper is that agreements, not on price, but more subtle, on backstage parameters such as remuneration schemes could be a more lawful or discrete means to achieve a restriction of competition between firms. This strategy could resemble that used in vertical relations to restore some of the monopoly power and overcome the issue of producer opportunism using more lawful means than resale price maintenance (Montez, 2015). As will be explained, the fixation of backstage variables such as the structure of remuneration may attract less antitrust scrutiny and yet enable similar collusive outcomes than direct price fixing by sales managers.

Although fines are only one aspect of public enforcement instruments used by antitrust authorities, this paper focuses on monetary penalties - a type of sanction used homogeneously in cartel prosecution across jurisdictions. In addition, private enforcement in which private parties seek to recover damages suffered from anti-competitive practices are also outside of the scope of this study.

1.1 Overview of results

In this paper, we address the question of collusion over managerial compensation in a duopoly model of two two-tier companies. The board of directors is in charge of fixing the compensation given to the manager who is responsible for the pricing policy. The manager operates here as an hybrid actor be-

tween an executive and a sales manager respectively oriented towards profit and sales revenue maximization. The firms compete on the product market as price setting duopoly. Collusion may take place at either level of the organization: between the two boards of the companies (collusion over managerial compensation) and/or between the managers (collusion on price). We assume that both levels choose independently to behave collusively or competitively through a preliminary selection of payoff functions. This behavioral stage results in four combinations of payoffs that define *arrangements*, according to the behavior the group of boards and the group of managers have chosen. Once an arrangement is selected by the parties, it cannot be further changed and the two-tier firms compete with each other over compensation schemes and then over prices. The *backstage arrangement*, in which boards collude and the managers compete, deserves a particular attention.

This defines two types of games: a two- entry static inter-level game, in which the actors of similar status select a collusion or competition state, followed by one of four sequential inter-firm games. Note that these games confront the actors differently grouped (the group of the boards, the group of the managers in the inter-level game, two-tier firm 1 against firm 2 in any of the four inter-firm games). Open loop equilibrium strategies of the inter-firm games are considered.

We assume that the manager holds a fixed minority share of the capital of her company. Besides this dividend part, the compensation schemes are based on the sales revenue. There is no managerial opportunism prevailing within the companies (as for instance in Brisley et al. 2011, J.Thépot, 2013). Accordingly, no price distortion due to vertical interactions may occur. This way, the boards act as in standard duopoly. Price distortion may only result from collusive practices at both levels of the organization.

Any antitrust enforcement system is defined as the combination of (i) a detection mode in charge of providing evidence of collusion (ii) a regime of sanction defining the fines:

- Two modes of detection are considered here: a limited mode where collusive practices are only detected when undertaken at the manager level and an extended mode where they are detected at either level of the organization.
- Two regimes for setting fines are defined according to whether the fine is related to the sales revenue or the loss of consumer surplus. The sales-based regime is commonly used by the authorities both in US and EU. (with the concept of affected sales/commerce). To the best of our knowledge, the loss of consumer surplus is not explicitly considered in the antitrust literature.

This article is in line with previous work by Spagnolo (2005) and Aubert (2009) among others where managerial incentives are analyzed in view of their impact on market collusion. Our specific contribution is to introduce collusive practices among the boards in the design of these managerial incentives.

The main results are the following.

When fines are low, collusion at any level prevails. When fines are high, conventional wisdom suggests that collusion is deterred. This is not always true in the context of two-tier firms where *backstage arrangements* in which collusion holds at the upstream but not at the downstream level, may undermine the efficiency of the authority: The backstage arrangement is the unique equilibrium when detection is limited, as it makes the monopolization undetectable. When detection is extended, the backstage arrangement generates the duplicity of equilibria as it sustains the collusion strategy of both the boards and the managers (although this arrangement is dominated by competition). In addition when detection is extended, the two-tier structure of the companies imposes the authority to apply higher fines an/or to use more sophisticated investigation. This is due to the manager equilibrium strategies which interfere with the deterrence process.

Thus monopolization can be really deterred by the system "extended detection/surplus-based", which is deemed to be the most effective enforcement regime. This reinforces the arguments developed by Katsoulacos and Ulph (2013), Katsoulacos et al. (2015), Houba et al. (2010), Bageri et al. (2013) suggesting that fines based on sales may have a negative impact on welfare.

This phenomenon is due to the fact that the cost of the fine is partially transferred along the vertical structure of the firms so that the fine burden is borne by the board, the manager and the consumer altogether. This creates a collective punishment situation that influences the collusion vs competition choice of the parties.

Under the consumer surplus-based regime, the cost of the fine leads to a decrease in the collusive price, so that the consumer directly benefits from the antitrust enforcement regime. In terms of welfare, there exists an optimal value of the fine cost for which the duopoly output prevails.

The remainder of the paper is organized as follows: Section 2 presents the model, and defines the inter-level and inter-firm games. Section 3 examines the case in absence of detection. In section 4, antitrust enforcement is introduced in terms of detection modes and fine regimes. For all the options considered, equilibrium conditions of the inter-level games are discussed. A comparative welfare analysis of the different regimes of sanctions is developed. Policy implications for antitrust enforcement and concluding remarks are provided in section 5.

2 The model

Let us consider two identical monoprodukt firms involved in a price duopoly competition. Let q_i and p_i be the output and the price of firm $i = 1, 2$. The firms are involved in a price competition with differentiated products where the demand system is symmetric, linear and given by the following standard specification (cf. Deneckere and Davidson, 1985):

$$q_i = D(p_i, p_j) = (1 - p_i - \gamma(p_i - \frac{p_1 + p_2}{2})). \quad (1)$$

Coefficient $\gamma \geq 0$ is a substitutability parameter. When γ tends to zero, goods become independent, and each firm is in a monopoly situation. When γ tends to infinity, brands become perfect substitutes and Bertrand competition prevails. Thus the intensity of competition in the industry is measured by γ . The profit of firm i is $P_i = (p_i - c)q_i$, where $c < 1$ is the operating unit cost of any firm.

Each firm has a two-tier structure with two decision levels, hereafter called the "board" and the "manager" respectively, represented in figure (1). The "board" (he) stands for the board of directors which fixes the compensation package of the manager. The board of directors represents the shareholders, acts on their behalf to define the strategy of the company and is in charge of the internal control of the company, making sure that managers act in the company's best interest. From that perspective, the board is typically in charge of defining the remuneration policy of senior executives.

The manager (she) owns a small part $\alpha \leq 1$ of the equity. She is basically in charge of the pricing policy on the final market. The model belongs to the strategic delegation games literature (Fershtman and Judd, 1987, Aggarwal and Samwick, 1999) in which managerial incentives based on performance are designed to master the competitive interactions on the product market. Asymmetric information and moral hazard issues are not considered here.

The compensation of the manager is defined as a linear function of the sales revenue, $C_i = \beta_i p_i q_i$, where β_i defines the sales-based component of the compensation. Hereafter, β_i is termed the *compensation factor*.

The utility of each manager combines both the dividend received as partial shareholder and the revenue-based compensation she gets from the board. The utility is $G_i = \alpha P_i + \beta_i p_i q_i - h q_i = \alpha(p_i - c)q_i + \beta_i p_i q_i - h q_i$, where $h q_i$ with $h \geq 0$ denotes the cost of effort incurred through delegating activities of the manager, which is proportional to the output level.

We assume that the cost of effort which is borne by an individual is significantly lower than the operating cost of the whole organization, namely: $h \ll c$. As we will see later, this implies that the compensation is negligible

as compared to the profit. This point of view is in line with most models of strategic delegation (Fershtman and Judd, 1987, Spagnolo, 2000), where compensation expenditures are assumed to be small compared to the profits. As a result, the objective of the boards reduces to a pure maximization of profit P_i .

In this model, the manager operates as a hybrid actor between the executive and the sales manager respectively oriented towards profit and sales revenue maximization. This relates to the standard controversy around the works by Baumol (1967). This utility specification introduces some discrepancies between the goals of the boards and the executives that makes relevant the vertical decomposition of the companies. As we will see below, this creates different collusion opportunities at the level of the boards and the managers.

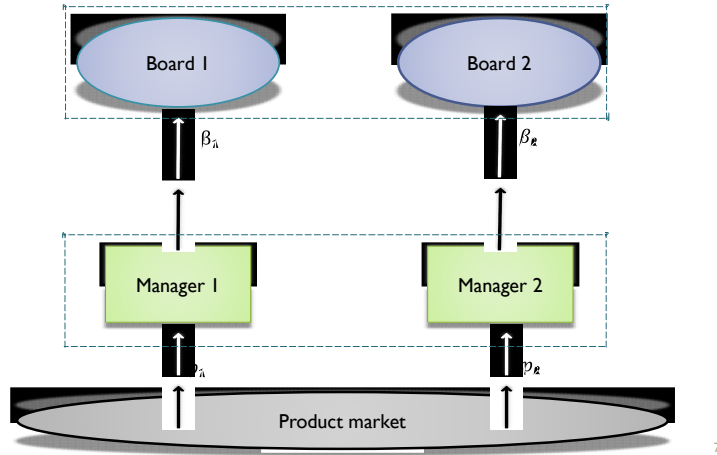


Figure 1: Inter-level and inter-firm games

The key point of this paper is to see how the collusive practices of the companies may indirectly come from *backstage arrangements*. These arrangements are designed in terms of managerial compensation policies which impact the incentives of managers acting competitively in frontstage commercial activities. The aim of this paper is thus to show how a collusive outcome can be reached indirectly through fixing incentive parameters of managerial compensation – and not through fixing prices on the product market.

2.1 Inter-level and inter-firm games

Collusion may occur at the upstream or downstream levels if the boards and/or the managers choose to maximize the joint instead of their individual payoffs. Collusion vs competition states (denoted Comp and Col) selected at the preliminary stage are simultaneously implemented through two inter-level agreements among the boards and the managers respectively. No deviation from these agreements can occur further.

The problem can be stated as a sequence of two related games, successively played by the four parties operating in the industry.

- At stage 0, the **inter-level game** between the group of the boards and the managers of both firms where both levels simultaneously choose to behave colluding or not. Under competition state the boards (resp. the managers) seek to maximize the profits P_i (resp. the utility G_i). Under collusion state, the boards (resp. the managers) seek to maximize the joint profit $\Pi = P_1 + P_2$ (resp. the joint utility $J = G_1 + G_2$). The various combinations of states at both levels define the *arrangements*, respectively denoted as (Comp,Comp), (Comp, Col), (Col, Comp) and (Col, Col).
- At stages 1 and 2, the 4 **two-stage inter-firm games** between the companies where: (i) the payoffs are determined by the arrangement selection previously made, (ii) at stage 1 the boards fix the compensation scheme (iii) at stage 2 the managers fix the prices.

2.2 On the stability of upstream and downstream coalitions.

As indicated in the introduction, the incentive conditions to remain in upstream or downstream coalitions are not part of the model. Three arguments may justify this choice

First, collusion v. competition state selected in stage 0 results from *behaviors* embedded in the choice of individual payoffs. For any party, acting collusively (resp. competitively) amounts to choosing a function, not to taking a one-dimensional decision. *On ne change pas de comportement comme de chemise*. Collusive behavior of boards and/or managers is rooted in values and traits in line with long run considerations or social acquaintances, while the compensation and pricing decisions taken within the firms are respectively made on a medium and short term basis.

Second, the stability of collusive behaviors is supported by various studies on the average duration of cartels, according to which cartels typically

last between 5-8 years (see e.g. Connor, 2010, Levenstein and Suslow, 2011). In addition, some studies estimated that out of the cartels eventually discovered, the probability of detection ranges in the area of 13-17%. (Bryant and Eckard, 1991; Combe et al, 2008), which means that even in the presence of strong antitrust enforcement deemed to threaten the external stability of cartels, collusive practices may definitely exist on a long-run basis. Empirical data specifically referred to in Ezrachi and Stucke (2016, footnote p 267) supports the finding that cartels may be ‘bimodal’: some last less than a year while many others last between 4 and 6 years. This comforts the existence of two distinct types of collusion: behavior-oriented collusions leading to long-run agreements and decision-oriented collusions leading to short-term ones. The behavior-oriented type particularly fits the upstream level collusion which is thus the focus of this paper.

Third, our model assumes that the collusive behaviors of the parties at both levels cannot be divergent. In case of divergence, the competition state prevails. Our approach can easily be extended to include cases of individual deviation within each group. By symmetry, we could consider that only the board and the manager of firm 2 would be allowed to deviate. This would define an additional strategy (Dev) in which board (or manager) 1 maximizes the joint payoff while board (or manager) 2 maximizes his/her own payoff.

2.3 The inter-firm open loop equilibria

As represented in figure (1), an inter-firm game is a four-player sequential game. The equilibrium concept we use belongs to the class of open loop equilibria (cf. Fudenberg & Tirole, 1991). Firm i determines its best response (β_i, p_i) to expectations (β_j^e, p_j^e) of the rival’s action. But within each firm, the board and the manager are in a leader-follower situation so that the manager’s price strategy is built as an internal response to the compensation i.e. $p_i(\beta_i; \beta_j^e, p_j^e)$, which is incorporated into the board’s decision. Equilibrium solutions are determined under rational expectations conditions, namely $(\beta_i, p_i) = (\beta_i^e, p_i^e)$ ¹. Open loop solution means here that the compensation contracts are *private information*: at the beginning of stage 2, manager i does not observe the remuneration scheme β_j decided by the board of his rival. This lack of information prevents any board from taking into account the direct impact of her sales-based ratio on the rival’s pricing. Hence the open loop equilibrium solutions of the four inter-firms games (dropping the subscript e , for simplicity):

¹For a game formulation mixing actions and expectations in an oligopoly model see J. Thépot, 1995.

1. *The arrangements with manager competition: (Comp, Comp), (Col, Comp).*

- At stage 2, each manager i fixes her price knowing β_i and taking the rival price p_j as given. The best response is a function $p_i^*(\beta_i, p_j)$ solution of the equation $\frac{\partial G_i}{\partial p_i} = 0$ ($i = 1, 2$).
- At stage 1, the board i fixes the compensation scheme β_i through the best response function $\beta_i^*(p_j)$, solution of the equation $\frac{dP_i(p_i^*(\beta_i, p_j), \beta_i, p_j)}{d\beta_i} = 0$, if the boards compete, of the equation $\frac{d\Pi(p_i^*(\beta_i, p_j), \beta_i, p_j)}{d\beta_i} = 0$, if they collude. In both situations the symmetric equilibrium point is given by the pair (p, β) such that $p = p_i^*(\beta, p)$, $\beta = \beta_i^*(p)$, $i = 1, 2$.

2. *The arrangements with manager collusion: (Comp, Col), (Col, Col).*

- At stage 2, manager i fixes $p_i^{**}(\beta_i, \beta_j, p_j)$ that maximizes the joint gain J , for β_i, β_j, p_j fixed, namely that solves $\frac{\partial J}{\partial p_i} = 0$.
- At stage 1, the board i fixes the compensation scheme β_i as the best response function $\beta_i^{**}(\beta_j, p_j)$, solution of $\frac{dP_i(p_i^{**}(\beta_i, \beta_j, p_j), \beta_i, p_j)}{d\beta_i} = 0$, when the owners compete, of the equation $\frac{d\Pi(p_i^{**}(\beta_i, \beta_j, p_j), \beta_i, \beta_j, p_j)}{d\beta_i} = 0$, if they collude. In both cases, the symmetric equilibrium point is given by the pair (p, β) such that $p = p_i^{**}(\beta, \beta)$, $\beta = \beta_i^{**}(\beta_j, p)$, $i, j = 1, 2$.

It is important to notice that here the open loop equilibrium is not subgame perfect, as, at stage 1, board i does not take into account the impact of her compensation factor β_i to the rival's price p_j . Open loop equilibrium focuses here on the interplay between vertical and horizontal relationships and not on the cross interactions arising from more sophisticated strategic considerations. This point of view provides tractable formulas and easily interpretable results; it is consistent with the imperfect information prevailing in the real world.

3 Case 1: absence of sanctions

Let us first analyze the case where the authority is unable to detect the collusion at any level and/or to impose sanctions. Under backward induction,

Arrangements	price	β	profit	manager's utility
(Comp,Comp)	$\frac{(2c+c\gamma+2)}{\gamma+4}$	h/c	$2 \frac{(\gamma+2)(1-c)^2}{(\gamma+4)^2}$	$2 (h/c + \alpha) \frac{(\gamma+2)(1-c)^2}{(\gamma+4)^2}$
(Comp,Col)	$\frac{(2c+c\gamma+2)}{\gamma+4}$	$\frac{2h(2+\gamma)+\alpha\gamma(1-c)}{4c-\gamma+2c\gamma}$	$2 \frac{(\gamma+2)(1-c)^2}{(\gamma+4)^2}$	$(h/c + \alpha) \frac{(\gamma+2)^2}{\gamma+4} \frac{(1-c)^2}{4+2\gamma-\gamma/c}$
(Col,Comp)	$\frac{1+c}{2}$	$\frac{2h(2+\gamma)-\alpha\gamma(1-c)}{(4c+\gamma+c\gamma)}$	$\frac{(1-c)^2}{4}$	$(h/c + \alpha) \frac{(1-c)^2}{4 + \gamma + \gamma/c}$
(Col,Col)	$\frac{1+c}{2}$	h/c	$\frac{(1-c)^2}{4}$	$(h/c + \alpha) \frac{(1-c)^2}{4}$

Table 1: Inter-firm games results

let us solve successively the stage 1 and 2 of the inter-firm games.

The results are given in the following proposition.

Proposition 1 *In open loop equilibria of any the four games,*

- *The price quantities and profits are independent of the ownership structure and the cost of effort. These parameters only affect the manager's utility in a multiplicative way.²*
- *The standard monopoly prices prevail only when the owners collude, i.e. in arrangements (Col,Col) and (Col, Comp).*
- *The standard duopoly prices prevail only if the boards compete, i.e.; in arrangements (Comp,Comp) and (Comp, Col)*
- *The compensation factor equals the relative effort cost, h/c when both parties use the same strategies.*

Proof. see Appendix A. ■

The results are summarized in the table (1).

These equilibrium outcomes result from the combination of both the inter-level interaction within each company and the inter-firm one at work in the industry according to the various collusive arrangements. The results illustrate the role of compensation designed to impose the preeminence of the boards over the managers: Under collusion or competition of the boards, the first best price and output prevails irrespective of what the managers do. This is not surprising in absence of moral hazard.

²This is consistent with our assumption that the compensation packages are small compared to the profit. Take $\alpha = 0.0001$ and $h = 0.0001$ for instance.

B\M	Col	Comp
Col	$\frac{(1-c)^2}{4}, \frac{(h+\alpha c)(1-c)^2}{4c}$	$\frac{(1-c)^2}{4}, \frac{(h+\alpha c)(1-c)^2}{4c+\gamma+c\gamma}$
Comp	$2\frac{(\gamma+2)(1-c)^2}{(\gamma+4)^2}, \frac{(\gamma+2)^2}{\gamma+4} \frac{(h+\alpha c)(1-c)^2}{4c-\gamma+2c\gamma}$	$2\frac{(\gamma+2)(1-c)^2}{(\gamma+4)^2}, 2\frac{(h+\alpha c)(\gamma+2)(1-c)^2}{c(\gamma+4)^2}$

Table 2: Bimatrix game under no detection

3.1 The collusion strategies

In the absence of sanctions, the stage 0 inter-level game is a standard bimatrix game given in table (2), where the entries are respectively the equilibrium payoffs value of the boards and the managers of one firm.

Comparing the payoffs indicated in the entries leads to the evident following inequalities:

$$P(Col, Col) \geq P(Comp, Col), \quad (2)$$

$$P(Col, Comp) \geq P(Comp, Comp), \quad (3)$$

$$G(Col, Col) \geq G(Col, Comp), \quad (4)$$

which implies that the bimatrix game has an unique equilibrium solution (Col,Col). More interestingly, in the *backstage arrangement* (Col,Comp), collusion only holds at the board level: the monopolization in terms of prices and profits is realized but not in terms of manager utility which is not proportional to the profit. Because of this lack of alignment between the parties, the manager is worse off and the backstage arrangement is not an equilibrium solution.

This is no longer true when the authority may detect collusive practices and inflict fines to the guilty companies. Since the cost of the fine is transmitted to the managers through the compensation they receive, this will affect the collusive behavior of the managers and then weakens the preeminence of the boards. In particular, when sanctions are introduced, the backstage arrangement might constitute an equilibrium.

4 Case 2: introduction of sanctions

Let us examine now the case where collusion may be detected and penalized. We first explain why, from a legal point of view, collusion on prices by sales manager is more likely to being detected and prosecuted than 'upstream collusion'. We then provide a brief overview of sanctions imposed in case of antitrust infringements.

4.1 Detection of downstream v. upstream collusion

In general higher prices or parallel pricing in a market do not in themselves constitute proof of anti-competitive collusion. Parallel prices can be the result of common external factors (e.g. variation of the price of an input) or the outcome of tacit collusion, which is seen as the strategic and independent adaptation to oligopolistic market characteristics in which the outcome of collusion is achievable without communication³. The combination of higher prices and exchange of some sort of information is more likely to attract antitrust scrutiny, depending on the type of information exchanged. The exchange of commercially sensitive information between two companies can in itself constitute a very serious restriction of competition, even without any agreement to fix any of the variables exchanged. Indeed the mere exchange of price/quantity information, individualized (instead of aggregated); exchanged privately constitutes an objective restriction of Art 101 TFEU (no need to prove any effect of the exchange of information, European Commission, Horizontal Cooperation Guidelines, 2011). Meetings between two sales managers will be under higher scrutiny; as these are the risky roles in terms of competition law infringement. Moreover any discussion of prices; outputs and market shares is likely to attract more attention than a discussion on remuneration practices (unless this is merely salary fixing).

If two directors secretly exchange a list of future remuneration ranges there is, in principle, no need to provide further evidence that directors have been following each other's salary range. The proof that such information has been exchanged can constitute a violation of competition law as remuneration plans can also be viewed as "commercially sensitive information". As trade association meetings are a typical meeting place between board members – any written proof (e.g. minutes of meeting) indicating that future remuneration plans are discussed may attract antitrust scrutiny. However, apart from a US case involving major Silicon Valley companies, there is no (or little) cases involving collusion over compensation schemes⁴.

³Relevant EU cases: Case C-40/73 Suiker Unie v Commission [1975] ECR 1663; Case C-48/69 ICI v Commission [1972] ECR 619 Joined Cases C-89, 104, 114, 116-117, 125-129/85 etc A Ahlström Oy v Commission (Woodpulp II) [1993]

Relevant US cases: Interstate Circuit, Inc. v. United States, 306 U.S. 208 (1939), Theatre Enterprises v. Paramount Film Distrib. Corp., 346 U.S. 537, 540-42 (1954)

⁴In 2014, Google, Apple, Intel and Adobe entered in a settlement with US courts over presumption of illegal no-poaching agreement, reflecting a possible intent to drive down salaries of Silicon Valley's employees.< footnote>Dan Levine, Chicago Tribune, 'Apple, Google agree to settle lawsuit alleging hiring conspiracy' (24 April 2014) available at <http://articles.chicagotribune.com/2014-04-24/business/sns-rt-us>

In addition, while the US prohibits directors being members of the board of competing companies, no such prohibition exists in the EU (apart from Italy in the financial sector). In practice situations of interlocking directorates are not uncommon in European economies, and existence of networks of companies via multiple board links are a distinctive feature of some industries in France and Germany⁵.

It has been argued that these situations trigger anti-competitive effects that are currently not captured by EU competition law unless a board representation is attached to an acquisition of one company by a competitor (F. Thépot et al. 2016). Therefore, colluding over matters discussed at board meetings (typically the compensation structure of executives) could be in practice a very effective collusive device, presenting the advantage of attracting very little attention from competition authorities.

In addition, information on remuneration policy could even be publicly disclosed – either under obligation to do so or as part of a company’s policy to increase transparency in remuneration practice of top executives. On this point there may be conflicting goals between the governance rules which advocate transparency to preserve the shareholder’s interests and the competition policy which may consider any transmission of information as distorting the market competitive conditions.

Accordingly collusion is in practice easier to be evidenced and detected if concerning prices and occurring between sales managers. Conversely, upstream collusion over compensation schemes occurring within the private sphere of board meetings will be much more immune from antitrust scrutiny for the reasons exposed. Of course, the ability to detect collusion depends on the enforcement rules and resources allocated to the antitrust authority for its investigations.

4.2 Sanctions

Sanctions imposed for breach of antitrust rules typically take the form of monetary sanctions. Particularly in the US, individuals responsible for engaging their companies in collusive behavior may face criminal sanctions

apple-google-settlement-20140424_1_google-ceo-eric-schmidt-kelly-dermody-steve-jobs

⁵K. van Veen and J. Kratzer, National and international interlocking directorates within Europe: corporate networks within and among fifteen European countries, *Economy and Society*, 2011, 40, 1. V. statistiques: “France (83.7 per cent) and Germany (85.2 per cent) have the lowest number of individuals with only one board seat. Only in the Netherlands was the percentage slightly lower (82.5 per cent) (...) The biggest European linkers are mostly from Germany and France. For a more recent empirical study comparing the structure and evolution of interlocking directorates in France, Germany and the UK, see Allemand et al. (2017).

entailing prison sentences. In the EU, actors within the firm rarely face any consequences for engaging their companies into anti-competitive practices⁶. This is because there is either no criminal enforcement of sanctions, or an absence of enforcement of the existing provisions. In addition, individuals may have left the firm by the time a cartel is uncovered and prosecuted.

Although fines are only one aspect of public enforcement instruments used by antitrust authorities, this paper focuses on monetary penalties - a type of sanction used homogeneously in cartel prosecution across jurisdictions. Leniency policies providing amnesty or fine reduction to cartel members coming forward to the authority with evidence of the cartel will not be examined here. In addition, private enforcement in which private parties seek to recover damages suffered from anti-competitive practices is also outside of the scope of this study.

4.3 Enforcement regimes in the model

In our model, two detection modes can be defined:

- *Under limited detection*, the detection relies on evidence of market price arrangements between competitors with no consideration of other elements of the firm's strategies. Then only the collusive actions of the sales managers are likely to be detected since they are directly responsible for the final prices. Here, the case (Col,Comp) can never be detected as infringing antitrust law.
- Under *extended detection*, collusion is established if collusive actions (calls, mails, meetings, etc..) are detected among any members of the firms operating at any level of the organization. This concerns here the cases (Col,Col), (Comp, Col), (Col,Comp).

Of course extended detection is more effective since evidence of collusion can be established based on a wider range of elements. Furthermore, extended detection may induce some sort of collective punishment in backstage arrangement (Col, comp). In this case, the authority establishes the existence of collusive behavior of the firms while the managers are not themselves involved in it. According to the compensation scheme, they are going

⁶For example, in EU Competition Law, undertakings are the subject-matters of competition law provisions and decisions sanctions are addressed to undertakings. There is no criminal enforcement of EU competition law. But some jurisdictions may impose criminal sanctions See eg. example in the UK: Enterprise Act 2002, s 188 and 204; in the US: Sherman Act, 15 USC §1. Many EU Member States have sanctions against individuals but the enforcement level is low.

to indirectly suffer from the fines imposed on the company. This depends on the various penalty regimes used by the authority. Three fines regimes will be considered here successively based on revenue, profit or loss in consumer surplus.

We now consider the combination of each mode of detection with different fine calculation methods; revenue-based and loss of consumer-surplus based fines.

4.4 Revenue-based fines

Firms having infringed antitrust law incur a fine which traditionally depends on the activity and the duration of infringement: the relevant sales are usually the sales of the products affected by the infringement during the last full year of the infringement. In the EU the percentage which is applied to the value of the company's relevant sales can be up to 30%, depending on the seriousness of the infringement. For cartels, the relevant percentage tends to be in the range of 15 -20%. The fine can be increased (for example if the company is a repeat offender), or decreased (for example if the company's involvement was limited, or legislation or authorities encouraged the infringement). In cartel cases the fine will be increased by a one -time amount equivalent to 15-25% of the value of one year's sales as an additional deterrent which bites essentially in the case of short cartels and is designed to deter from even trying out a cartel (so called "entry-fee"). The fine is limited to 10% of the overall annual turnover of the company⁷.

In our monoprodukt context, these arguments lead to consider the fine z_i incurred by firm i as proportional to the sales revenue and given by:

$$z_i = ap_iq_i, \tag{5}$$

with $a \geq 0$ taking values in the range 10%-30%. Let b the probability of detection, which depends on various factors related to the efficiency of the authority and the peculiarities of the industry. The expected fine is then θp_iq_i , where $\theta = ba \leq 1$ denotes *the toughness* of the penalty regime (cf. Katsoulacos et al. , 2015) We assume that the fine θp_iq_i is borne by the shareholders represented by the boards of directors who are risk neutral. As a result, a part of this cost is directly transferred to the managers, since they own a part α of the capital. But as an extra cost reducing the profit, the fine may alter the compensation schemes designed by the boards and then distort the final prices, so that the fine is also indirectly transferred to the

⁷Commission guidelines on the method of setting fines imposed pursuant to Article 23(2)(a) of Regulation No 1/2003 [2006] OJ C2010/2

managers through these price and compensation adjustments. The profit of the boards and the gains of the managers are now given by:

$$P_i = (p_i - c)q_i - \theta p_i q_i, \quad (6)$$

$$G_1 = \alpha ((p_i - c)q_i - \theta p_i q_i) + \beta_i p_i q_i - h q_i. \quad (7)$$

We assume henceforth that the cost of the fine does not induce negative demands to the firms, namely $\theta + c \leq 1$. As a benchmark for further results, let us first analyze the integrated case where the firms operate directly on the market without delegating the decision to the managers.

4.4.1 The integrated case as benchmark

When the firms collude, they directly fix their price to maximize the joint profit $\Pi = P_1 + P_2$, where P_i is given by (6). Solving $\left\{ \frac{\partial \Pi}{\partial p_1} = \frac{\partial \Pi}{\partial p_2} = 0 \right\}$ yields $p_1 = p_2 = \frac{(1+c-\theta)}{2(1-\theta)}$ and $P_1 = P_2 = P^m(\theta) = \frac{1}{4(1-\theta)} (c + \theta - 1)^2$. If they compete, the duopoly outputs are obtained, as above, with $p_1 = p_2 = \frac{(2c+c\gamma+2)}{\gamma+4}$ and $P_1 = P_2 = P^c = 2 \frac{(\gamma+2)(1-c)^2}{(\gamma+4)^2}$. Let $\theta^* \leq 1 - c$ the value of the toughness solving $P^m(\theta) = P^c$, namely:

$$\theta^* = \frac{(1-c) \left(8c + 4\gamma + 4c\gamma + \gamma^2 - 2\sqrt{2} \sqrt{(\gamma+2)(2c+c\gamma+2)(2c+\gamma+2)} + 8 \right)}{(\gamma+4)^2}. \quad (8)$$

The rule used by the firms is clear : they collude if $\theta \leq \theta^*$, they compete if not. It is worth mentioning that the collusive price is an increasing function of the toughness. Thus the authority succeeds in deterring collusion if it can fix a toughness higher than θ^* . The lower is θ^* , the more efficient is the enforcement regime. If expected fines are not sufficient to deter the cartel, which seems to be the case given the estimation of probability of detection; ranging between 13 and 17%, and the number of cartels that competition authorities continue to discover, " fines based on revenue rather than on collusive profits push firms to increase cartel prices above the monopoly level to reduce the penalty, thus exacerbating the anticompetitive harm caused by the cartel" (Bageri et al. 2013, p. 546). The mere prospect of being penalized induces higher prices that are detrimental to the consumer.

Let us now examine how these results are altered by the governance structure, when the companies delegate the pricing decision to managers. This substantially depends on the detection mode used by the authority.

B\M	Col	Comp
Col	$\frac{(1-c-\theta)^2}{4(1-\theta)}, \frac{1}{4c(1-\theta)} (h + c\alpha) (c + \theta - 1)^2$	$\frac{(1-c)^2}{4}, \frac{(h+\alpha c)(1-c)^2}{4c+\gamma+c\gamma}$
Comp	$\frac{2}{1-\theta} \frac{(\gamma+2)(1-c-\theta)^2}{(\gamma+4)^2}, \frac{1}{1-\theta} \frac{(\gamma+2)^2}{\gamma+4} (h + c\alpha) \frac{(c+\theta-1)^2}{4c-\gamma+2c\gamma+\theta\gamma}$	$2 \frac{(\gamma+2)(1-c)^2}{(\gamma+4)^2}, 2 \frac{(h+\alpha c)(\gamma+2)(1-c)^2}{c(\gamma+4)^2}$

Table 3: Bimatrix game under limited detection

4.4.2 Limited detection

Under limited detection, the fine is taken into account in arrangements (Col,Col) and (Comp, Col) which are identified as arising from collusive conducts, although the latter does not lead to monopolization in terms of price and output. In (Comp, Col), intent is sanctioned rather than actual effect. In (Col, Comp), the fine cost is not incurred since the authority has no proof of collusion due to the limitations of detection; the price and output values remain unchanged.

The inter-level game takes the form of a bimatrix game, given in table 3. See Appendix B for the computations.

Both in arrangements (Col,Col) and (Comp,Col), the fine borne by the boards is transferred to the manager through the compensation scheme, even when the manager has no share of the firm ($\alpha = 0$) since the fine cost is mainly incorporated in the final price which is indirectly controlled by the shareholders via the compensation. In turn, the manager transfers the fine to the final consumer when charging a final price higher than the monopoly price since the market price is an increasing function of the toughness (as in the integrated case). As a result, the fine burden is shared among the the boards, the managers and the consumer.

Let us determine the equilibrium of this bimatrix game according to the values of the toughness θ . Let $\tilde{\theta} \in [0, 1 - c]$ the value such that $G(\text{Col},\text{Col}) = G(\text{Col},\text{Comp})$, We have:

$$\tilde{\theta} = \frac{(1-c) \left(2c + \gamma + c\gamma - 2c\sqrt{(c+1)(c+\gamma+1)} + 2c^2 \right)}{4c + \gamma + c\gamma}. \quad (9)$$

As a result, $G(\text{Col}, \text{Comp}) \geq G(\text{Col},\text{Col})$ for $\theta \geq \tilde{\theta}$. Moreover we have $P(\text{Col}, \text{Comp}) \geq P(\text{Col},\text{Col})$ and $P(\text{Col},\text{Col}) \geq P(\text{Comp},\text{Col})$ for any value of θ . These inequalities determine the equilibrium as indicated in the following proposition:

Proposition 2 *Under limited detection:*

B\M	Col	Comp
Col	$\frac{(1-c-\theta)^2}{4(1-\theta)}, \frac{1}{4c(1-\theta)} (h + c\alpha) (c + \theta - 1)^2$	$\frac{(1-c-\theta)^2}{4(1-\theta)}, \frac{(h+c\alpha)(1-c-\theta)^2}{(1-\theta)(4c+\gamma+c\gamma-\theta\gamma)}$
Comp	$\frac{2}{1-\theta} \frac{(\gamma+2)(1-c-\theta)^2}{(\gamma+4)^2}, \frac{1}{1-\theta} \frac{(\gamma+2)^2}{\gamma+4} (h + c\alpha) \frac{(1-c-\theta)^2}{4c-\gamma+2c\gamma+\theta\gamma}$	$2 \frac{(\gamma+2)(1-c)^2}{(\gamma+4)^2}, 2 \frac{(h+c\alpha)(\gamma+2)(1-c)^2}{c(\gamma+4)^2}$

Table 4: Bimatrix game under extended detection

- For $\theta \leq \tilde{\theta}$, the equilibrium arrangement is (Col, Col) .
- For $\tilde{\theta} \leq \theta$, the equilibrium is the backstage arrangement $(Col, Comp)$.

For small values of the toughness θ , the cost of the fine is low enough; both parties prefer to collude. No unilateral deviation is profitable. But for high values of the fine, the managers choose to compete and the boards to collude since this arrangement is not detected by the authority, yielding the monopoly profit. Accordingly the authority cannot deter the firms colluding at the upstream level. Under limited detection, the authority does not detect the collusive conducts underlying the backstage arrangement $(Col, Comp)$.

4.4.3 Extended detection

Under extended detection, the authority is able to identify the arrangement $(Col, Comp)$ resulting from a collusive behavior of the boards. This changes the payoffs in table (3) only in arrangement $(Col, Comp)$ which becomes $\left(\frac{(1-c-\theta)^2}{4(1-\theta)}, \frac{(h+c\alpha)(1-c-\theta)^2}{(1-\theta)(4c+\gamma+c\gamma-\theta\gamma)} \right)$. The new payoffs are given in table (4).

We now have $G(Col, Col) \geq G(Col, Comp)$ for any value of θ . For $\theta \geq \theta^*$, we have $P(Comp, Comp) \geq P(Col, Comp)$ and, for $\theta \geq \bar{\theta}$, $G(Comp, Comp) \geq G(Comp, Col)$, where $\bar{\theta} = \frac{(1-c)((2c+c\gamma+2)(2c+\gamma) - \sqrt{2c(\gamma+2)}\sqrt{\frac{1}{\gamma+2}(2c+c\gamma+2)(2c+\gamma+2)}}{8c+2\gamma+2c\gamma+c\gamma^2+2c^2\gamma} \geq \theta^*$.

Proposition 3 *Under extended detection:*

- For $\theta \leq \bar{\theta}$, the equilibrium arrangement is (Col, Col) .
- For $\bar{\theta} \leq \theta$, there are two different equilibrium arrangements, (Col, Col) and $(Comp, Comp)$. The latter dominates the former.

For any value of the toughness, there is no incentive of either party to unilaterally deviate from collusion, since any deviation from collusion would not protect them against the consequences of detection of their partner's behavior. For high values of fine there is also no incentive of either party

to deviate from competition since deviation would expose them to detection. This equilibrium indeterminacy is characteristic of the two-tier structure of the firms. It highlights the role of the backstage arrangement (Col,Comp) which sustains the (Col,Col) equilibrium conditions by making deviation from the manager not profitable. This may explain the instability of collusive behavior for multilevel organizations.

$\bar{\theta}$ defines the toughness value that triggers collusion deterring. consequently since $\bar{\theta} \geq \theta^*$, the governance structures makes the antitrust policies less efficient.

These results illustrate how ineffective antitrust enforcement may be in multi-layers organizations:

When the enforcement regime is permissive namely when the detection system is poor, some individuals are tempted to act badly, as they have the prospect of freeriding compliant partners ; this is the case in the limited detection case, for $\tilde{\theta} \leq \theta$ the boards are covered by the managers who may ostensibly compete while the boards are discretely and smoothly colluding on compensation packages that yield the monopoly outcome.

When the enforcement regime is stronger meaning it can detect collusive practices among boards, collusion deterrence still needs greater resources as it holds for higher value of the toughness as compared to the integration case (since $\bar{\theta} \geq \theta^*$). But, due to the existence of arrangement (Col,Col) as alternative equilibrium, deterrence of collusion is not fully guaranteed.

4.4.4 Backstage arrangement yields collective punishment

These results illustrate how ineffective antitrust enforcement may be in multi-layers organizations: When the enforcement regime is permissive namely when the detection system is poor, some individuals are tempted to act badly, as they have the prospect of freeriding compliant partners ; this is the case here in the limited detection case, for $\tilde{\theta} \leq \theta$ the boards are covered by the managers who may ostensibly compete while the boards are discretely and smoothly colluding on compensation packages that yield the monopoly outcome.

In turn, when the law is stricter, supported with a strong detection system, the actors are tempted to act badly as they would be penalized anyway, since punishment is collective. This is the case in the extended detection where the managers are always better off under (Col, Col) than under backstage arrangement (Col,Comp). If they are not guilty, they pay anyway for the board's behaviors.

4.4.5 Welfare analysis

Let us examine now the effectiveness of the detection systems when the welfare impact is considered in the appropriate choice of the penalty value θ by the authority. The welfare (including the public earning due to the penalty and the effort cost of the manager) per company is (dropping the indices) $\Omega = P + S + \theta pq - hq$, where the consumer surplus per firm is conventionally given by $S_i = \int_{\frac{1}{2(1-\theta)}(c-\theta+1)}^1 (1-u)du = \frac{1}{8(\theta-1)^2} (c+\theta-1)^2$, in case of detected monopolization.

Under both detection systems, in arrangement (Col,Col) we have $\Omega^m(\theta) = \frac{1}{8} \frac{(1-c-\theta)(4c\theta+3-3c-3\theta-4h(1-\theta))}{(1-\theta)^2}$ while, in arrangement (Comp, Comp), we have $\Omega^c = \frac{1}{2} \frac{(\gamma+2)(1-c)(6-6c-8h) + (1-c-2h)\gamma}{(\gamma+4)^2} \geq \Omega^m$.

Under extended detection, in the backstage arrangement (Col,Comp) we also have the welfare equal to $\Omega^m(\theta)$ while it is equal to $\Omega^m(0)$ under limited detection. It turns out that the welfare is a decreasing function of the fine cost. The price distortion induced by the fine is not compensated by the public gain. The optimal choice of the authority is represented on figure (2).

- Under limited detection, the best penalty cost is $\theta = 0$, since the authority cannot make the welfare higher than the monopoly value $\Omega^m(0)$.
- Under extended detection, the regulator makes the toughness equal to $\bar{\theta}$, which is higher than θ^* .

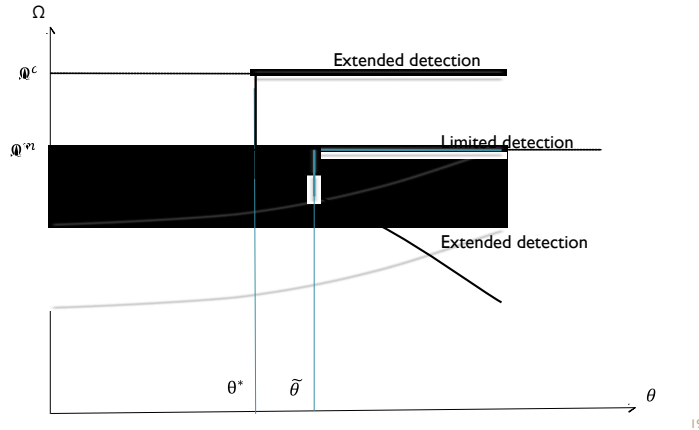


Figure 2: Welfare in the revenue based regime

4.5 Surplus-based fines

The above results show how antitrust enforcement may fail in a multi-tier firm context. This can be corrected using a more suitable fine system. Let us elaborate on this. From an economic point of view, the fines need to be related to the damages created to the consumer by the collusive behavior of the firms (cartel overcharge). Economically, this is captured by the loss in consumer surplus generated by collusion. The loss in consumer surplus due to colluding firm i charging price p_i when the rival charges p_j is given by the general expression $L_i = \int_{p_c}^{p_i} D(u, p_j) du$, with the competitive price $p_c = \frac{(2c+c\gamma+2)}{\gamma+4} \leq p_i$. For the sake of tractability, we assume that this loss in surplus under collusion is estimated only when both firms charge the same price p_i , namely: $L_i = \int_{p_c}^{p_i} D(u, u) du = \int_{p_c}^{p_i} (1 - u - \gamma(u - \frac{u+p_c}{2})) du = (p_i - p_c) \frac{q_i + q_c}{2}$, where the competitive output per firm is $q_c = \frac{\gamma+2}{\gamma+4} (1 - c)$.

Note that the price overcharge (Katsoulacos et al., 2015) is given here by $(p_i - p_c) q_c$. This reveals that price overcharge is a proxy value of the loss in consumer surplus (especially in the linear demand case).

The loss in consumer surplus due to firm i only depends on the own price, i.e.

$$L_i = \frac{1}{2} (2c - 4p_i + c\gamma - \gamma p_i + 2) \frac{2c - 2\gamma + 4p_i + c\gamma + \gamma p_i - 6}{(\gamma + 4)^2}. \quad (10)$$

In this case the fine z_i is defined as proportional to the loss in consumer surplus, namely $z_i = eL_i$. Accordingly, the expected fine cost is εL_i , with $\varepsilon = eb < 1$. and the profit and the manager's payoff are here $P_i = (p_i - c)q_i - \varepsilon L_i$ and $G_i = \alpha((p_i - c)q_i - \varepsilon L_i) + \beta_i p_i q_i - h q_i$. Similar computations as in the previous situations show that, under limited or extended detection, the equilibrium price in arrangements (Col, Col), and (Col, Comp) is $p_1 = p_2 = \frac{1}{2-\varepsilon} (1 + c - \varepsilon)$. This departs from the sales-based fine system since the price decreases with the fine cost ε . In other words taxing the colluding companies is here beneficial to the consumer. Clearly, for $\varepsilon = 1$, we have $p = c$, namely the perfect competitive price. This is not feasible here as we assume that the authority is only interested in correcting the market failures created beyond the standard duopoly case. This implies that the equilibrium price must be higher than p_c , namely the toughness ε cannot be higher than $\varepsilon^* = \frac{\gamma}{\gamma + 2}$. The payoffs of the parties in arrangement (Col, Col) are given as $P_i = \frac{1}{2} (1 - c)^2 \frac{(\gamma + 4)^2 - \varepsilon (\gamma + 2)^2 (2 - \varepsilon)}{(\gamma + 4)^2 (2 - \varepsilon)}$ and

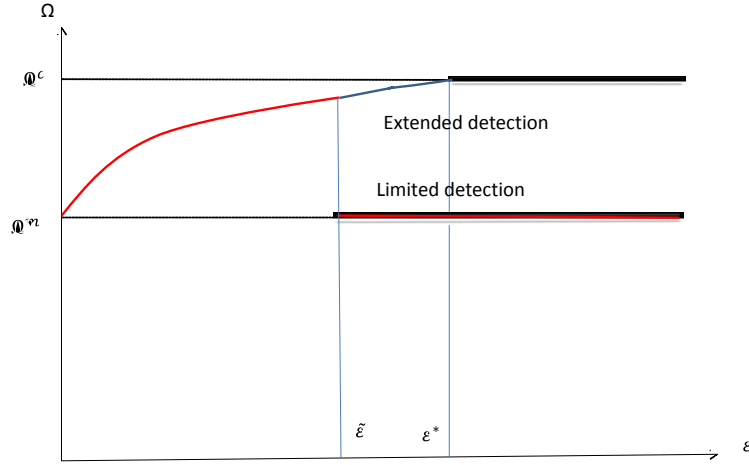


Figure 3: Welfare in the consumer surplus based regime

$G_i = \frac{h}{(2-\varepsilon)(2c-\varepsilon)} (1-c)^2 + \frac{\alpha}{2} (1-c)^2 \frac{(\gamma+4)^2 - \varepsilon(\gamma+2)^2(2-\varepsilon)}{(\gamma+4)^2(2-\varepsilon)}$ and the consumer surplus is $\int_{\frac{1}{2-\varepsilon}(1+c-\varepsilon)}^1 (1-u)du = \frac{1}{2} \frac{(c-1)^2}{(\varepsilon-2)^2}$, so that the welfare per firm is $\Omega = \frac{1}{2} (1-c) \frac{-3c - 4h - 2\varepsilon + 2c\varepsilon + 2h\varepsilon + 3}{(\varepsilon-2)^2}$. As in the previous cases, there exists a value $\tilde{\varepsilon} \leq \varepsilon^*$ above which, in the limited detection mode, the back-stage arrangement dominates (Col,Col). As a result, the collusion strategies are qualitatively similar to the revenue-based cases. A key difference concerns the welfare which increases with the toughness ε , as depicted on figure (3).

These results show that a surplus-based system is a better tool to master the governance structure effects exhibited in the sales-based fine system. Increasing the toughness is anyway welfare improving. More specifically:

- Under limited detection the authority needs to fix the toughness at the switching value $\tilde{\varepsilon}$ to get the best welfare value;
- In the extended case, the authority merely needs to fix a toughness equal to ε^* which fully corrects the distortions of competition regardless any other internal considerations of the companies. Monopolization is fully deterred by a fine system which leads the firms to duplicate the competitive situation.

5 Policy discussion and concluding remarks

In the delegation setting adopted here, the role of the compensation system is threefold: (i) to neutralize the impact of the cost of effort on price fixing (ii) to align the objectives of the managers and the boards when they collude or compete (iii) to pass-on the fine cost from the organization down to the consumer. Combining these three elements leads to strategies that may affect the efficiency of antitrust policies.

This paper has therefore potential policy implications within and beyond the field of antitrust rules.

One of the core implications of this paper lies in the identification of strategies that may be employed by companies to achieve collusive outcome with more discrete means than fixing prices, such as fixing compensation schemes. These strategies are what we have called backstage arrangements. Under current antitrust laws, these techniques may be realistically undertaken since the fixation of managerial incentives do not attract as much attention as the fixation of prices or output. The publication of Guidelines by the DoJ and the FTC for Human Resources Professionals the first time in 2016 show the very recent concern over these practices. The agencies there recall that agreeing on any parameter of an employees' compensation with a competitor or agreeing to refrain from approaching a competitor's employee for recruitment (no-poaching agreement) constitutes a violation of antitrust law. Despite this recent interest and affirmed awareness, there have been very few cases of collusion over the parameters of remuneration.

In addition, in the EU, competitors can easily interact via common board members (interlocking directorates), a practice that has been widespread in Europe. A board meeting is a place where remuneration/parameters affecting the structure of managerial incentives are typically discussed. The practice of interlocking directorates among competitors of companies of a certain size is subject to a prohibition in the US, laid down in Section 8 of the Clayton Act. There is no such provision in the EU or in the Member States. Therefore, this paper can feed into the debate of whether the prohibition existing in the US should be extended to other jurisdictions to bridge a possible enforcement gap. (F. Thépot et al. (2016)).

Secondly, this paper attracts the attention on possible conflicting goals, or dilemma, between corporate governance and competition policy. Remuneration policy of top executives is designed with the aim of aligning the interests of managers with that of shareholders, and to prevent the existence of conflict of interests. In some jurisdictions, compensation schemes may also need to comply with certain legal requirements, such as disclosure obligation. For example, a number of countries impose disclosure requirements on manager

remuneration (most of the time for member of boards, but not strictly, and as such transparency requirements may also extend to non-board members).⁸

In a context of recent heavy criticism on manager remuneration, companies may take the initiative to publicize a number of information relating to remuneration, such as wage level and compensation structure. While an increase in transparency may be desirable from the perspective of better corporate accountability and ethics, transparency can also help companies coordinate on certain parameters without needing to directly communicate.

Showing the possible effects on prices, this paper calls for rethinking the welfare consequences that requirements for greater transparency of top executive compensation may have. In addition, board representation being often associated with shareholdings, this paper has also relevance to the debate on the impact of shareholders' value maximization strategies on competition, and the existence of a dilemma between both. A recent study by Azar et al. (2018) show that strategies of portfolio diversification through institutional investors lead to common ownership of competing companies – with detrimental impact on prices. Our paper also echoes this and other studies showing the unilateral or coordinated effects of upstream arrangements on competition, through various channels.

Thirdly, this paper also contributes to the discussion on optimality of antitrust fines when the firm is composed of multiple actors. Corroborating the findings by Katsoulacos, Motchenkova and Ulph (2015), this paper shows that fines based on price overcharge outperform those based on sales. This conclusion is logical: price overcharge is a proxy of the loss of consumer surplus and fines based on such proxy are welfare enhancing. Our paper shows that consumer surplus-based fines are deemed to be much more deterrent for two-tier companies since it eliminates collusion strategies that persist for high values of the penalty. In other words, considering the reality of a cartel activity within a firm increases the need for a redefinition of fine calculation by authorities. Ignoring the multi-tier dimension of companies therefore may be counterproductive for the design of fining regimes as it may ignore the welfare implication of backstage arrangements between competitors. The insight into multi-tier organizations also makes the case for making greater use of tools that impact incentives of all the actors involved in whatever types of collusion: leniency or whistle-blower programmes, as well as individual sanctions which remains largely outside of the toolkit of antitrust enforcement in Europe.

⁸Practical Law Company'Executive remuneration: international comparison of required approvals and disclosure' <http://uk.practicallaw.com/9-522-6320?q=&qp=&>

References

- [1] Aggarval R, Samwick A. Executive compensation, strategic competition, and relative performance evaluation: Theory and evidence. *The Journal of Finance* 1999; 54; 1999-2042.
- [2] Allemand I, Brullebaut B, Prinz E, Thépot F. Structure et évolution des réseaux d'administrateurs : Une analyse comparée France, Allemagne et Royaume-Uni. 2017; mimeo.
- [3] Angelucci C, Han M. Self-reporting schemes and corporate crime. *Columbia Business School Research Paper* 2015; 16-40.
- [4] Aubert C. Managerial effort incentives and market collusion. *Toulouse School of Economics* 2009; 127.
- [5] Azar J, Schmalz M, Tecu I. Anticompetitive effects of common ownership. *The Journal of Finance* 2018; 73; 1513-1565.
- [6] Baumol W. *Business behavior, value and growth*. Harcourt, Brace and World: New York; 1967.
- [7] Bageri V, Katsoulacos Y, Spagnolo G. The distortive effects of antitrust fines based on revenue. *The Economic Journal* 2013; 123; 545–557.
- [8] Bhaskar V, Manning A, To T. Oligopsony and monopsonistic competition in labor markets. *Journal of Economic Perspectives* 2002; 16; 155-174.
- [9] Brisley N, Bris A, Cabolis C. A theory of optimal expropriation, mergers and industry competition. *Journal of Banking & Finance* 2011; 35; 955-965.
- [10] Bryant PG, Eckard EW. Price fixing: the probability of getting caught. *The Review of Economics and Statistics* 1991; 73; 531-536.
- [11] Combe E, Monnier C, Legal R. Cartels: The probability of getting caught in the European Union. *Bruges European Economic Research papers* 2008; 2.
- [12] Connor J. Cartel detection and duration worldwide. *CPI Antitrust Chronicle* 2011.
- [13] Deneckere R, Davidson C. Incentive to form coalitions with Bertrand competition. *Rand Journal of Economics* 1985; 16; 473-486.

- [14] Ezrachi A, Stucke ME. Virtual competition: The promise and perils of the algorithm-driven economy. Harvard University Press; 2016.
- [15] Fershtman C, Judd K. Equilibrium incentives in oligopoly. *American Economic Review* 1987; 77; 927-940.
- [16] Fudenberg D, Tirole J. *Game theory*. MIT Press; 1991.
- [17] Herold D. The impact of incentive pay on corporate crime. *MGAKS Papers on Economics* 2017; 05.
- [18] Houba H, Motchenkova E, Wen Q. Antitrust enforcement with price-dependent fines and detection probabilities. *Economics Bulletin* 2010; 30; 2017-2027.
- [19] Joh SW. Strategic managerial incentive compensation in Japan: Relative performance evaluation and product market collusion. *Review of Economic Studies* 1999; 81; 303-313.
- [20] Katsoulacos Y, Ulph D. Antitrust penalties and the implications of empirical evidence on cartel overcharges. *The Economic Journal* 2013; 123; 558-581.
- [21] Katsoulacos Y, Motchenkova E, Ulph D. Penalizing cartels: the case for basing penalties on price overcharge. *International Journal of Industrial Organization* 2015; 42; 70-80.
- [22] Leslie CR. Trust, distrust, and antitrust. *Texas Law Review* 2004; 82; 515-680.
- [23] Laffont JJ, Martimort D. 1998, Collusion and delegation. *The Rand Journal of Economics* 1998; 29; 280-305.
- [24] Leslie CR. Cartels, agency costs, and finding virtue in faithless agents. *William & Mary Law Review* 2008; 49; 1621-1700.
- [25] Levenstein MC, Suslow VY. Breaking up is hard to do: Determinants of cartel duration. *Journal of Law and Economics* 2011;54; 455-492.
- [26] Montez J. Controlling opportunism in vertical contracting when production precedes sales. *Rand Journal of Economics* 2015; 46; 650-670.
- [27] Polinsky AM, Shavell S. The economic theory of public enforcement of law. *Journal of Economic Literature* 2000; 38; 45-76.

- [28] Spagnolo G. Stock-related compensation and product-market competition. *Rand Journal of Economics* 2000; 31; 22-42.
- [29] Spagnolo G. Managerial incentive and collusive behavior. *European Economic Review* 2005; 49; 1501-1523.
- [30] Szimanski S. Strategic delegation with endogenous costs. A duopoly with wage bargaining. *International Journal of Industrial Organization* 2000; 12; 105-112.
- [31] Thépot F. Competition law and corporate governance: opening the ‘black box’. Cambridge University Press: Cambridge; 2018 (under press).
- [32] Thépot F, Hugon F, Luinaud M. Cumul de mandats d’administrateur et risques anticoncurrentiels: un vide juridique en Europe? *Concurrences* 2016; 1; 1-11.
- [33] Thépot J. Bertrand competition with decreasing returns to scale. *Journal of Mathematical Economics* 1995; 24; 689-718.
- [34] Thépot J. Private benefits and product market competition. *Louvain Economic Review* 2013; 79; 5-26.
- [35] Tirole J. *The Theory of Corporate Finance*. Princeton University: Princeton NJ; 2006.
- [36] EU Communication from the Commission - Guidelines on the applicability of Article 101 of the Treaty on the functioning of the European Union to horizontal cooperation agreements [2011] OJ C 11/1.

Appendix A: The open loop equilibria. Proof of proposition (1).

Let us examine successively the four cases.

1. *The (Comp, comp) game.*

At stage 2, manager 1 price decision is given by $\frac{\partial G_1}{\partial p_1} = 0$. This defines the best response price function:

$$p_1^*(\beta_1, p_2) = \frac{(2h + 2\alpha + 2\beta_1 + 2c\alpha + h\gamma + c\alpha\gamma + \alpha\gamma p_2 + \gamma\beta_1 p_2)}{4\alpha + 4\beta_1 + 2\alpha\gamma + 2\gamma\beta_1}. \quad (11)$$

At stage 1, owner 1 solves $\frac{dP_1(p_1(\beta_1, p_2), \beta_1, p_2)}{d\beta_1} = 0$. As we are looking for a symmetric equilibrium solution, straightforward computations give

$\beta_1 = \beta_2 = \frac{h}{c}$. Accordingly, equation (11), with $p_1 = p_2$ yields $p_I = p_2 = \frac{1}{\gamma+4} (2c + c\gamma + 2)$. Hence the standard duopoly result.

2. The (Comp, Col) game

At stage 2, manager 1 charges a price p_1 solution of $\frac{\partial J}{\partial p_1} = 0$, namely

$$p_1(\beta_1, \beta_2, p_2) = \frac{h + \alpha + \beta_1 + c\alpha + \alpha\gamma p_2 + \frac{1}{2}\gamma\beta_1 p_2 + \frac{1}{2}\gamma\beta_2 p_2}{2\alpha + 2\beta_1 + \alpha\gamma + \gamma\beta_1} \quad (12)$$

This defines the best response function when both managers seek to maximize the joint profit resulting from collusion. At stage 1 owner 1 solves $\frac{dP_1(p_1(\beta_1, \beta_2, p_2), \beta_1, p_2)}{d\beta_1}$, which leads to the following equation:

$$\frac{1}{4(\gamma + 2)(\alpha + \beta_1)^3} (2h + 2c\alpha + \alpha\gamma p_2 + \gamma\beta_2 p_2) (2h - 2c\beta_1 - c\alpha\gamma - c\gamma\beta_1 + \alpha\gamma p_2 + \gamma\beta_2 p_2) = 0. \quad (13)$$

Combining (12) and (13) with $p_1 = p_2$ and $\beta_1 = \beta_2$, yields to the symmetric solution $\beta_1 = \beta_2 = \frac{(4h+h\gamma+\alpha\gamma-c\alpha\gamma)}{4c-\gamma+2c\gamma}$, $p_1 = p_2 = \frac{1}{\gamma+4} (2c + c\gamma + 2)$. Hence the duopoly solution.

3. The (Col, Comp) game

As in the two-level competition case, any manager seeks to maximize her utility and the price best response is still given by (11). At stage 1 owner 1 maximizes the joint profit Π . by solving $\frac{d\Pi(p_1(\beta_1, p_2), \beta_1, \beta_2, p_2)}{d\beta_1} = 0$. Using

similar arguments as in the previous case, we get $\beta_1 = \beta_2 = \frac{(4h+2h\gamma-\alpha\gamma+c\alpha\gamma)}{4c+\gamma+c\gamma}$ and $p_1 = p_2 = (1+c)/2$. In other words, if the boards agree on a common sales factor β , this eliminates all the competitive pressure on the final market. This is a form of cooperation which does not rely on an explicit price collusion at the manager level.

4. The (Col, Col) game

As in the downstream case, the best response price 1 function is given by (12). At stage, 1, the owner 1 operates as in the upstream collusion case. Through similar computations, we get $\beta_1 = \beta_2 = h/c$ and the monopoly outcomes are obtained.

Appendix B: Collusion under limited/extended detection

Let us consider the various cases.

a. *Arrangement (Comp, Col)*: The price strategy at the downstream level results from the equation $\frac{\partial J}{\partial p_1} = 0$. Similar computations as above give $p_1 =$

$p_2 = \frac{(2c-2\theta+c\gamma+2)}{(1-\theta)(\gamma+4)}$, $\beta_1 = \beta_2 = (1-\theta) \frac{4h+h\gamma+\alpha\gamma-c\alpha\gamma-\theta\alpha\gamma}{4c-\gamma+2c\gamma+\theta\gamma}$ and the utility of the manager is $G_1 = \frac{(h+c\alpha)(\gamma+2)^2}{1-\theta} \frac{1}{\gamma+4}$.

b. Arrangement (Col, Col): At the upstream level we solve now $\frac{\partial \Pi}{\partial \beta_1} = 0$. Similar computations give $p_1 = p_2 = \frac{1}{2(1-\theta)}(c-\theta+1)$, $\beta_1 = \beta_2 = \frac{1}{c}(h-h\theta)$ and $G_1 = G_2 = \frac{(h+c\alpha)(c+\theta-1)^2}{4c(1-\theta)}$.

c. Backstage arrangement (Col, Comp) under extended detection.

Similar computations give $p_1 = p_2 = \frac{1}{2(1-\theta)}(c-\theta+1)$, $\beta_2 = \beta_1 = (1-\theta) \frac{4h+2h\gamma-\alpha\gamma+c\alpha\gamma+\theta\alpha\gamma}{(4c+\gamma+c\gamma-\theta\gamma)}$, $P_1 = P_2 = \frac{1}{4(1-\theta)}(1-c-\theta)^2$ and $G_1 = G_2 = \frac{(h+c\alpha)(1-c-\theta)^2}{(1-\theta)(4c+\gamma+c\gamma-\theta\gamma)}$.

⋮



Working Papers

Laboratoire de Recherche en Gestion & Economie

<http://ideas.repec.org/s/lar/wpaper.html>

Université de Strasbourg
Pôle Européen de Gestion et d'Economie
61 avenue de la Forêt Noire
67085 Strasbourg Cedex

<http://large.em-strasbourg.eu/>