Draft version

Committing to raise expectations: the interplay between competition authorities and cartels.

Michiel Jan Bijlsma *

February 20, 2006

Abstract

Why would competition authorities openly communicate about their investigative efforts? We show, by studying the interplay between expected detection probability, actual detection probability, deterrence and desistance of cartels, that competition authorities may face a commitment problem in allocating their limited resources, in which case a sub-optimal allocation of these resources results. We argue that competition authorities might solve this problem by acquiring external financing for investigative efforts, by pre-announcing and committing to publish economic research efforts, or by making their internal resource allocation transparent and verifiable.

1 Introduction

In practically all developed countries competition law nowadays plays a central role in regulating the commercial strategies of firms. It should therefore not come as a surprise that the importance of economic analysis in competition policy practise is growing. Competition authorities are hiring more and more economists. The (economic) merits of high profile cases are discussed in everyday newspapers. Consultancy companies are earning a good living off antitrust cases and universities' economics and law faculties have founded research departments dedicated to competition law. These are fairly recent developments. In Europe, the application of economic analysis in competition law took off only in the early nineties. In the U.S. this discussion had already culminated in the works of Bork and Posner explaining, often using arguments based on Chicago school reasoning, what types of economic theory and evidence should guide competition policy.

*The author is a visiting guest at ENCORE and employed by the Netherlands Competition Authority. The analysis and opinions presented here are solely the responsability of the author.

There are several driving forces behind the growing importance of economic analysis in competition policy practise. It is partly driven by developments in court. Companies accused of breaking competition law and their representatives in competition cases increasingly use economic concepts in court to defend their case. An inspiring example is the theory of two-sided markets, which was spawned by the seminal paper of Baxter.[1] This paper indeed originated in Baxter's thinking about the antitrust implications of interchange fees. Recently, the literature on two-sided markets has been developed further.[2] [3] [4] Again the renewed interest was partly driven by antitrust cases in the E.U. and the U.S. against international credit card networks. A second court related reason is the increasing height of fines. These fines are based on economic benefits for the cartel and damages for consumers. The higher stakes trigger the discussion in court of how the (illegal) benefits and damages should be quantified and force competition authorities and accused alike to invest heavily in the measurement and determination of these effects. This spawns for example empirical studies of cartel profits. A final reason related to developments in court, specifically in the E.U., are several rulings by the Court of First Instance against the European Commission that pointed out a lack of sound economic arguments in its analysis. This led the European Commission to strengthen its economic expertise and the use of economics.

Another class of reasons for the increased importance of economics is related to the dynamic interaction between competition authorities and the markets they police. Especially in the E.U. countries, where competition law was implemented fairly recently in most countries, it is probable that cartels are learning how to evade detection. Although this conjecture is almost impossible to found on empirical evidence, its truth is often proclaimed by practitioners of competition law using the argument to justify claims that more ingenious detection techniques should be used by competition authorities. Economic theory can help in identifying what parameters should be looked at and what type of dynamics these parameters should exhibit in order to identify possible cartels.[5] [6].

A final class of reasons central to this paper is more fundamentally linked to the underlying goals of competition policy. The goal of competition law is inherently economic: making sure the market process works effectively. Therefore it requires economic analysis to assess how policies that aim to contribute to achieving this goal should be designed. Optimization of leniency policies by competition authorities, where economic theory has played a role of some importance, and development of fining guidelines, where empirical results on cartel profits have been of interest [7], are important example of policy design aided by economic theory. Apart from the literature on optimal fines and leniency policy [8] [9], however, studies of the interaction between competition authorities and firms competing in markets are sparse. Questions such as: what is the effect of asymmetric information between cartel members and competition authorities, for example about detection probabilities, investigation costs, prioritized sectors, or the fail or success probability of cases in court have been little studied in the context of competition law. This is in contrast with the economic studies of the interaction between regulators and firms. For example in the case of central banks many regulatory issues, such as moral hazard issues, reputation effects, asymmetric information, have been studied more intensively and have found application in practise. Competition authorities are only recently discovering the use of economics in optimally designing their enforcement policies. An understanding of comparable issues in the case of competition authorities is of great importance. Competition authorities should know what the potential effects of their policies are on the markets they are supervising and should try to find economic rationales for all choices with regard to the policy parameters at their discretion. Increased understanding of these issues will allow competition authorities to better understand the impact of their enforcement strategy on markets and to try and optimize their enforcement strategies, not only with respect to what detection methods to use, but also how to organize processes internally, how transparent they should be about their policies, etc.

In this paper, we focus on the interaction between competition authorities and firms. A central strategic variable competition authorities can use to influence firms' behavior is the probability that cartels are detected . This probability results in two effects: deterrence, where cartels do not form because the firms expect that the detection probability is too high, and desistance, when cartels that in spite of the chances of being caught do form are actually caught. Thus, a competition authority has two probabilities to worry about: the expected and the actual detection probability. In addition, suppose a competition authority has many sectors to police, and not enough resources to actively supervise all of them. It will have to choose how to allocate its' resources. Once a competition authority has realized a certain expected detection probability in a sector, it has an incentive to switch to one of the sectors that is not under active supervision. This raises potential commitment issues.

In this respect it is interesting to note that competition authorities increasingly publicly pre-announce the enquiries into certain sectors and publicly publish the results of these enquiries. The enquiries can take the form of taskforces or external consultants that are hired to do the job. For example, in 2002 the Netherlands Competition Authority established the financial sector monitor. Also the Irish Competition Authority has over the years issued studies of competition in the financial markets (banking and insurance) and professional services.[1] More recently, the European Commission in 2005 announced the start of sector enquiries in the electricity & gas and the financial markets. Finally, in 2005 the Office of Fair Trade in its annual plan announced that it will install a monitor function to identify areas where there is greatest potential for the OFT

[1] The Competition Authority, 'Indecon's assessment of restrictions in the supply of professional services', March 2003; 'Competition in professional services, Dentists', December 2005; 'Competition in professional services, Optometrists', December 2005; 'Study of Competition in Legal Services, preliminary report', 24th February 2005; 'Competition in professional services, Engineers', 1 December 2004; 'Study of Competition in Professional Services in Ireland: consultation Document 2, architects', November 2003; 'Competition in the (non-investment) banking sector in Ireland', September 2005; 'Competition Issues in the Non-Life Insurance Market, Final Report and Recommendations Volume I and II', march 2005.

to have a beneficial impact.[2] The reasons cited by competition authorities to justify their efforts are diverse: identifying restrictions of competition, focussing investigative efforts, increasing effectiveness of competition policy, and improving knowledge of particular sectors. In essence, these are all arguments that the detection probability is increased. However, the arguments do not justify the public announcement of these enquiries and the commitment to publish the results. An important question is therefore why competition authorities communicate so openly about these enquiries and why they choose to organize them the way they do. We conjecture that a possible explanation is that the public commitment it implies is a way of committing resources in order to credibly optimize competition authorities' resource allocation.

To study these issues, we have to take into account that a competition authority has to decide how to allocate its limited resources optimally and analyze the interplay between resource allocation, deterrence and desistance. We will present a simple and well-known model. In particular, in section 2 we will study a simple two-sector model of a competition authority. We analyze how a competition authority should allocate its limited resources in a game where firms form rational expectations with regard to the detection probabilities realized due to a certain allocation of resources in one period, and competition authorities can optimize their allocation given these rational expectations in the next period. In section 3 we discuss what the models implication for the day-to-day practise of competition authorities might be.

2 Commitment

A competition authority has limited resources. In addition, competition law applies to the economy as a whole, which consists of various sectors. In practise, some of these sectors might be more prone to collusion than others. Also, the one sector might be larger than the other. In response to such differences in non-compliance rates, risk and economic importance, a competition authority might want to allocate different amounts of resources to different sectors, thereby influencing the *expectations* by firms of the cartel detection probability as well as the *actual* detection probability in a particular sector.

When a competition authority allocates its resources in a particular way, this will translate in actual detection probabilities for the supervised sectors. If the competition authority does not announce its allocation of resources, generally the firms in these sectors do not know what the actual detection probabilities are. They have to infer these probabilities from observing the number of cartels caught. Thus, a change in allocation of resources will not be noticed immediately by firms. The time scale on which firms 'detect' changes in competition authorities allocation by observing the number of cartels caught is probably considerable compared to the time scale on which competition authorities can change their internal allocation of resources. To speed up this process of firms adjusting their expectations of the cartel detection probability in their sector,

[2] OFT, 'Annual Plan 2006-07, Consultation draft', December 2005.

the competition authority might want to announce its re-allocation of resources. However, firms also know that the competition authority can depart from this allocation unobserved by firms on a very short time scale, for example by moving employees to different investigative units. The competition authority will therefore have an incentive to reallocate its resources to other sectors, once the cartels that have become unstable due to adjusted expectation by firms (a high detection probability) have disappeared. The competition authority thus faces a commitment problem similar to the one faced by central banks when determining their inflationary policy [10] [11] [12]. It wants to deter as many cartels as possible from forming by appropriately choosing its resource allocation and the associated cartel detection probabilities, but once firms expect a particular resource allocation the competition authority might want to change this allocation.

2.1 The model

To study the above formulated commitment problem faced by a competition authority, we consider an economy consisting of two sectors (1 and 2) with different marginal returns on investigative effort and different total numbers of cartels. The competition authority can choose a detection probability in a given sector by appropriately allocating its resources. We assume that firms know the total amount of resources available to competition authorities.

We first consider a two-period game. In the first period firms in the sector form their expectations about the resource allocation of the competition authority. In the second period, the competition authority allocates its resources and firms decide whether to collude or not based upon their expectations. In the second period, the payoff to the competition authority consists of two parts. The first part is due to the deterrence effect of a particular detection probability: a number of cartels will be deterred because of the firms' expectation with regard to the cartel detection probability. The second part is a desistance effect due to the actual detection probability: the remaining cartels that are detected by the competition authority in period two and therefore cease their illegal activities in that period. We assume that the detection probability is equal for all cartels, independent of size or cartel profits. The number of cartels detected is therefore proportional to the number of cartels existing in the sector times the detection probability.

Suppose first that in the second period, the competition authority simply observes the first period expectations formed by firms of the detection probabilities in the two sectors. The competition authority then chooses its detection probability by maximizing its objective function subject to the competition authorities' budget constraint. We assume that the objective function of the competition authority is given by

$$U(\bar{\mathbf{t}}, \mathbf{t}) = \sum_{i=1,2} \left[W_i(\bar{t}_i) + \beta_i(t_i)\Pi_i^C(\bar{t}_i) \right] \ . \tag{1}$$

Here, $\bar{\mathbf{t}} = (\bar{t}_1, \bar{t}_2)$ denotes allocation of resources expected by firms in sector

1 and 2 and $\mathbf{t} = (t_1, t_2)$ the actual allocation by the competition authority The detection probability $\beta_i(t)$ is an increasing function of invested resources t. We assume that firms know how the detection probability is related to invested resources. It's dependence on t might differ between the two sectors, because in one sector it might easier to detect cartel than in the other. The total amount profits earned by cartels that are deterred in sector i as a function of $\beta_i(t)$ is denoted by $W_i(t)$ and the profit earned by stable cartels is denoted by $\Pi_i^C(t)$. We take the total amount of resources of the competition authority to be fixed (thus total costs are fixed, explaining their absence from the objective function).We incorporate this constraint by requiring that the sum of resources allocated to the two sectors is constant

$$t_1 + t_2 = 1 \ . \tag{2}$$

Assume that for each sector potential cartel profits $\pi^C(\mathbf{s})$ and potential profits from deviating $\pi^D(\mathbf{s})$ are a function of structural properties $\mathbf{s}$ of the sector. The latter might for example be demand curve parameters, the height of entry barriers, or the number of firms. Assume in addition a probability distribution $f(\mathbf{s})$ over these structural properties. Given this probability distribution, $\Pi_i^C(t)$ and $W_i(t)$ are determined by

$$\begin{aligned} W_i(t) &= \int_{\substack{\frac{\pi^D(\mathbf{s})-\beta(t)F}{1+r} \geq \frac{\pi^C(\mathbf{s})-\beta(t)F}{r+\beta(t)} \\ \pi^C(\mathbf{s}) \geq \beta(t)F}} f(\mathbf{s})\pi^C(\mathbf{s})d\mathbf{s} \ , \\ \Pi_i(t) &= \Pi_i - W_i(t) \ , \\ \Pi_i &= \int f(\mathbf{s})\pi^C(\mathbf{s})d\mathbf{s} \ . \end{aligned} \tag{3}$$

Here, F denotes the (exogenously determined) fine expected by cartels upon detected and r denotes the discount rate. Note that cartel profit should be positive, and cartels should be stable.[3] This means that increasing the detection probability destabilizes cartels by making deviating more attractive relative to colluding, or by making expected cartel profits unattractive relative to not colluding.

Maximizing the competition authority's objective function subject to the budget constraint implies that it will choose its resource allocation such that the marginal return from investing more in sector 1 equals the marginal return from allocating more resources to sector 2

$$\beta_1'(t_1)\Pi_1^C(\bar{t}_1) = \beta_2'(t_2)\Pi_2^C(\bar{t}_2) \ . \tag{4}$$

[3] In principle constraints on cartel behaviour due to the existence of a leniency program should also be included to assess the effect of an increase in detection probability. For simplicity we have left out these constraints.

For later reference, we introduce the solution $t_i = h_i(\bar{t}_i, \bar{t}_j)$ to this equation. This solution is a maximum if $G_i(t, \bar{t}) \equiv W_i(\bar{t}) + \beta_i(t)\Pi_i^C(\bar{t})$ is strictly concave and increasing in t. This condition is satisfied if $\beta_i''(t) < 0$ and $\Pi_i^C(\bar{t}) > 0$. These requirements seem reasonable: the marginal increase in detection probability when investing an extra unit of resources of investing is a decreasing function of t, costs are convex, and the total cartel profit is strictly larger than zero: there are always some cartels left. In addition we don't want to consider a situation where it is optimal in equilibrium for a competition authority to allocate all its' resources to one sector only. An interior solution exists if the condition $G_i'(0,0) - G_j'(1,1) > 0 > G_i'(1,1) - G_j'(0,0)$ is met. Indeed, suppose that $\beta_i(t) = \beta(t)$, meaning that the detection probability depends on invested resources in the same way in both sectors. The condition for an interior solution to exist then becomes $\frac{\Pi_j^C(1)}{\Pi_i^C(0)} < \frac{\beta'(0)}{\beta'(1)}$. This means that an interior solution exists if the two sectors are not too dissimilar.[4]

We assume that firms have rational expectations: they want to anticipate the detection probability in their sector correctly. If an interior solution exists, an interpretation of this assumption is that cartels might be unsure as to what their profits might exactly be, so there is always a chance a cartel might end up in a range where defecting is attractive or collusion unattractive. In this case, the costs to the cartel in the case of underestimating the detection probability would be that fines outweigh profits, whereas the costs of overestimation would be potential profits foregone. To simplify or analysis, we model the payoff to firms in sector i from expectations $\bar{t}$ as

$$V_i(t, \bar{t}) = -(t - \bar{t})^2 \ . \tag{5}$$

The optimal expectations for the firms to have for the detection probabilities are the solutions to the second period optimal choices of t_i by the competition authority. These expectations are the rational expectations to have for the firms in the sector. They solve

$$\bar{t}_i = h_i(\bar{t}_i, \bar{t}_j) \ . \tag{6}$$

Note that in equilibrium $\bar{t}_i = t_i$. We denote the solution to equation (6) by t_i^*. The utility of the competition authority in this stage game equilibrium will thus be given by $U(t_i^*, t_i^*)$. In general, this solution is different from the resource allocation the competition authority would choose, were it able to determine first period expectation by somehow committing to a particular resource allocation.

[4] Because $\beta(t)$ is strictly concave $\frac{\beta'(0)}{\beta'(1)} > 1$. If $\Pi_i^C(t)$ is a decreasing function of t and independent of i (the case of identical sectors), then $\frac{\Pi_j^C(1)}{\Pi_i^C(0)} < 1$ and the condition is satisfied. Suppose that we have $\Pi_i^C(0) = \Pi_j^C(0)$, implying that the sectors only differ in the ease with which cartels are detected. Then $\frac{\Pi_j^C(1)}{\Pi_i^C(0)} < 1$ and the condition is also satisfied. Indeed, if $\Pi_j^C(0) > \Pi_i^C(0)$ then $\frac{\Pi_i^C(1)}{\Pi_j^C(0)} < 1$.

In this case, the competition authorities' allocation problem is represented by

$$U(\mathbf{t},\mathbf{t}) = \sum_{i=1,2} \left[W_i(t_i) + \beta_i(t_i)\Pi_i^C(t_i)\right] \quad \text{s.t.} \quad t_1 + t_2 = 1 \ , \tag{7}$$

resulting in the following first order conditions

$$\Pi_1^C(t_1)\beta_1' + (\beta_1 - 1)\Pi_1'^C(t_1) = \Pi_2^C(t_2)\beta_2' + (\beta_2 - 1)\Pi_2'^C(t_2) \ . \tag{8}$$

A maximum exists if $F_i(t) \equiv W_i(t) + \beta_i(t)\Pi_i^C(t)$ is strictly concave and increasing in t. These requirement are satisfied if $\beta_i'(t) > 0$, $\beta_i''(t) < 0$, $\Pi_i^C(t) > 0$, $\Pi_i'^C(t) \leq 0$, and $\Pi_i''^C(t) \geq 0$ (these are sufficient conditions, so less strict conditions are possible). The additional restrictions seem reasonable: the detection probability in a particular sector should increase if more resources are allocated to that sector and the marginal decrease in total cartel profit decreases with increasing resources. Again, we don't want to study the situation where it is optimal in equilibrium for a competition authority to allocate all its' resources to one sector only. The condition for the existing of an interior solution reads $F_i'(0) - F_j'(1) > 0 > F_i'(1) - F_j'(0)$.

We denote the allocation that solves equation (8) by t_i^o. An important observation is that this allocation in general does not coincide with the allocation t_i^* that obtains when a competition authority cannot determine expectations. Furthermore, by definition the value of the objective function of the competition authority will be higher in the former than in the latter case

$$U(\mathbf{t}^o, \mathbf{t}^o) \geq U(\mathbf{t}^*, \mathbf{t}^*) \ . \tag{9}$$

So far we have studied a two-period game. In reality, the interaction between competition authorities and firms is a repeated game. We will briefly discuss under what conditions an equilibrium exists in which committing to a particular allocation of resources is subgame perfect in a game where the stage game presented above is infinitely repeated. Consider the following strategies for the firms. In the first period firms hold expectations that $\bar{t}_i = t_i^o$. In subsequent periods $\bar{t}_i = t_i^o$, provided that in all prior periods expectations $\bar{t}_i = t_i^o$ and actual resource allocations $t_i = t_i^o$. Else, expectations in the next period will be $\bar{t}_i = t_i^*$. The competition authorities' strategy is as follows. In the first period, it chooses allocation $t_i = t_i^o$. In subsequent periods, allocation is $t_i = t_i^o$ provided that in all prior periods expectations $\bar{t}_i = t_i^o$ and actual resource allocations $t_i = t_i^o$. Else, allocations are $t_i = t_i^*$. We denote by $\mathbf{t}^D = (t_1^D, t_2^D)$ a competition authorities' optimal allocation of resources if firms' expectations are given by $\bar{t}_i = t_i^o$. The competition authority's strategy is a best response to the firms' expectations if

$$\frac{U(\mathbf{t}^o, \mathbf{t}^o) - U(\mathbf{t}^*, \mathbf{t}^*)}{1-\delta} \geq U(\mathbf{t}^o, \mathbf{t}^D) - U(\mathbf{t}^*, \mathbf{t}^*) \ . \tag{10}$$

The firms' expectations are a best response to the competition authority's strategy because deviating will result in a negative payoff for the first period after deviation, and zero forever after. Condition (10) states that the pay-off from deviating should not be too big.

Let us discuss a simple and tractable theoretical example. As in the above, our model economy has only two sectors. In sector i the total demand curve is given by $a_i - b_i p_i$, and the marginal costs c_i in sector i are uniformly distributed over $[0, a_i]$. One way of interpreting this assumption is that each sector consists of many (relevant) markets. One could for example think of sectors, such as the financial sector or the construction sector, each consisting of many markets (payment systems, mortgages, savings account etc. respectively highway construction, residential building, green maintenance etc.). Homogeneity was partly introduced to keep things tractable, but one can imagine that competitive circumstances are relatively homogeneous within one sector relative to the other. In each of the markets in these sectors, two firms compete by Bertrand price-competition. In principle, one could expand the model by allowing firms in different markets to differ in their demand and cost parameters. Per firm cartel profit is given by $\pi_i^C = \frac{(a_i-c_i)^2}{8b_i}$ (monopoly profit split equally between the two firms) and the profit from deviation is given by $\pi_i^D = \frac{(a_i-c_i)^2}{4b_i}$. The total turnover is given by $T_i = \frac{(a_i-c_i)(a_i+c_i)}{4b_i}$. The exogeneously determined fine is given by a fraction of total turnover: $F_i = xT_i$. this closely models the way in which competition authorities set fines in reality. In principle, cartels could be deterred by setting an infinite (or extremely large) fine. However, this case is uninteresting as well as unrealistic. The condition for stability against defection reads

$$\frac{\pi_i^D - \beta F_i}{1+r} \leq \frac{\pi_i^C - \beta F_i}{r+\beta} \Leftrightarrow c_i \leq a_i \left(1 - \frac{4x\beta - 4x\beta^2}{1 - r - 2\beta + 2x\beta - 2x\beta^2}\right) . \quad (11)$$

Note that for $\beta = 0$ and $r < 1$ cartel profit is strictly positive if $c \leq a_i$, as one would expect. Whereas the condition for collusion to be attractive, the profit from colluding should be bigger than the detection probability times the expected fine, reads

$$\pi_i^C \geq \beta F_i \Leftrightarrow c_i \leq a_i \left(1 - \frac{2x\beta}{1+x\beta}\right) . \quad (12)$$

Note that if $\beta = 0$ cartel profit is strictly positive if $c \leq a_i$, as one would expect. In the neighborhood of $\beta = 0$ the condition for cartel stability is the more restrictive condition.[5] Approximating the dependency of the total number of cartels on t linearly in the neighborhood of $\beta = 0$, assuming that detection probability is zero if no resources are allocated $\beta_i(0) = 0$, and that the probability strictly increases if more resources are allocated $\beta_i' > 0$, that there are decreasing marginal returns to scale $\beta_i'' < 0$ results in the following specifications

[5] The derivative with respect to β at $\beta = 0$ is given by $-2xa$ in the latter case and $\frac{-4xa}{1-r}$ in the former.

$$
\begin{aligned}
\beta_i(t) &= \gamma t - t^2 \ ; \ 2 < \gamma < 3 \ , \\
\Pi_i^C(t) &= \Pi - \nu_i t \ ; \ 0 < \nu_i < \Pi \ .
\end{aligned} \tag{13}
$$

These functional forms satisfy the concavity requirements. The parameter γ is restricted in order for β to be a strictly increasing function of t in the range $[0, 1\rangle$. An interior solution to equation (4) exists if $\frac{\Pi-\nu_i}{\Pi} < \frac{\gamma}{\gamma-2}$. For the allowed values of γ and ν_i this condition is satisfied. An interior solution to equation (8) exists if $\nu_i + 2\Pi > (\gamma - 2)2\nu_j$. This condition is also satisfied for the γ and ν_i are allowed to take. If the competition authority cannot commit its resources (in analogy with the case of central banks we might call this 'discretion') the solution to equation (4) for the optimal allocation of resources satisfies

$$
t_i = \frac{1}{2} \frac{(2-\gamma)\Pi_j^C(\langle t_j \rangle) + \gamma \Pi_i^C(\langle t_i \rangle)}{\Pi_1^C(\langle t_1 \rangle) + \Pi_2^C(\langle t_2 \rangle)} \ . \tag{14}
$$

The solution to this equation is given by

$$
\begin{aligned}
t_1^* &= \frac{\theta - \sqrt{\theta^2 - 4(\theta - \gamma(\nu_1 - \nu_2))(\nu_1 - \nu_2)}}{4(\nu_1 - \nu_2)} \ , \\
\theta &= 4\Pi - 4\nu_2 + \gamma\nu_1 + \gamma\nu_2 \ .
\end{aligned} \tag{15}
$$

Note that in the limit that $b_1 = b_2$ we get $t_1^* = t_2^* = 1/2$. If the competition authority can commit to allocating its resources (in analogy with the case of central banks we might call this 'rules'), the solution to equation (8) is given by

$$
\begin{aligned}
t_1^o &= \frac{\theta - \sqrt{\theta^2 - 3(\theta + (1-\gamma)(\nu_1 - \nu_2))(\nu_1 - \nu_2)}}{3(\nu_1 - \nu_2)} \ , \\
\theta &= 2\Pi - 3\nu_2 + \gamma\nu_1 + \gamma\nu_2 \ .
\end{aligned} \tag{16}
$$

Note again that in the limit that $b_1 = b_2$ we also get $t_1^o = t_2^o = 1/2$. The optimal deviation by the competition authority, given that the firms expect it to allocate resources according to t_i^o is given by

$$
t_1^D = \frac{1}{2} \frac{(2-\gamma)\Pi_2^C(1 - t_1^o) + \gamma \Pi_1^C(t_1^o)}{\Pi_1^C(t_1^o) + \Pi_2^C(1 - t_1^o)} \ . \tag{17}
$$

Let's consider small asymmetries. In this case, we can expand t_1^* and t_1^o to first order in $\nu_1 - \nu_2$ (assuming that $\nu_1 > \nu_2$), which results in

$$
\begin{aligned}
t_1^* &= \frac{1}{2} - \frac{(\nu_1 - \nu_2)}{8} \frac{4\gamma - 4}{4\Pi + (2\gamma - 4)\nu_2} \ , \\
t_1^o &= \frac{1}{2} - \frac{(\nu_1 - \nu_2)}{8} \frac{4\gamma - 7}{2\Pi + (2\gamma - 3)\nu_2} \ , \\
t_1^D &= \frac{1}{2} - \frac{(\nu_1 - \nu_2)}{8} (\gamma - 1) \ .
\end{aligned} \tag{18}
$$

In both cases, a small asymmetry will cause the equilibrium allocation in the sector where an increase in resources reduces the number of cartels the most to decrease. This is intuitively correct: you have to invest less to achieve the same result. More formally, $\nu_1 > \nu_2$ will mean $\Pi_1^C(\frac{1}{2})\beta_1'(\frac{1}{2}) < \Pi_2^C(\frac{1}{2})\beta_2'(\frac{1}{2})$, implying that the right hand side will have to increase to equate the two sides. This is a general feature if $\Pi_1^C(\frac{1}{2})\beta_1'(\frac{1}{2}) < \Pi_2^C(\frac{1}{2})\beta_2'(\frac{1}{2})$ then we get $t_1^* < 1$.In addition if if $\Pi_1''^C \geq 0$ then from $\Pi_1^C(t_1)\beta_1' + (\beta_1 - 1)\Pi_1'^C(t_1) < \Pi_2^C(t_2)\beta_2' + (\beta_2 - 1)\Pi_2'^C(t_2)$ it follows that $t_1^o < 1$. Again, this can be understood as 'you have to invest less to achieve the same result'.

Note that for $\gamma < \frac{5}{2}$ the difference $t_1^* > t_1^o$, whereas for $\gamma > \frac{5}{2}$ we get $t_1^* < t_1^o$. Thus the optimal allocation in a particular sector in the case of rules can be both above or below the optimal allocation in the case of discretion depending on the value of γ. If the detection probability rises fast with t, a competition authority that cannot commit will overinvest in the sector with the highest detection probability. If the detection probability rises slowly with t, the competition authority that cannot commit will underinvest in the sector with the highest detection probability.

3 Conclusion

Once a sector thinks it is under heavy scrutiny by the competition authority and hence expects that the cartel detection probability is high, the competition authority might have an incentive to reallocate its resources to a different sector. The above model is meant to capture this effect. The model shows that the commitment problem faced by the competition authority causes it to choose a suboptimal resource allocation. A concrete example shows that the optimal resource allocation in a particular sector can be both higher and lower that the suboptimal resource allocation. The model also shows that in an infinitely repeated game, a subgame perfect equilibrium where resources are allocated optimally is possible, if the short term gains from deviating are not too large and in an initial period, the competition authority can commit itself to an optimal allocation. These profits are small if differences are not too large. This suggests it is possible to commit if differences between sectors are not too large.

These results calls for suggestions on ways to solve the commitment problem. We can think of a number of solutions. First, the competition authority might try to make its resource allocation as transparent and verifiable as possible. If the competition authority is unable to change its resource allocation without firms knowing, then firms' immediately adjust their expectations about the detection probability and the two-period model considered here will no longer be correct. Instead, competition authorities will choose their resource allocation knowing that firms will expect the detection probability this allocation realizes and the optimal allocation obtains. Second, a competition authority might outsource economic studies of sectors to commit itself in this way not to reallocate resources. Third, a competition authority might acquire external financing for investigative efforts in certain sectors. In this case, reallocations will have to be explained to the external suppliers of financing. Therefore it will be harder to change the allocation of resources. Finally, competition authorities might want to pre-announce sector enquiries and commit to publish the results of these enquiries. This will put constraints on the amount of reallocation possible, because a minimum amount of effort will have to be invested in order to produce results.

The framework presented here lends itself to several extensions. For example, one might study the competition authority as an entity composed of management and several subunits, where there is asymmetric information between management and the subunits. The latter own all information on detection probabilities as well as structural properties of the market and the former has to allocate resources. Also, competition in several markets might be correlated: if competition becomes more intense in the one market, it becomes less or more intense in the other. Another possible extension is to introduce competition authorities 'types', where one type prefers short run gains ('desistance') over long run effects ('deterrence') more than the other and firms are uncertain about what type they are facing. This might give rise to signalling issues. A rather strong assumption was made that competition authorities can observe the expectations of firms with regard to the detection probability. Loosening this assumption might be the topic of future research.

finally, there are differences in the way in which sector enquiries are implemented. In the Netherlands monitoring of the financial sector is structural, and part of the economic analyses and results are published annually.[6] The European Commission, on the other hands, seems to favour incidental monitoring. In the United Kingdom, key areas will be selected on the basis of an assessment of consumer detriment and productivity impact.[7] It is unclear whether the OFT will publish the results of it's studies, and whether it will announce what sectors it will scrutinize. The OFT has announce that revised guidance on the OFT's approach to market studies will be published in March 2007. It would be interesting to further explore possible economic rationales behind these differences.

References

[1] W.F. Baxter. Bank interchange of transactional paper: Legal perspectives. *Journal of Law and Economics*, 26:541–588, 1983.

[2] R. Schmalensee. Payment systems and interchange fees. *Journal of Industrial Economics*, 50:103–122, 2002.

[3] J.C. Rochet and J. Tirole. Cooperation among competitors: Some economics of payment card associations. *RAND Journal of Economics*, 33:1–22, 2002.

[6] NMa, 'Financial Sector Monitor 2003', December 2003; NMa, 'Financial Sector Monitor 2004', December 2004; NMa, 'Financial Sector Monitor 2005', December 2005.

[7] OFT, 'Annual Plan 2006-07, Consultation draft', December 2005.

[4] J. Wright. Optimal card payment systems. *European Economic Review*, 47:587–612, 2003.

[5] R.H. Porter. Detecting collusion. *Review of Industrial Organisation*, 26:147–167, 2005.

[6] J.E. Harrington Jr. *Handbook in Antitrust Economics*, chapter Detecting Cartels. MIT Press, Forthcoming.

[7] J.M. Connor and Y. Bolotove. Cartel overcharges: Survey and metaanalysis. *University of Purdue Working Paper*, 2005.

[8] M. Motta and M. Polo. Leniency programs and cartel prosecution. *International Journal of Industrial Organization*, 21:347–379, 2003.

[9] G. Spagnolo. Optimal leniency programs. *FEEM working paper No. 42.2000*, 2000.

[10] R.J. Barro. Inflationary finance under discretion and rules. *The Canadian Journal of Economics*, 16(1):1–16, February 1983.

[11] R.J. Barro. Reputation in a model of monetary policy with incomplete information. *Journal of Monetary Economics*, 17:3–20, 1986.

[12] J. Vickers. Signalling in a model of monetary policy with incomplete information. *Oxford Economic Papers*, 38(3):443–455, November 1986.