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Endogenous choice of minority shareholdings: Effects on product market competition

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Abstract

Non-controlling minority shareholdings in rivals (NCMS) lower the sustainability of collusion under a wide variety of circumstances. Nevertheless, NCMS are sometimes deemed to facilitate collusion, in particular if the level of NCMS is exogenous. The present paper endogenizes firms' choice of NCMS and answers the question: Would colluding firms find it rational to acquire NCMS in rivals? The study of the acquisition reveals that firms have an incentive to acquire NCMS which are accompanied by a shift from collusive to competitive behaviour.

JEL codes: G34, K21, L41
Keywords: Collusion, Coordinated Effects, Minority Shareholdings, Merger Control, Unilateral Effects

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1 Introduction

This article models firms' endogenous choice of non-controlling minority shareholdings in rivals (NCMS). Additionally, we analyze corresponding effects on firms' competitive behaviour, i.e., the decision to compete or collude in the product market. One speaks of non-controlling minority shareholdings if firm i buys a stake of a rival j that is lower than 50% and does not grant control rights, i.e., the buyer acquires a silent interest (Reynolds and Snapp 1986).

The effects of NCMS on competitive behavior have recently been discussed both in practice and in academia. For example, in July 2014 the European Commission adopted a White Paper on proposals to improve EU merger control that deals with NCMS. Currently, EU merger control does not allow the Commission to examine the acquisition of NCMS although they were suspected by prior research (starting with Reynolds and Snapp (1986)) to impair competition. In other jurisdictions, such as Austria, Germany, UK, US and Japan, aquisition of NCMS is subject to merger control. For a more detailed overview from a viewpoint of law and legal practice see Salop and O'Brien (2000) and Tzanaki (2015).

Paralleling the policy discussion, this topic has been studied in academia at least since the seminal contribution of Reynolds and Snapp (1986). Different stranks of theoretical literature based on a variety of assumptions have recently been analyzed by de Haas and Paha (2016). This paper also proofs analytically effects that have only been established numerically by prior literature. However, in the model firms' level of NCMS was given exogenously, as is the case for most related literature (Reynolds and Snapp 1986, Malueg 1992, Gilo *et al.* 2006). This raises the questions: 1.a) Why would firms want to acquire shares of each other? 1.b) Why would they want to buy minority shares instead of larger shareholdings? 2) What does this imply for consumers? These questions are explored in the present paper.

Thus, in the present model, we assume NCMS to be chosen *endogenously* by firms and study whether this choice is more likely to produce situations where NCMS promote or hinder collusion. We assume that acquisition decisions affect profits on the product market but abstract from other considerations, e.g., such as economies of scope (Karle *et al.* 2011). Prior research (Malueg 1992, de Haas and Paha 2016) indicates that NCMS may have negative effects on the sustainability of collusion. Therefore, NCMS may raise total welfare even when causing unilateral effects, i.e., increasing competitive prices. This is the case when NCMS causes firms to (imperfectly) compete instead of collude.

We complement prior research by studying the endogenous choice of NCMS and its effects on competition in an integrated model. We are not aware of any other paper that studies both topics within one model. Our results indicate that firms may have an incentive to acquire NCMS that benefits themselves by causing unilateral effects while at the same time NCMS benefit consumers by disrupting collusion. To provide an intuition: The competitive prices with NCMS are higher than without. Additionally, the shift from collusion to competition removes the threat of being detected and sanctioned by a competition authority for explicitly collusive conduct. Therefore, the expected profits of the firms could rise, if they invest in NCMS and start to compete instead of collude on the product market.

The structure of this paper is as follows. Section 2 briefly reviews existing literature and details how the present study contributes. In Section 3.1 we present an overview of the model. Section 3.2 summarizes the product market stage of the model. Section 3.3 describes the acquisition stage of the model. Corresponding implications for competition and welfare are stated in Section 4. A conclusion is drawn in Section 5. Proofs are stated in the Appendix.

2 Related Literature

Reynolds and Snapp (1986) showed that in a static Cournot model with symmetric firms and homogeneous goods NCMS cause unilateral effects: With NCMS it would be the best response for the firms to restrict aggregate output and raise aggregate profits. Empirical evidence of such unilateral effects on the fares of US airlines has been provided by Azar *et al.* (2016) for the related issue of common ownership. Trivieri (2007) shows that cross-ownership also reduced the degree of competition among Italian banks.

Malueg (1992) extended that analysis and showed that NCMS in an infinitely repeated game have an ambiguous impact on the stability of collusion. On the one hand, a colluding firm holding shares of its co-conspirator receives a lower short-run gain when cheating. This is because the deviator receives lower dividends when deviating, since being cheated on depresses the profits of its former co-conspirator. On the other hand, by softening competition the unilateral effects of NCMS also soften the long-run punishment that is imposed on the deviating firm. Hence, by lowering both the short-run gain from a deviation and the long-run punishment for such conduct, NCMS have an ambiguous effect on the sustainability of collusion. Concerning the net effect, Malueg (1992) showed that NCMS lower the sustainability of collusion only when demand is convex.

Gilo *et al.* (2006) used a slightly different objective function and studied the effects of minority shareholding on collusion in a dynamic environment. However, they only analyzed a Bertrand model with homogeneous goods where minority shareholdings do not cause any unilateral effects such that the long-run punishment following a deviation is not softened by NCMS. They found minority shareholdings to stabilize collusion because the deviator only takes into account that a deviation lowers the dividends it receives from its former co-conspirators.

de Haas and Paha (2016) extended these models in several ways: They combine the different assumptions of the literature cited above and presented corresponding analytic proofs for effects that have only been shown numerically in former literature. Additionally, they added a new element to this debate by assuming an antitrust authority along the lines of Aubert *et al.* (2006), i.e., collusion may be detected with a certain probability and sanctioned thereafter. They showed that in the presence of an effective antitrust authority NCMS are quite likely to lower the sustainability of collusion under a wide variety of conditions. They also studied how firm j's shares of firm i affect firm i's critical discount factor. As a central result, they found that unilateral (one-sided) minority shareholdings destabilize collusion in Cournot competition with homogeneous products and in Bertrand competition with differentiated products, i.e., firm i's discount factor rises when firm j raises its shareholdings in firm i. Summarizing, they showed that NCMS might have pro-competitive effects by disrupting collusion under a wider set of assumptions than was suggested by previous literature.

Flath (1991) presented a static model and studied the unilateral effects of NCMS. He verbally argued, that firms have incentives to invest in NCMS only in Bertrand competition with differentiated goods. This is based on the fact, that competitive profits of firm i will increase with the level of NCMS (of firm i in firm j) only for Bertrand competition with differentiated goods and not for Cournot competition or Bertrand competition with homogenous goods (as also shown by de Haas and Paha (2016)). Flath (1991), however, does not analytically integrate endogenous choice of NCMS and its effects on competition, as we do.

Karle *et al.* (2011) also studied incentives of firms to invest in NCMS. In their model they distinguished between direct investments of firms in rivals and indirect investments by investors holding a controlling stake in firm i and investing in a non-controlling stake of firm j. They showed, that an investor, holding controlling shares in one of the firms, does not desire to acquire full ownership in both firms in order to exercise full monopoly power. That surprising result concerning the acquisition decisions is mainly influenced by ownership structures of both firms: As also discussed by Grossman and Hart (1980), if the target firm j is controlled by very small shareholders that individually cannot exercise control, the typical shareholder will wait for allocation to be implemented, that maximizes the value of their stake. Hence, there is a free rider problem and none of the small shareholders would sell her shares at the current price if the net present value would be increase due to NCMS (by increasing product market prices). This implies that the investor, e.g., firm i cannot obtain rents from the acquired shares, but only from increases of the own product market profits. However, if firm j is owned by one controlling investor, firm i can acquire shares by compensating that investor for his current profits. As also shown by Gilo *et al.* (2016), any acquisition which increased profits lead to an absorption of rents by the acquirer, e.g., firm i. We will discuss this in detail in Section 3.3.2.

The present article along with Reynolds and Snapp (1986), Flath (1991), Malueg (1992), Gilo *et al.* (2006) and de Haas and Paha (2016) concentrates on the most anticompetitive acquisition decisions, i.e., decisions being purely driven by the rationale of receiving a dividend and raising the acquirer's expected profits. Other authors have pointed out that minority shareholdings may be made, for example, to provide a financially constrained target firm with additional funds, to solve hold-up problems when engaging in joint investment projects (Ouimet 2013), or they may be driven by efficiency considerations such as the generation of economies of scope in the production process (Karle *et al.* 2011).

3 The Model

3.1 An Overview

We modify the game presented by de Haas and Paha (2016), based on the ideas of Reynolds and Snapp (1986), Malueg (1992) and Gilo *et al.* (2006), by endogenizing the investment decision of the firms. The timing is as follows:

1. At the beginning of the game, the firms decide whether and how much to invest in NCMS (Flath 1991, Karle *et al.* 2011). This investment stage is discussed in detail in Section 3.3

2. The firms enter into an infinitely repeated game and make the decision whether to compete or collude, i.e., they set their prices / quantities on the product market, as is described and analyzed in Section 3.2.

We assume a duopoly with symmetric firms, in particular, that the firms are cost-symmetric and have the same discount factor, $\delta_i = \delta_j \equiv \delta$. Obviously, this game has to be solved by backwards induction. Therefore, we establish some notation: π_i denoted the one period product market profits of firm i, that are depending on NCMS, α_i, α_j, as discussed in Section 3.2. $\bar{\pi}_i$ denotes the one period product market periods without any NCMS, $\alpha_i = \alpha_j = 0$. The sum of profits on the product market and payoffs from NCMS (dividends) in firm j, is denoted by $\hat{\pi}_i = \pi_i + \alpha_i \hat{\pi}_j$ ('accounting profits'). Firms present values are denoted by $\hat{\Pi}_i = \hat{\pi}_i/(1-\delta)$ (or $\bar{\Pi}_i$ without NCMS, respectively).

We assume firms to maximize the net present value of their investments, $\hat{\Pi}_{i,NPV}(\alpha_i, \alpha_j)$ as is defined in equation 3.1: By acquiring shares a firm receives a gross payoff of $\hat{\Pi}_{i,PO}(\alpha_i, \alpha_j)$. The gross payoff correspond to the present value of firms, $\bar{\Pi}_i$, and depending on NCMS, as discussed in deteil in Section 3.3.1. We subtract, first, the payoff (i.e., the present value of future profits) $\bar{\Pi}_i$ when not buying shares and, second, the costs $\Gamma_i(\alpha_i, \alpha_j)$ of acquiring shares, that are defined in detail in Section 3.3.2. Note that $\bar{\Pi}_i$ is simply an abbreviation of $\hat{\Pi}_i(\alpha_i = 0, \alpha_j^*)$ and reflects the 'outside option' of not buying shares at all. We assume every firm to individually choose an optimal level of α_i by maximizing $\hat{\Pi}_{i,NPV}(\alpha_i, \alpha_j)$. The optimal level of shares, i.e., $\alpha_i^*(\alpha_j)$, would be given by (3.2). A strategy profile $\alpha^* = (\alpha_i^*, \alpha_j^*)$ would be a

Nash equilibrium if 3.3 applies.[1] In the context of *non-controlling* minority shareholdings, we are interested in Nash equilibria where $\alpha_i^* < 0.5 \forall i \in \{1, 2\}$ applies. For $\alpha_i^* \geq 0.5 \forall i \in \{1, 2\}$ neither the payoff function nor the cost function would correspond to the ones discussed in the following. This is because the requested level of shareholdings is then accompanied with acquisition of control and thus per definition no NCMS.[2] Instead, these values of α_i^* would correspond to a merger, e.g., as discussed in Grossman and Hart (1980). Additionally a merger would not only correspond with different payoff and cost functions, but in the most jurisdications a (full) merger have higher requirements concerning to the involved firms as investments in NCMS.

$$\hat{\Pi}_{i,NPV}(\alpha_i, \alpha_j) = \hat{\Pi}_{i,PO}(\alpha_i, \alpha_j) - \bar{\Pi}_i - \Gamma_i(\alpha_i, \alpha_j) \tag{3.1}$$

$$\alpha_i^*(\alpha_j) = \max\left\{0, \arg\max_{\alpha_i}\left\{\hat{\Pi}_{i,n}(\alpha_i, \alpha_j)\right\}\right\} \tag{3.2}$$

$$\forall i, \alpha_i \in [0, 0.5] : \hat{\Pi}_{i,NPV}(\alpha_i^*, \alpha_j^*) \geq \hat{\Pi}_{i,NPV}(\alpha_i, \alpha_j^*) \tag{3.3}$$

3.2 The Product Market Stage

The following analysis of the product market is mainly based on the results of de Haas and Paha (2016). Given we assume explicit collusion, we introduce an antitrust authority on the product market stage in our model (following Aubert *et al.* (2006)): We assume that collusive behaviour generates hard evidence which can be found by the antitrust authority if it audits the industry. This evidence disappears at the end of the period, so only current behaviour can be 'punished'

[1] A numerical example is given in the Appendix.

[2] This is the case whenever the investments in rivals stakes are accompanied with acquisition of control, which could also apply for $\alpha_i^* < 0.5 \forall i \in \{1, 2\}$ (Tzanaki 2015).

by the antitrust authority. The external probability of audit is: ρ. If the antitrust authority obtains evidence about collusion, it impose a fine for all firms involved: F.[3]

Competitive profits As shown by Reynolds and Snapp (1986), Flath (1991) and Malueg (1992) the competitive profits in a Cournot model (CM) or Bertrand model with differentiated goods (BDM), with bilateral and symmetric NCMS, $\alpha_i = \alpha_j > 0$, are higher than without: $\pi_{i,c} > \bar{\pi}_{i,c}$.[4] This is based on the assumption of an adjusted objective function: Firm i maximizes its accounting profits, $\hat{\pi}_i$. As described above, that are profits on the product market, π_i, and in addition payoffs from NCMS in firm j, $\alpha_i \hat{\pi}_j$ (Gilo *et al.* 2006):

$$max\ \hat{\pi}_i = \pi_i + \alpha_i \hat{\pi}_j = \frac{\pi_i + \alpha_i \pi_j}{1 - \alpha_i \alpha_j} \tag{3.4}$$

This implies an (imperfect) internalization (due to NCMS) of negative effects of the own price / quantity decisions on rival's profit. Therefore, adjusted prices are increasing and adjusted quantities are decreasing in the level of own investments in NCMS, α_i (de Haas and Paha 2016).[5] As shown by Flath (1991), unilateral investments in NCMS have ambiguous effects on competitive profits on product market, depending on the nature of competition. For a BDM (strategic complements) unilateral NCMS could increase own profits, $\partial \pi_{i,c} / \partial \alpha_i > 0$. In a CM (strategic substitutes) profits are always decreasing in unilateral NCMS, $\partial \pi_{i,c} / \partial \alpha_i < 0$. Nevertheless, the net effect for the competitive profits of firm j is positive for both models (de Haas and Paha 2016): $\partial \pi_{j,c} / \partial \alpha_i > 0$. This is based on the fact, that firm i internalize the effects of the own price / quantity decisions on rival's profit and thus acts

[3] To analyze tacit collusion within this model framework, one can simply set $\rho = 0$.

[4] This results holds for asymmetric levels of NCMS, if the asymmetry is not too large (de Haas and Paha 2016).

[5] The results of the adjusted behavior of firms on the product market are known as unilateral effects of NCMS.

less 'agressive' on the product market. This holds for both, bilateral and unilateral investments in NCMS, as long as $\Delta\alpha_i \geq \Delta\alpha_j$ (de Haas and Paha 2016). In a Bertrand model with homogenous goods (BHM), competitive profits are not affected by NCMS (Gilo *et al.* 2006): $\pi_{i,c} = \bar{\pi}_{i,c} = \partial\pi_{i,c}/\partial\alpha_i = \partial\pi_{j,c}/\partial\alpha_i = 0$

Collusive profits Additionally, the firms may decide to collude on the product market. In line with the related literature (Malueg 1992, Gilo *et al.* 2006), we assume that the firms agree on the monopoly price and/or quantity and split the monopoly profit, π^M, evenly. As the monopoly profit is the maximum profit that can be earned in this market, collusive profits on the product market are independent of the value of NCMS: $\pi_{i,k} = \bar{\pi}_{i,k}$. Since NCMS are by definition smaller than full acquisition of a rival, the collusive profits are higher than competitive ones with NCMS: $\pi_{i,k} > \pi_{i,c}$.

Profitability of collusion However, we assume firms to collude only if it is profitable. That is the case if the expected value of collusion is higher than the one of competition. As discussed above, in a CM or a BDM competitive profits of firm j, $\pi_{j,c}$, are increasing for bilateral investments as well as unilateral investments of firm i, $\partial\pi_j/\partial\alpha_i > 0$. Therefore, the probability for collusion to be profitable (profitability constraint for both firms, PC, see also 3.11) is decreasing in NCMS. This constraint is not affected by NCMS in a BHM, since neither collusive profits nor competitive profits are affected by NCMS.

Deviation profits Firms can deviate from an collusive agreement and earn the deviation profit $\pi_{i,d}$ on the product market. The deviation profits are decreasing in NCMS in a CM or a BDM, since firm i will interalize a part of the negative effects on the 'betrayed' firm[6] j (Malueg 1992, de Haas and Paha 2016): $\partial\pi_{i,d}/\partial\alpha_i < 0$. Therefore, the product market profits of the betrayed firm j, $\pi_{j,-d}$, will increase in

[6]The firm that stick to the collusive agreement.

NCMS, $\partial\pi_{j,-d}/\partial\alpha_i > 0$ (de Haas and Paha 2016). In a BHM, deviation profits are independent of the level of NCMS, since deviation profits equal monopoly profits and profits of the betrayed firm are zero (Gilo *et al.* 2006): $\pi_{i,d} = \pi^M$ and $\pi_{j,-d} = 0$.

Sustainabillity of collusion However, we assume firms not to deviate from a collusive agreement, as long as they value the future high enough. That is the case if their discount factor, δ_i, exceeds a critical value, δ_i^* (Gilo *et al.* 2006). We derive the critical discount factor by assuming the firms to play a grim trigger strategy (Friedman 1971).[7] For unilateral investments in NCMS, it can be shown, that the own critical discount factor is decreasing in α_i if we are in a CM (de Haas and Paha 2016) or in a BHM (Gilo *et al.* 2006), $\partial\delta_i^*/\partial\alpha_i < 0$. In a BDM unilateral investments might increase the critical discount factor, $\partial\delta_i^*/\partial\alpha_i > 0$ (de Haas and Paha 2016). However, the critical discount factor of firm j is in a CM or BDM always increasing in unilateral investments in NCMS of firm i, $\partial\delta_j^*/\partial\alpha_i > 0$, and the probability for collusion to be sustainable (sustainability constraint for both firms, SC, see also 3.12) is therefore decreasing (de Haas and Paha 2016). In a BHM the critical discount factor of firm j is not affected by unilateral investments of firm i, $\partial\delta_j^*/\partial\alpha_i = 0$. For bilateral investments, the effect on the critical discount factors is not clear: In a CM or BDM critical discount factors of both firms may decrease and thus, SC is increasing, if investments are sufficiently symmetric and small (Malueg 1992, de Haas and Paha 2016). In a BHM, critical discount factors are decreasing for bilateral investments (Gilo *et al.* 2006).

Therefore, the only case for which NCMS may increase the probabillity of collusion in a CM or BDM is for bilateral and sufficiently symmetric investments. However, if these bilateral investments are too high, collusion is not profitable any more. Since unilateral investments in a BHM, solely affect PC and SC of firm i, the probabillity of collusion is increasing (in general) if and only if firm i is the

[7] As was done in related literature.

	Profitability Constraint		Sustainability Constraint	
	unilateral invest.	bilateral invest.	unilateral invest.	bilateral invest.
CM	$\partial PC/\partial\alpha_i < 0$	$\partial PC/\partial\alpha_i < 0$	$\partial SC/\partial\alpha_i < 0$	unclear
BDM	$\partial PC/\partial\alpha_i < 0$	$\partial PC/\partial\alpha_i < 0$	$\partial SC/\partial\alpha_i < 0$	unclear
BHM	$\partial PC/\partial\alpha_i = 0$	$\partial PC/\partial\alpha_i > 0$	$\partial SC/\partial\alpha_i = 0$	$\partial SC/\partial\alpha_i > 0$

Table 1: Effects of NCMS on PC and SC

industry maverick (Baker 2002).[8] For bilateral investments, however, probability of collusion is always increasing in a BHM. These effects[9] are summarized in Table 1 (for symmetric firms)[10].

3.3 The Investment Stage

As shown above, higher shareholdings α_i may increase or decrease cartel stability and causing unilateral effects at the same time. This raises the questions: 1.a) Why would firms want to acquire shares of each other? 1.b) Why would they want to buy minority shares instead of larger shareholdings? 2) What does this imply for consumers? These questions are explored below. In the following, we define firms' payoffs and costs when buying shares of each other. This setup is used to study the implications for competition and welfare.

Given the assumptions stated in Section 3.1, per period accounting profits of firm i in competition, collusion, and deviation are given as follows:

$$\hat{\pi}_{i,c} = \frac{\pi_{i,c} + \alpha_i \pi_{j,c}}{1 - \alpha_i \alpha_j} \tag{3.5}$$

[8]The industry maverick is the firm with the highest incentive to deviate due to individual PC and SC.

[9]Theses effects are known as coordinated effects of NCMS.

[10]If firms are not symmetric, response of the industry maverick's PC and SC is crucial for probability of collusion. However, this is beyond our assumption of a symmetric duopoly.

$$\hat{\pi}_{i,k} = \frac{(\pi_{i,k} - \rho F) + \alpha_i(\pi_{j,k} - \rho F)}{1 - \alpha_i \alpha_j} \tag{3.6}$$

$$\hat{\pi}_{i,d} = \frac{(\pi_{i,d} - \rho F) + \alpha_i(\pi_{j,-d} - \rho F)}{1 - \alpha_i \alpha_j} \tag{3.7}$$

The firm present values are given as follows:

$$\hat{\Pi}_{i,c} = \frac{\hat{\pi}_{i,c}}{1 - \delta_i} \tag{3.8}$$

$$\hat{\Pi}_{i,k} = \frac{\hat{\pi}_{i,k}}{1 - \delta_i} \tag{3.9}$$

$$\hat{\Pi}_{i,d} = \hat{\pi}_{i,d} + \frac{\delta_i}{1 - \delta_i}\hat{\pi}_{i,c} \tag{3.10}$$

3.3.1 The Payoff Function

This section determines firm i's payoff function when buying shares α_i of firm j. As discussed above, we assume collusion to arise if it is profitable and sustainable, both for firm i and firm j. The corresponding conditions are shown in (3.11) and (3.12).

$$PC_i = \hat{\Pi}_{i,k} - \hat{\Pi}_{i,c} > 0 \forall i \in \{1, 2\} \tag{3.11}$$

$$SC_i = \hat{\Pi}_{i,k} - \hat{\Pi}_{i,d} > 0 \forall i \in \{1, 2\} \tag{3.12}$$

In this context, it is also important to consider Lemma 3.1.

Lemma 3.1. *If* $\alpha_j = 0$ *then* $SC_i < PC_i$.

Proof. Using 3.12 and 3.11 to re-write the condition $SC_i < PC_i$, plugging in 3.8, 3.9, and 3.10 and simplifying somewhat yields $\hat{\pi}_c < \hat{\pi}_d$. This is satisfied for all unilateral investments of firm i, since $\pi_{i,k} > \pi_{i,c}(\alpha_i, \alpha_j = 0)$ is by definition the smallest value for $\pi_{i,d}$ (e.g. in case of a full merger).[11] This proves Lemma 3.1. □

[11] This is also satisfied for sufficient symmetric or sufficient small unilateral investments of firm j in NCMS.

Lemma 3.1 implies that (at least prior to acquisition of shareholdings by rival, α_j) the sustainability constraint for collusion is more restrictive than the profitability constraint. Hence, there might be situations when collusion is profitable but not sustainable but not the other way around. This simplifies the analysis of the implications on welfare, in Section 4, somewhat.

As discussed above, higher shareholdings α_i reduce the profitability of collusion. Therefore, we can define a set of levels of NCMS, as defined in (3.13), for that collusion is profitable. Note that (3.13) cannot be found by simply plugging $\hat{\pi}_{i,c}$ and $\hat{\pi}_{i,k}$ (equations 3.5 and 3.6) in and solving for PC_i. This is because competitive profits $\pi_{i,c}$ itself are a function of α_i and α_j. This has to be taken into account by plugging the equilibrium profit function (as a function of α_i and α_j) in PC_i and then solving for (3.13).

$$\Psi_i = \{\alpha_i(\alpha_j) \mid PC_i \geq 0 \wedge PC_j \geq 0\} \tag{3.13}$$

When focusing the sustainability of collusion, we have to distinguish two cases: Either, sustainability of collusion is decreasing in NCMS (Malueg 1992, de Haas and Paha 2016) or sustainability is increasing (Gilo *et al.* 2006, de Haas and Paha 2016), in the relevant range ($\alpha_i \in (0, 0.5]$). However, for both cases there is a set of levels of NCMS, as defined in (3.14), for that collusion is sustainable.

$$\Omega_i = \{\alpha_i(\alpha_j) \mid SC_i \geq 0 \wedge SC_j \geq 0\} \tag{3.14}$$

Note, that the ranges of (3.13) and (3.14) depend on the nature of competition, the demand curve and the effectiveness of the antitrust authority. There may even be empty sets in the relevant range (de Haas and Paha 2016).

This implies that firm i's payoff function can be written as in 3.15. Firms collude if both, profitability constraints, $PC_i > 0 \wedge PC_j > 0$, and sustainability constraints,

$SC_i > 0 \wedge SC_j > 0$, are satisfied. Otherwise the firms compete on the product market.

$$\hat{\Pi}_{i,PO} = \begin{cases} \hat{\Pi}_{i,k} \text{ if } \alpha_i \in \Psi_i \wedge \alpha_i \in \Omega_i \\ \hat{\Pi}_{i,c} \text{ otherwise} \end{cases} \tag{3.15}$$

Thereby, the payoff function is not decreasing and might be increasing in a convex manner for NCMS as shown in Lemma 3.2.[12]

Lemma 3.2. $\frac{\partial \hat{\Pi}_{i,PO}}{\partial \alpha_i} \geq 0$
and $\frac{\partial^2 \hat{\Pi}_{i,PO}}{\partial \alpha_i^2} \geq 0$ *if* $\frac{\partial \tilde{\pi}_{j,c}}{\partial \alpha_i} + \alpha_j \frac{\partial \tilde{\pi}_{i,c}}{\partial \alpha_i} + \frac{\partial \pi_{j,c}}{\partial \alpha_i} \geq -(\frac{\partial^2 \pi_{i,c}}{\partial \alpha_i^2} + \alpha_i \frac{\partial^2 \pi_{j,c}}{\partial \alpha_i^2})$

Proof. See Appendix. □

3.3.2 The Investments' Cost Function and Net Present Value

Equation 3.1 indicates that the acquisition decision is decisively determined by costs $\Gamma_i(\alpha_i, \alpha_j)$ that will be defined more closely below.

$$\Gamma_i(\alpha_i, \alpha_j) = \bar{\Gamma}_i + \alpha_i \gamma_i(\alpha_i, \alpha_j) \tag{3.16}$$

First, we assume $\Gamma_i(\alpha_i = 0, \alpha_j) \equiv \bar{\Gamma}_i$ and $\bar{\Gamma}_i > 0$, which means that the acquisition costs include a component that is incurred irrespective of the fraction of the shareholdings (fixed costs), i.e., even when the value of the acquired shares would only be small. This cost component may be thought of as the costs incurred when preparing the relevant documents that are required in the acquisition process (e.g., contract costs or procedural costs (Grossman and Hart 1980)). Existence of fixed investment costs $\bar{\Gamma}_i > 0$ affects firm i's decision whether to invest in NCMS at all and may rule out some (very small) investments α_i. Hence, one would observe some

[12]Given that payoffs are increasing in a convex manner, there are potential problems to find a closed-form solution. However, as discussed below, this function describes payoffs for NCMS and thus, by definition remains only valid up to a natural limit, e.g., 50%.

industries where firms do not hold cross-shareholdings in each other. Note that assuming $\bar{\Gamma}_i > 0$ does not affect the firms' decision whether to establish collusion or not because $\bar{\Gamma}_i$ is incurred irrespective of firms' behavior in the product market.

Second, the costs $\Gamma_i(\alpha_i, \alpha_j)$ also include the payment that firm i makes to the current shareholders of firm j, $\alpha_i \gamma_i(\alpha_i, \alpha_j)$. These costs depend crucially upon the nature of current shareholders - we distinguish three benchmarks, a), b), and c). To define the corresponding net present values (see 3.1), we have to distinguish two cases for each benchmark: Either the firms collude or compete on the product market before acquiring rivals stakes ('pre-investment'). Obviously, this depends on the exogenous variables, e.g., the individual discount factors, demand and costs. Furthermore, the investments in NCMS may be accompanied with a shift from competition to collusion on the product market (and vice versa), what a further distinction of net present values involved ('post-investment'). As discussed above, NCMS influence the PC and SC and thus, can lead to such changes in competitive behavior on the product market. In this Section we will state analytical expressions of the net present values for each benchmark and briefly discuss the corresponding incentives to invest in NCMS. A detailed discussion of (theoretical) necessary conditions and implications for competition welfare is given in Section 4. A numerical example (using one of the benchmarks and linear demand) is given in the Appendix.

a) Grossman and Hart (1980) argue that current, non-pivotal and dispersed shareholders may not have an incentive to tender their shares at a price level of the pre-investment firm's value, $\bar{\Pi}_j$, because they expect higher dividends in the future. Instead, they are willing to sell their shares at a minimum price level of the post-investment firm's value, $\gamma_{i,a)} \geq \hat{\Pi}_j$. In this case, net present value can be simplified and is given as follows, if firms collude pre-investment.

$$\hat{\Pi}_{i,NPV,a)} \leq \begin{cases} \frac{1}{1-\delta}(\pi_{i,k} - \pi_{i,k}) - \bar{\Gamma}_i \leq 0 \text{ if } \alpha_i^* \in \Psi_i \wedge \alpha_i^* \in \Omega_i \\ \frac{1}{1-\delta}(\pi_{i,c} - (\pi_{i,k} - \rho F)) - \bar{\Gamma}_i \text{ otherwise} \end{cases} \quad (3.17)$$

As discussed above, $\partial\pi_{i,k}/\partial\alpha_i = 0$ hold. Given the fixed costs, $\bar{\Gamma}_i$, there is no incentive to invest in NCMS levels for that PC and SC still holds, for firms that collude pre-investment. That is reflected in the upper part of 3.17, that is smaller then zero. However, if $\partial\pi_{i,c}/\partial\alpha_i > 0$ hold, e.g., in a BDM, pre-investment colluding firms might invest in NCMS. In particular when the PC is not fulfilled anymore: $\pi_{i,c} > \pi_{i,k} - \rho F$. This is because they can increase their expected profits by avoiding potential fines. This lower part of 3.17 is discussed in detail in Section 4, Case 3.

If firms compete pre-investment, the net present value is given as follows:

$$\hat{\Pi}_{i,NPV,a)} \leq \begin{cases} \frac{1}{1-\delta}(\pi_{i,k} - \rho F - \pi_{i,c}) - \bar{\Gamma}_i \text{ if } \alpha_i^* \in \Psi_i \wedge \alpha_i^* \in \Omega_i \\ \frac{1}{1-\delta}(\pi_{i,c} - \bar{\pi}_{i,c}) - \bar{\Gamma}_i \text{ otherwise} \end{cases} \quad (3.18)$$

In the upper part of 3.18, NCMS lead to collusion: The PC and SC are fulfilled due to NCMS. Firms incentives are coordinated effects. This is for example the case for bilateral investments in a CM, where $\partial\pi_{i,c}/\partial\alpha_i < 0$ holds. Implications for competition and welfare are discussed in more detail below (see 4, Case 2).

There might be also incentives to invest in NCMS levels that do not correspond with collusion, for firms competing pre-investment. This is reflected in the lower part of 3.18 and is given if $\partial\pi_{i,c}/\partial\alpha_i > 0$ holds. This is the case, e.g., in a BDM. Corresponding effects on welfare are discussed in Section 4, Case 1.

b) However, the payment of firm i to the current shareholders of firm j may differ from the one previously discussed for several reasons. As discussed in Grossman and Hart (1980), in practice valuation of firm j might differ between current shareholders and firm i. This is a result of differences in risk preferences or information (e.g. due to information costs there might be an 'optimal ignorance' of some information). Additionally, some shareholders may have a higher valuation for receiving a relatively low share price now instead of increased dividends after acquisition. Hence, at least some current shareholders are willing to sell their shares to firm i at a price below post-investment value, $\gamma_i < \hat{\Pi}_j$. Thus we assume a minimum price level of $\gamma_{i,b)} \geq \bar{\Pi}_j$.[13] Assuming heterogeneous current shareholders (different valuations) of firm j, however, implies increasing costs per share above a critical value of NCMS, $\partial\gamma_i/\partial\alpha_i \geq 0$. If firms collude pre-investment, net present value is then given as follows.[14]

$$\hat{\Pi}_{i,NPV,b)} \leq \begin{cases} \frac{\alpha_i\alpha_j}{1-\delta}\hat{\pi}_{i,k} - \bar{\Gamma}_i \text{ if } \alpha_i^* \in \Psi_i \wedge \alpha_i^* \in \Omega_i \\ \frac{1}{1-\delta}(\hat{\pi}_{i,c} - (1-\alpha_i\alpha_j)\hat{\pi}_{i,k}) - \bar{\Gamma}_i \text{ otherwise} \end{cases} \quad (3.19)$$

The upper part of 3.19 illustrates why colluding firms would want to acquire shareholdings in each other although this would leave their product market profits the same (also colluding after investments in NCMS). The reason is based on the assumption that firms maximize their product market profits plus dividends received but without considering dividends payable (see (3.4)). This assumption is in line with Gilo *et al.* (2006). The results of that assumption implies that firms can increase accounting profits due to NCMS, without increasing product market profits. This is surely worth to be discussed.[15] Implications for welfare are discussed in more detail below (see 4, Case 4).

[13]Potentially there are also some current shareholders that value firm j even lower. However, in this case there will be other investors than firm i that are willing to buy shares until price level is equal to present value, $\bar{\Pi}_j$.

[14]A numerical example is given in the Appendix.

[15]This is, however, not discussed in this paper, given our results are not affected in general by this effect.

In the lower part of 3.19, the incentive for firms to invest in NCMS that are corresponding with a shift from collusion to competition is stated. As discussed above, the reason for this is that firms can increase their expected profits by avoiding potential fines. Necessary conditions and implications for welfare are discussed below (see 4, Case 3).

If firms, however, compete pre-investment, net present value is given as follows.

$$\hat{\Pi}_{i,NPV,b)} \leq \begin{cases} \frac{1}{1-\delta}(\hat{\pi}_{i,k} - (\bar{\pi}_{i,c} + \alpha_i \bar{\pi}_{j,c})) - \bar{\Gamma}_i \text{ if } \alpha_i^* \in \Psi_i \wedge \alpha_i^* \in \Omega_i \\ \frac{1}{1-\delta}(\hat{\pi}_{i,c} - (\bar{\pi}_{i,c} + \alpha_i \bar{\pi}_{j,c})) - \bar{\Gamma}_i \text{ otherwise} \end{cases} \tag{3.20}$$

The upper part of 3.20 illustrates a situation, where firms shift from competition to collusion due to NCMS. Firms' incentives are then coordinated effects of NCMS, e.g., if $\partial SC/\partial \alpha_i$ holds (Gilo *et al.* 2006). This is discussed in more detail below in Section 4, Case 2.

The lower part of 3.20 illustrates a situation where firms compete before and after investing in NCMS. Incentives are solely given by unilateral effects of NCMS, i.e., $\partial \hat{\pi}_{i,c}/\partial \alpha_i > 0$ (de Haas and Paha 2016). The welfare implications are discussed below in Section 4, Case 1.

c) As shown by Gilo *et al.* (2016), a single controlling shareholder, holding a major part, b_j, of firm j, however, has an incentive to sell a part of their shares below the pre-investment price level. This is based on the fact, that she takes into consideration that firm j's value and thus the rest of her shares, $b_j - \alpha_i$, will rise in NCMS. Incentives to sell shares to firm i are given for price level $\gamma_i \geq (b_j \bar{\Pi}_j - (b_j - \alpha_i)\hat{\Pi}_j)/\alpha_i$.[16] However, while firm j's value will increase more and more, $\partial \hat{\Pi}_j/\partial \alpha_i > 0$, shares of the current single controlling shareholder will be smaller and smaller, $\partial(b_j - \alpha_i)/\partial \alpha_i < 0$. Thus, price per

[16] That is derived by rearranging the condition $(b_j - \alpha_i)\hat{\Pi}_j + \alpha_i \gamma_j > b_j \bar{\Pi}_j$, for that selling α_i shares to firm i at price level γ_i is better than not selling.

share, γ_i has to increase in NCMS above a critical value of α_i.[17]

In the case of firms collude pre-investment, net present value is given as follows.

$$\hat{\Pi}_{i,NPV,c)} \leq \begin{cases} \frac{b_j \alpha_j}{1-\delta}\hat{\pi}_{i,k} - \bar{\Gamma}_i \text{ if } \alpha_i^* \in \Psi_i \wedge \alpha_i^* \in \Omega_i \\ \frac{1}{1-\delta}(\pi_{i,c} + b_j \hat{\pi}_{j,c} - (\pi_{i,k} - \rho F) - b_j(\pi_{j,k} - \rho F)) - \bar{\Gamma}_i \text{ otherwise} \end{cases} \tag{3.21}$$

The upper part of 3.21 illustrates the incentive for colluding firms to acquire shareholdings in each other for that collusion is still profitable and sustainable. In contrast to benchmark b) this is not only due to an increase in accounting profits. Instead, firm i could buy some shares below its post-investment valuation, given that the current shareholder also benefits from NCMS (as discussed above). Corresponding implications for welfare are discussed below in Section4, Case 4.

Firms may also shift from collusion to competition, what is illustrated in the lower part of 3.21. As discussed before, this is based on the fact, that accounting profits for competition might increase and thus collusion is not profitable anymore. Necessary conditions for that case are discussed in more detail below, see Section 4, Case 3.

If firms compete before investments in NCMS, net present value is given as follows.

$$\hat{\Pi}_{i,NPV,c)} \leq \begin{cases} \frac{1}{1-\delta}(\pi_{i,k} - \rho F - \bar{\pi}_{i,c} + b_j(\hat{\pi}_{i,k} - \bar{\pi}_{j,c})) - \bar{\Gamma}_i \text{ if } \alpha_i^* \in \Psi_i \wedge \alpha_i^* \in \Omega_i \\ \frac{1}{1-\delta}(\pi_{i,c} - \bar{\pi}_{j,c} + b_j(\hat{\pi}_{j,c} - \bar{\pi}_{j,c})) - \bar{\Gamma}_i \text{ otherwise} \end{cases} \tag{3.22}$$

The upper part of 3.22 illustrates a situation in which firms' incentive for NCMS are coordinated effects. As discussed above, a reason for shifting from

[17] The critical value is given when α_i ensures $b_j(\hat{\Pi}_j - \bar{\Pi}_j) \geq \alpha_i(b_j - \alpha_i)\frac{\partial \hat{\Pi}_j}{\partial \alpha_i}$ and thus, $\frac{\partial \gamma_i}{\partial \alpha_i} \geq 0$.

competition to collusion after investing in NCMS might be, that $\partial SC/\partial \alpha_i > 0$ is fulfilled. For more details see Section 4, Case 2.

The lower part of 3.22 illustrates a situation where firms compete before and after investments in minority shareholdings, e.g., due to the fact that collusion was not profitable before investing in NCMS and given $\partial PC/\partial \alpha_i \leq 0$, is even less profitable afterwards. The incentive for investments are unilateral effects, i.e., $\partial \hat{\pi}_{i,c}/\partial \alpha_i > 0$. This is also discussed below, see Section 4, Case 1.

4 Implications for Competition and Welfare

This section first explores the outcomes of firm i's decision to acquire a stake α_i in firm j and, second, studies the welfare consequences of this decision. In principle, four cases can emerge.

Case 1: The firms compete before and after acquiring shareholdings.

Case 2: The firms compete before acquiring shareholdings and collude thereafter.

Case 3: The firms collude before acquiring shareholdings and compete thereafter.

Case 4: The firms collude before and after acquiring shareholdings.

Two questions arise in this context. First, under what conditions would each of these cases occur. Second, how likely is it that these conditions are satisfied in reality. While the first question can and is be answered from our theoretical model, answering the second questions would require an in depth empirical analysis of cross-shareholdings in practice. However, the theoretical analysis produces hypotheses for empirical analyses. Before turning to the results of our analysis for each of these four cases some further remarks are needed.

The firms would collude if and only if collusion is profitable (i.e., $PC_i > 0 \forall i \in \{1, 2\}$, see equation 3.11) and sustainable (i.e., $SC_i > 0 \forall i \in \{1, 2\}$, see equation

3.12). As has been shown in de Haas and Paha (2016) and further illustrated in Subsection 3.3.1, the sustainability constraint SC_i can be inversely u-shaped and rise or fall with the value of shareholdings. Similarly, the critical discount factor can be inversely u-shaped and rise or fall with the value of shareholdings. Crucially, the aforementioned paper have shown that the difference between these scenarios depends among other factors on (i) the nature of competition (e.g., Cournot vs. Bertrand), (ii) the shape of the demand curve, and (iii) the intensity of antitrust enforcement. As discussed above, the nature of current shareholders and thus, price level of investments in NCMS is also crucial and determinate which case occurs.

Case 1 - Competition with and without NCMS Assume that collusion was unprofitable (i.e., $PC_i(\alpha_i = 0, \alpha_j = 0) < 0$) prior to the acquisition of minority shareholdings. The acquisition of minority shareholdings α_i raise competitive profits ($\partial\pi_{j,c}/\partial\alpha_i > 0$, unilateral effects) while leaving collusive profits unchanged ($\partial\pi_{i,k}/\partial\alpha_i = 0$) in a CM and BDM. This lowers the profitability of collusion such that the firms would continue competing even after the acquisition of shareholdings α_i.

In this case, total welfare and consumer surplus would be highest when firm i does not acquire shares of firm j. This is because an acquisition would cause unilateral effects by softening competition. These unilateral effects are the only reason why firms would want to acquire shares of each other. Under the assumptions of our model there is no defense for such NMCS when the antitrust authority pursues a consumer surplus standard.

This would suggest that antitrust authorities, who manage to deter collusion effectively (i.e., $PC_i < 0$), should prohibit the acquisition of shareholdings α_i. However, the observation of explicit collusion in practice appears to suggest that at least in these observed cases, collusion was profitable (i.e., $PC_i > 0$), which confirms the practical relevance of a more comprehensive discussion of NCMS.

There is a second reason why firms would compete before acquiring shareholdings α_i, i.e., collusion is profitable ($PC_i(\alpha_i = 0, \alpha_j = 0) > 0$) but not unsustainable ($SC_i(\alpha_i = 0, \alpha_j = 0) < 0$). Two effects would cause the firms to continue competing even after the acquisition of shareholdings. First, collusion would become unprofitable after the acquisition of the shares, i.e., $PC_i < 0 \vee PC_j < 0$. Second, the firms would also continue competing when the acquisition of shareholdings α_i lowers the sustainability of collusion further or did not increase it sufficiently, so that $SC_i < 0 \vee SC_j < 0$ is still fulfilled.

Proposition 4.1. *Firms will stick to competitive behavior on the product market if they compete pre-investment, if the investments are unilateral*

Proof. Given Lemma 3.1 at least the general SC ($SC_i < 0 \forall i \in \{1, 2\}$) was violated before investments. As was shown in Section 3.2, only for bilateral investments situations arise for that $\partial SC/\partial\alpha_i > 0$ is possible. □

The discussion in Section 3.2 and de Haas and Paha (2016) shows that even for bilateral investments it is not necessary that $\partial SC_i/\partial\alpha_i > 0 \forall i \in \{1, 2\}$ holds. That, however, depends on certain exogenous parameter, for example, (i) the nature of competition (Bertrand vs. Cournot) or (ii) the demand function.

Note, that there is no incentive for investments in NCMS that are not corresponding with a shift from competitive to collusive behavior on the product market in an BHM. This is based on the fact, that competitive profits are not affected by NCMS in a BHM, $\partial\pi_{i,c}/\partial\alpha_i = \partial\pi_{i,c}/\partial\alpha_j = 0$.

Case 2 - Competition without NCMS but Collusion with NCMS Given Lemma 3.1 and $\partial PC_i/\partial\alpha_i < 0 \vee \partial PC_i/\partial\alpha_j < 0$ a shift from competition to collusion in a CM or BDM can only occur iff - prior to the acquisition of shares - collusion is profitable ($PC_i > 0$) but not sustainable ($SC_i < 0$), while an increasing α_i makes collusion sustainable (i.e., $SC > 0$). This would occur under two conditions. First, the higher shareholdings α_i must not make collusion unprofitable (i.e., $PC_i < 0 \forall i \in \{1, 2\}$). Second, the higher shareholdings α_i must raise $SC_i \forall i \in \{1, 2\}$ above zero (or, analogously, lower the critical discount factor δ_i^* below the true discount factor δ_i).

Following the discussion in Section 3.2 and de Haas and Paha (2016), the latter would be the case, e.g., for specific demand curves and a fairly ineffective competition authority. Second, Proposition 4.1 indicate that $\partial SC / \partial \alpha_i > 0$ can in principle occur only for bilateral and sufficient symmetric investments. However, the value of the shareholdings α_i must not be too large as for high enough values of α_i the profitability constraint is violated.

Also for a BHM, at least the SC must be violated pre-investment (maybe also the PC, since $\partial PC / \partial \alpha_i > 0$ is possible). However, as above, Proposition 4.1 indicate that bilateral investments are required to make collusion post-investment profitable *and* sustainable.

The case that acquisition of shareholdings α_i terminates competitive conduct and causes firms to behave collusively is relevant for competition policy because it suggests a situation where NMCS have both unilateral and coordinated effects. The firms would invest in minority shareholdings with the objective to end competition and shift to a collusive regime. However, summarizing the above line of argument the cases in which an acquisition of shareholdings α_i leads to a change of market conduct from competition to collusion appear to be fairly limited. The joint emergence of specific demand curves, an *ineffective* competition authority (given the low expected fines ρF) and sufficient symmetric and small investments in NCMS should be unlikely in countries with a developed competition law tradition (Bryant and Eckard 1991). However, this have to be analyzed in empirically.

Case 3 - Collusion without NCMS but Competition with NCMS However, if collusion is both profitable and sustainable (i.e., $PC_i > 0 \forall i \in \{1, 2\}$ and

$SC_i > 0 \forall i \in \{1, 2\}$) before acquiring shareholdings α_i^*, investments in NCMS could lead to a situation for which $\alpha_i^* \notin \Psi_i \vee \alpha_i^* \notin \Omega_i^*$. This case occurs, for example, (i) for sufficiently large investments, (ii) when greater shareholdings lower the sustainability of collusion ($\partial SC_i/\partial \alpha_i < 0 \vee \partial SC_i/\partial \alpha_j < 0$) (or equivalently raise the critical discount factor δ_i^*), (iii) when the product market profits are increasing in NCMS, $\partial \pi_{i,c}/\partial \alpha_i > 0$ (e.g. Bertrand competition with differentiated goods) or (iv) when the antitrust authority is fairly effective. This case is even facilitated when the detection probability $\rho(\alpha_i)$ of collusion rises in the level α_i of NMCS (de Haas and Paha 2016). However, this assumption is not necessary. For a more detailed discussion see Section 3.2, Section 3.3.1 or de Haas and Paha (2016).

Case 3 is interesting because it illustrates situations where firms find it most profitable to terminate collusion after they have bought minority shareholdings. Or interpreting it in a different way, firms are tempted to collude but would then rather acquire minority shareholdings. What do firms gain from behaving like this? First, when behaving competitively the firms do not have to fear sanctions ρF. Second, the unilateral effects of the minority shareholdings (i.e., $\hat{\pi}_{i,c} > \bar{\pi}_{i,c}$) soften competition and, thus, make it a more desirable alternative. At the same time, consumers also benefit from the acquisition of minority shareholdings because being in a (imperfect) competitive state rather then under collusion leads to higher consumer surplus. Therefore, even in a 'worst case' scenario, where the only effect of NCMS is an increase in market power, NCMS might be welfare increasing as it reduces the probabillity of collusion. If investments in NCMS are forbidden in this case, firms wolud collude instead.

Case 4 - Collusion with and without NCMS In this case, collusion is also both, profitable and sustainable without shareholdings α_i. However, the acquisition of $\alpha_i^* > 0$ – despite lowering the profitability of collusion – does not necessarily bring a change in market conduct. The firms would collude with and without NCMS. This requires that the optimal value of shareholdings is still lower than the value where collusion would become unprofitable and/or unsustainable (i.e., $\alpha_i^* \in \Psi_i \wedge \alpha_i^* \in \Omega_i$). The case with $\alpha_i^* \notin \Psi_i \vee \alpha_i^* \notin \Omega_i^*$ is studied as Case 3 above in this section.

As discussed above, firms' incentive to acquire NCMS is given due to our assumption, that firms maximize their product market profits plus dividends. Thus, NCMS increase payoffs because firms receive higher dividends. This kind of strange result, however, is not discussed in this paper, given our results are not affected in general by this effect.

Would anyone be harmed by such conduct? Customers would remain unaffected because the market conduct of the firms does not change to the worse. Current shareholders of the firms would benefit because shareholdings will only be acquired if this generates a positive net payoff.

5 Conclusion

The effects of non-controlling minority shareholdings among competitors, i.e., shareholdings granting the acquirer no control rights, have recently been discussed both in academia and in practice. Research (Reynolds and Snapp 1986, Gilo *et al.* 2006, Malueg 1992, de Haas and Paha 2016) indicates that the acquisition of non-controlling minority shareholdings by competitors may have anti-competitive unilateral or coordinated effects, i.e., lessening of competition or facilitating collusion.

Our model predicts, that NCMS may also have pro-competitive effects by disrupting collusion. As a main contribution, our model does not only focus the effects of NCMS on competition, but also endogenizes the decision of acquiring shareholdings. This extends prior literature which often treats the stake to be acquired, i.e., the value of the shareholdings, as exogenous. Here, the questions arise (i) why competitors buy minority shareholdings instead of fully acquiring a competitor and (ii) why some competitors refrain from acquiring shares in each other at all. As to the first question, the model implies that it might be rational for firms to invest in NCMS rather than in a full acquisition of rivals, for example, when the takeover premium for shares is increasing with the level of investments, α_i. Second, our model predicts that it might not be profitable at all to invest in NCMS, given that the costs could be higher than the expected revenues of the corresponding investment.

In a second stage, we analyze the potential effects of minority shareholdings on competition, i.e., their effects on competitive prices and on cartel sustainability. It is evident that consumer surplus is lowered when the firms manage to soften competition and earn higher profits. This could be a result of either the unilateral effects or the coordinated effects of minority shareholdings. Our model suggests the following interpretation:

First, minority shareholdings have a negative effect on consumer surplus when the firms would compete without NCMS. This is based on the fact, that the unilateral effects of NCMS cause the firms to (imperfectly) maximize joint profits and therefore raise product prices. Under very limited circumstances, NCMS can even facilitate coordinated effects, if the sustainabillity constraints, SC_i and SC_j, are increasing in NCMS.

Second, in an industry with an incentive to collude without NCMS (the four required constraints, PC_i, PC_j, SC_i and SC_j are fulfilled), minority shareholdings may reduce the risk of coordinated effects (de Haas and Paha 2016), i.e., they would (for sufficiently high levels of NCMS) cause at least one of the required constraints for collusion to be violated. Speaking intuitively, this is because the softer competition being caused by NCMS may decrease the sustainability of collusion, i.e., the unilateral and coordinated effects of the acquisition of minority shareholdings may work in opposite directions. However, for sufficiently small values of NCMS, α_i and α_j, the incentive to collude is not disrupted by minority shareholdings. This is depending on the exogenous parameters like costs and demand. However, which of the four presented cases is more likely to occur is an empirical questions and has to be explored in furhter research.

One would conclude that competition authorities do not need to be highly concerned with the analysis of coordinated effects when an acquisition of minority shareholdings is proposed. When the firms had been colluding previously, the unilateral effects of minority shareholdings make collusion less profitable and may even disrupt existing agreements. Under such conditions it may not be necessary for antitrust authorities to investigate the acquisition of minority shareholdings because positive effects (i.e., fewer coordinated effects) in some industries and negative effects (i.e., more unilateral effects) in other industries offset each other. The conclusion of being parsimonious with enforcement would apply, in particular, when antitrust enforcement is costly and these costs can be saved by not investigating the acquisition of minority shares. This might provide one argument why the European merger control regime does not need to be necessarily amended to make acquisition of minority shareholdings subject to merger control.

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A Appendix

Proof of Lemma 3.2. Lemma 3.2 proposes $\frac{\partial \hat{\Pi}_{i,PO}}{\partial \alpha_i} > 0$ and $\frac{\partial^2 \hat{\Pi}_{i,PO}}{\partial \alpha_i^2} \geq 0$ if $\frac{\partial \hat{\pi}_{j,c}}{\partial \alpha_i} + \alpha_j \frac{\partial \hat{\pi}_{i,c}}{\partial \alpha_i} + \frac{\partial \pi_{j,c}}{\partial \alpha_i} \geq -(\frac{\partial^2 \pi_{i,c}}{\partial \alpha_i^2} + \alpha_i \frac{\partial^2 \pi_{j,c}}{\partial \alpha_i^2})$. If collusion is profitable and sustainable, derivatives of $\hat{\Pi}_{i,PO}$ are represented by A.1 and A.2. By using $\partial \pi_{i,k} = \partial \pi_{j,k} = 0$ one can show that the derivatives are larger or equal to zero:

$$\frac{\partial \hat{\Pi}_{i,PO}}{\partial \alpha_i} = \frac{1}{1-\delta_i} \frac{\partial \hat{\pi}_{i,k}}{\partial \alpha_i} = \frac{1}{1-\delta_i} \frac{\hat{\pi}_{j,k}}{1-\alpha_i \alpha_j} > 0 \tag{A.1}$$

$$\frac{\partial^2 \hat{\Pi}_{i,PO}}{\partial \alpha_i^2} = \frac{1}{1-\delta_i} \frac{2\alpha_j \hat{\pi}_{j,k}}{(1-\alpha_i \alpha_j)^2} \geq 0 \tag{A.2}$$

If collusion is not profitable and / or not sustainable, derivatives of $\hat{\Pi}_{i,PO}$ are represented by A.3 and A.4.

$$\frac{\partial \hat{\Pi}_{i,PO}}{\partial \alpha_i} = \frac{1}{1-\delta_i} \frac{\partial \hat{\pi}_{i,c}}{\partial \alpha_i} = \frac{1}{1-\delta_i} \frac{\hat{\pi}_{j,c} + \frac{\pi_{i,c}}{\alpha_i} + \alpha_i \frac{\pi_{j,c}}{\alpha_i}}{1-\alpha_i \alpha_j} \geq 0 \tag{A.3}$$

$$\frac{\partial^2 \hat{\Pi}_{i,PO}}{\partial \alpha_i^2} = \frac{1}{1-\delta_i} \frac{\frac{\partial \hat{\pi}_{j,c}}{\partial \alpha_i} + \alpha_j \frac{\partial \hat{\pi}_{i,c}}{\partial \alpha_i} + \frac{\partial \pi_{j,c}}{\partial \alpha_i} + \frac{\partial^2 \pi_{i,c}}{\partial \alpha_i^2} + \alpha_i \frac{\partial^2 \pi_{j,c}}{\partial \alpha_i^2}}{1-\alpha_i \alpha_j} \tag{A.4}$$

As shown in de Haas and Paha (2016), in the present of NCMS firms imperfectly maximize joint profits. Thus, total payoffs are increasing in NCMS in a BDM and in a CM, $\partial \hat{\pi}_{i,c}/\partial \alpha_i > 0$. In a BHM NCMS does not affect competitive profits and payoffs, $\partial \hat{\pi}_{i,c}/\partial \alpha_i = 0$, which proves $\partial \hat{\Pi}_{i,PO}/\partial \alpha_i \geq 0$.

de Haas and Paha (2016) showed also that $\partial \pi_{j,c}/\partial \alpha_i + \alpha_j \partial \pi_{i,c}/\alpha_i \geq 0$, and thus $\partial \hat{\pi}_{j,c}/\partial \alpha_i \geq 0$. The second and the third term of A.4 are also greater or equal to zero, as discussed above. Setting (A.4) equal to or greater than zero and rearrange proves the second part of Lemma 3.2. □

Numerical example For our example, we assume a CM duopoly and the inverse demand function, $p = 1 - q_1 - q_2$. Marginal costs of the symmetric firms are $c = 0$. Additionally, we assume a reasonably realistic detection probability of $\rho = 0.2$ and a fine of $F = 3(\pi_{i,k} - \bar{\pi}_{i,c})$ (Bryant and Eckard 1991). Product market profits are then given as follows.

$$\pi_{i,c} = \frac{(1-\alpha_i)(1-\alpha_i\alpha_j)}{(3-\alpha_i-\alpha_j-\alpha_i\alpha_j)^2} \tag{A.5}$$

$$\pi_{i,k} = \frac{1}{8} \tag{A.6}$$

$$\pi_{i,d} = \frac{9-\alpha_i^2}{64} \tag{A.7}$$

$$\pi_{i,-d} = \frac{3+\alpha_j}{32} \tag{A.8}$$

Assuming a discount factor of $\delta_i = 0.9$, collusion is both, profitable and sustainable without NCMS, $PC_i > 0 \wedge SC_i > 0 \forall i \in \{1,2\}$. However, critical discount factor is increasing and thus, sustainability is decreasing in NCMS. In this example, collusion is not sustainable anymore if symmetric investments in NCMS reach a critical value, $\Omega_i = (0, 0.136577) \forall i \in \{1,2\}$ s.t. $\alpha_i = \alpha_j$. As discussed above, profitability of

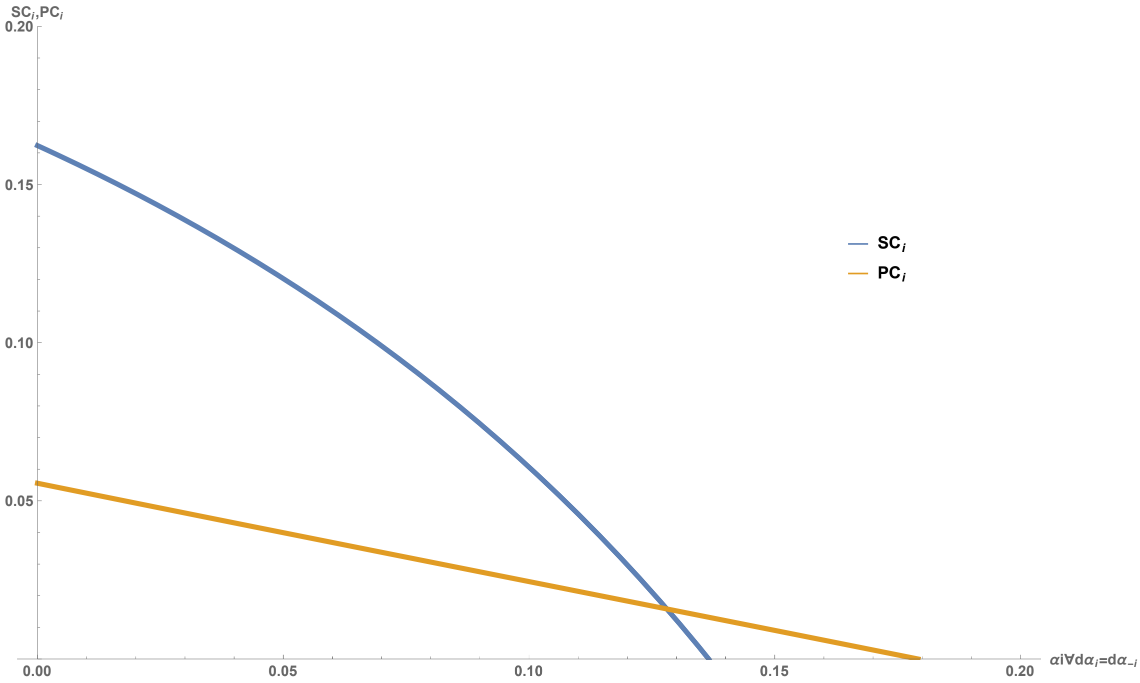

Figure 1: Profitability and sustainability constraint for symmetric NCMS

collusion is also decreasing in NCMS, that is illustrated in Figure 1 for symmetric investments.

We assume that current shareholders of firm j are non-pivotal and dispersed. However, as discussed in benchmark b) firm's valuation differ and they sell their shares at a price level of firm j's pre-investment value, $\bar{\Pi}_{j,k}$. Net present value is then given as follows and illustrated in Figure 2.

$$\hat{\Pi}_{i,NPV} \leq \begin{cases} \frac{\alpha_i\alpha_j(1+\alpha_i)}{1-\alpha_i\alpha_j}\frac{7}{6} - \bar{\Gamma}_i \leq 0 \text{ if } \alpha_i^* \in \Psi_i \wedge \alpha_i^* \in \Omega_i \\ \frac{10(1-\alpha_i\alpha_j)}{(3-\alpha_i-\alpha_j-\alpha_i\alpha_j)^2} - (1+\alpha_i)\frac{7}{6} - \bar{\Gamma}_i \text{ otherwise} \end{cases} \tag{A.9}$$

Maximizing net present values of both firms, (A.9), with respect to α_i or α_j, result in a symmetric Nash equilibrium: $\alpha_i^* = \alpha_j^* \approx 0.239$. Hence, firms buy stakes of about 23.9% in each other, if preparation costs $\bar{\Gamma}$ are not too high. After investing in NCMS, collusion is not sustainable anymore and firms start to compete on product market. Firms benefit by these investments due to higher expected profits, as shown

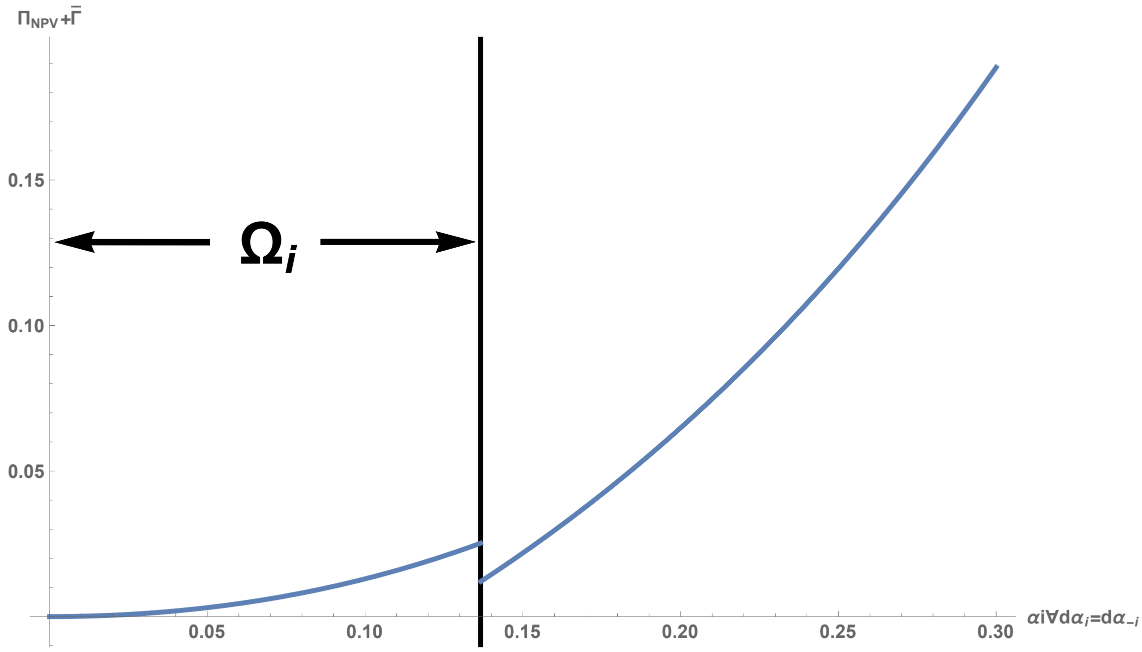

Figure 2: Net present value as a function NCMS

in Figure 2. However, consumer surplus is also increasing, since prices are decreasing: Product prices without and with NCMS, respectively, are $\bar{p} = 1/2 > p^* \approx 0.382$. Corresponding consumer surpluses are $\bar{CS} = 1/8 < CS^* \approx 0.558$.