universität wien

MASTERARBEIT / MASTER'S THESIS

Titel der Masterarbeit / Title of the Master's Thesis

„Segment reporting under competition“

verfasst von / submitted by

Elisabeth Leeb, BA

angestrebter akademischer Grad / in partial fulfilment of the requirements for the degree of

Master of Science (MSc)

Wien, 2022 / Vienna 2022

Studienkennzahl lt. Studienblatt / degree programme code as it appears on the student record sheet:	UA 066 914
Studienrichtung lt. Studienblatt / degree programme as it appears on the student record sheet:	Masterstudium Internationale Betriebswirtschaft UG2002
Betreut von / Supervisor:	Univ.-Prof. Dr. Thomas Pfeiffer

Table of contents

List of figures

List of tables

List of abbreviations

FASB	Financial Accounting Standards Board
IAS	International Accounting Standards
IASB	International Accounting Standards Board
IFRS	International Financial Reporting Standards
SFAS	Statement of Financial Accounting Standards
VHB	German Academic Association of Business Research

List of symbols

A	subscript for aggregated disclosure
a_i	demand intercept in market i
C	superscript for competitor
CS	Consumer Surplus
D	subscript for disaggregated disclosure
k	marginal production costs
M	superscript for monopoly
P_i	product price in market i
q_i	quantity produced by the incumbent firm in market i
q_i^C	quantity produced by the competitor in market i
t	time
W	Welfare
y	report produced by the internal accounting system of the incumbent firm
y_{D_i}	disaggregated report for market i
δ	deviation of the demand intercept
γ	parameter of the productivity advantage
π_i	profit of the incumbent firm in market i
$\pi_{A_{[\underline{\gamma},\hat{\gamma}]}}$	total profit of the incumbent firm under aggregated reporting when $\gamma \in [\underline{\gamma}, \hat{\gamma}]$
$\pi_{A_{[\hat{\gamma},\overline{\gamma}]}}$	total profit of the incumbent firm under aggregated reporting when $\gamma \in [\hat{\gamma}, \overline{\gamma}]$

$\pi^{C}_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ profit of the competitor in market 2 under aggregated reporting when $\gamma \in [\underline{\gamma},\hat{\gamma}]$

$\pi^{C}_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ profit of the competitor in market 2 under aggregated reporting when $\gamma \in [\hat{\gamma},\overline{\gamma}]$

1. Introduction

Firms use financial reporting and disclosure as an essential instrument to inform external investors about their performance and governance (Haley and Palepu, 2001, p.406). This information helps investors and other external parties to make a finer evaluation of a company's expected performance in the future and consequently, facilitate decision-making (Königsgruber et al., 2021, p.3). Firms that operate in multiple segments face the decision of which segment details to disclose via segment reports (André et al., 2016, p.1). Segment reporting is the disclosure of financial and non-financial information of a segment within a company (Alvarez, 2004, p.1). Segments are defined as legal and economic units of a company (Wiederhold, 2008, p.1). Details from segment reports are of utmost importance to financial statement users (Berger and Hann, 2003, p.164). The results of Epstein and Palepu's (1999) survey of sell-side analysts show that segment details are the most helpful financial information for making investment decisions. Segment reports present valuable supplementary details beyond corporate-level disclosures by exposing details of a company's diversification strategy as well as its different sources of operating performance (Königsgruber et al., 2021, p.3). Although segment details come with certain benefits for a variety of parties, many firms are hesitant or only unwillingly provide segment details (Ettredge et al., 2002, p.107). Disaggregated reporting refers to the separate reporting of segment information. Therefore, in the thesis the term "disaggregated reporting" is used as a synonym for segment reporting. Whereas the disclosure of segment information in an aggregated way is called aggregated reporting.

In the theoretical and empirical literature motives to conceal and disclose segment information can be found. When looking at the firms' point of view, it can be noticed that they face certain kinds of trade-offs when deciding whether to disclose or not (Wang et al., 2011, p.383). On the one side, segment disclosure imposes proprietary costs (e.g., Suijs and Wielhouwer, 2014; Ettredge et al., 2002; Ali et al., 2014; Wang et al., 2011; Ettredge et al., 2006; Muiño and Núñez-Nickel, 2016; Bens et al., 2011; Königsgruber et al., 2021) and agency costs on firms (e.g., Muiño and Núñez-Nickel, 2016; Berger and Hann, 2007; Bens et al., 2011; Wang et al., 2011), on the other side firms would benefit from lower cost of equity (Blanco et al., 2015, p.369) and external capital (e.g., Ettredge et al., 2006; Wang et al., 2011) as segment disclosure reduces the information asymmetry (Wang et al. 2011, p.391). Furthermore, disclosure can reveal unsolved agency problems (Murakami and Shiiba, 2021, p.2), but would at the same time facilitate monitoring (Muiño and Núñez-Nickel, 2016, p.325). Another aspect that supports disclosure is that analyst following enhances the firm's profitability (Arya and Mittendorf, 2007, p.321). The decision to disclose also depends on the type of competition (Königsgruber et al., 2021). The threat of potential competition reduces the firm's desire to disclose (Königsgruber et al., 2021; Tsakumis et al., 2006), whereas existing competition could be an incentive to disclose segment information (Königsgruber et al., 2021, p.19). Additionally, firms can benefit from their competitors' disclosure as it reduces the net proprietary costs (Berger and Hann, 2007, p.873).

Regarding the influence of segment disclosure on external parties, it is clearly observable that external parties are in favour of segment disclosure as they can only benefit from the disclosure of segment information. Although competition and the bargaining power of suppliers and consumers increase with segment disclosure (Ettredge et al., 2002, p.107), which is unfavourable from the firms' point of view, these circumstances would result in better-fitted products and lower prices for consumers (Arya et al., 2013, p.493; Arya and Mittendorf, 2007, p.321). In addition, it is important to mention that segment disclosure generates higher consumer surplus and total welfare (Suijs and Wielhouwer, 2014). Furthermore, external parties, like investors, creditors and analysts, gain information that improves their assessment of the firm's performance (Franco et al., 2016). Capital allocation, the estimation of future earnings and cashflows improve with segment reporting (Blanco et al., 2015, p.371).

The transparency that results from segment disclosure can be beneficial for the firms themselves and external parties. However, it is essential to keep in mind that from the firms' point of view segment reporting can also be harmful. Regulators should consider these factors when setting and evaluating those standards.

Regulations of segment reporting

Not all firms can decide if they want to reveal their segment information; some are obligated by regulations to do so (FASB, 1997, para.9). The most important international regulations regarding segment reporting are Statement of Financial Accounting Standards (SFAS) 131 and International Financial Reporting Standards (IFRS) 8. SFAS 131 affects publicly traded companies (FASB, 1997, para.9). SFAS 131 “Disclosures about Segments of an Enterprise and Related Information” was introduced in 1997 by the U.S. Financial Accounting Standards Board (FASB) and superseded SFAS 14 “Financial Reporting for Segments of a Business Enterprise” (Botosan and Stanford, 2005, p.752). The change from SFAS 14 to SFAS 131 meant the replacement of the industry approach with the management approach (Franzen and Weißenberger, 2018, p.2). The management approach requires firms to disclose segment information in the same manner the information is generated and used internally (FASB, 1997, para.4) instead of disclosing it by industry segments (FASB, 1976, para.10). Furthermore, under SFAS 131 segment details are disclosed by operating segments whereas under SFAS 14 they were disclosed by industry and geographic segments (Herrmann and Thomas, 2000, p.2). Operating segments are defined as components of an enterprise that fulfil the following requirements: (a) engage in business activities earning revenues and incurring expenses, (b) are regularly reviewed by management, and (c) for which discrete financial information is available (FASB, 1997, para.10). The objectives of SFAS 131 are “to help users of financial statements: (a) better understand the enterprise’s performance, (b) better assess its prospects for future net cash flows, and (c) make more informed judgments about the enterprise as a whole’’ (FASB, 1997, para.3).

IFRS 8 “Operating Segments” was issued in 2006 by the International Accounting Standards Board (IASB) and superseded International Accounting Standards (IAS) 14 “Segment Reporting” (IFRS, 2022). IFRS 8 is the result of a convergence project of the IASB and the FASB with the aim of assimilating the two standards (Deloitte, 2006). SFAS 131 and IFRS 8 only differ in some minor aspects (Deloitte, 2006). In the case of IFRS 8, the transition from IAS 14 was not as big as from SFAS 14 to SFAS 131, as IAS 14 already applied a modified management approach (Franzen and Weißenberger, 2018, p.4). In general, the IASB and the FASB expected several benefits from the changes of standards (IFRS 2012; Berger and Hann, 2003, pp.167-168). Several studies showed that after the implementation of the management approach firms disclosed more segments and more segment information and therefore, the regulations achieved one of its objectives, to enhance transparency (e.g., Berger and Hann, 2003; Botosan and Stanford, 2005; Cho, 2015; Ettredge et al., 2006; Wang et al., 2011). Ettredge et al. (2006, p.116) argue that although the new regulation induced firms to disclose more about segment profitability, it still allowed firms to withhold competitively harmful information about segment profitability to some extent. Berger and Hann's (2003, p.167) results provide empirical evidence that the new regulation grants a detailed insight into the management strategy of companies. However, the management approach comes at the expense of less comparability across firms (Hund et al., 2010, p.480). This is due to the fact that segment reports are more individualized under the management approach (Berger and Hann, 2003, p.167). Furthermore, external parties are concerned about the discretion that the management approach provides for firms to still withhold certain information (Mande and Ortman, 2002, p.34). Although the new standards do not fully prevent firms from aggregating segment data, they present less possibility to aggregate segment data discretionarily in comparison to the former standards (Berger and Hann, 2007, p.877). But, the enforcement of segment disclosure could encourage firms to alter their approach to do business in order to keep their competitive position (Ettredge et al., 2002, p.108). Not only could their way of doing business change, furthermore, it affects their preference for internal information systems (Schneider and Scholze, 2015, p.1369).

The objective of this thesis is two-folded. First, it should provide a review of the theoretical and empirical literature on segment reporting. Second, a simple theory model should demonstrate implications of segment reporting under competition. The simple theory model deals with the question which reporting system, disaggregated or aggregated reporting, is preferred by the firm when it faces the potential entry of a competitor. The management approach is applied in the model, therefore, all information gathered internally will be at the disposal of the competitor. This fact is significant when choosing a reporting system. The analysis of the model is structured in three sections. First, a benchmark case is established where no competitor is present. Then, the firm faces a potential competitor in the duopoly. Furthermore, implications for consumer surplus and total welfare are derived. The results of the model show that in the monopoly the firm prefers disaggregated over aggregated reporting, as higher profits can be obtained under disaggregated reporting. Whereas in the duopoly aggregation is beneficial for the firm under certain conditions. This is contrary to the claim that firms always benefit from more information. The results concerning welfare demonstrate that disaggregated reporting yields higher consumer surplus and higher total welfare in both settings, the monopoly and the duopoly. This shows that transparency is more beneficial for welfare.

This thesis is structured as followed: In chapter 2 recent theoretical and empirical literature is reviewed. Chapter 3 explains the model. Subsequently, chapter 4 includes the results of the analysis in the monopoly and duopoly setting, and the implications on consumer surplus and total welfare. Finally, the last chapter provides a summary and concluding remarks.

2. Review of theoretical and empirical literature

To limit the review of theoretical and empirical literature, two criteria are applied to select the relevant literature. First, only articles which fall in the publication date of 2000-2022 are included. Second, only articles from journals rated with A+, A and B by the German Academic Association of Business Research (VHB) for the sub-discipline Accounting are considered.

Most of the empirical articles in this chapter deal with SFAS 131 rather than IFRS 8 or other standards.

According to Fields et al. (2001, p.292) firms have reasons to disclose as well as to withhold data. Therefore, the chapter will be divided in incentives to conceal and incentives to reveal.

2.1. Incentives to conceal

This subchapter deals with the incentives to conceal segment information. The most stated incentives in the literature are competitive harm, proprietary costs and agency costs.

2.1.1. Competitive harm and proprietary costs

One of the main reasons for firms to conceal information are proprietary costs (Suijs and Wielhouwer, 2014, p.227) and competitive harm (Ettredge et al., 2002, p.107). Ettredge et al. (2002) who evaluate companies' responses to the exposure draft of SFAS 131 found that 86% of the companies believe that the disclosures under SFAS 131 would expose proprietary information. Proprietary costs are the costs that arise with the disclosing of abnormal segment profits and subsequently lead to more competition and thus, a decrease in abnormal profits (Berger and Hann, 2007, p.869). Proprietary costs of a firm's disclosure are positively correlated with the utility of the data disclosed (Ali et al., 2014, p.242). The more useful the data disclosed, the higher the costs and the greater the potential damage to the firm through the competitor (Ali et al., 2014, p.242). The firm's rivals might use the information to copy the firm's strategy or to enter the segment's market (e.g., Berger and Hann, 2007, p.873; Arya et al., 2019, p.758). Several studies show that proprietary costs are indeed a factor considered by firms to conceal information (e.g., Wang et al., 2011; Ettredge et al., 2006; Muiño and Núñez-Nickel, 2016; Bens et al., 2011; Königsgruber et al., 2021). Wang et al. (2011) provide empirical evidence that proprietary costs are one motive to withhold segment information. They examine firms' incentives to conceal information about their segments' earning growth rates. This information is essential to investors and competitors, as competitors can use this information to make strategic decisions (Wang et al., 2011, pp.384-385). Firms with high proprietary costs are afraid that the segment disclosure of high earning growth could increase damaging competition (Wang et al., 2011, p.391). Furthermore, Ettredge et al. (2006) examine the disclosure of segment profits of multiple-segment firms pre- and post-SFAS 131. They confirm that hiding segments' profits is related to proprietary costs (Ettredge et al., 2006, p.116). Muiño and Núñez-Nickel (2016) analyse the relationship between corporate disclosure and the different competition dimensions. They differentiate between firm- and industry-level measures of competition. Concerning firm-level competition measures they identify proprietary costs as the reason that firms hide information about segments with high abnormal profits (Muiño and Núñez-Nickel, 2016, p.325). Bens et al. (2011) use data of private and public companies to investigate the reasons for firms' preference of aggregated over disaggregated segment reporting. They find that proprietary costs have a crucial role in the segment disclosure choices of multi-segment firms (Bens et al., 2011, p.447). Königsgruber et al. (2021) examine the effects of different types of product market competition on firms' disclosure of their segment performance. They investigate potential and existing competition. An increase of potential competition is an incentive to conceal segment performance. The disclosure would be accompanied by higher proprietary costs because the possibility of a market entry of competitors grows (Königsgruber et al., 2021, p.19). Also, Ali et al. (2014) who study both private held and publicly traded companies conclude that the concentration of an industry is a factor that impacts disclosure. They consider different disclosure settings, and their results show that companies in higher concentrated industries reveal less information. Tsakumis et al. (2006) look at geographic segment disclosure of firms and find that potential competitive harm affects the firms' disclosure. High potential competitive harm reduces the quality of information related to a geographic area in order to protect the firms' competitive edge.

In addition to the empirical literature, also the theoretical literature discusses competition as one of the incentives to conceal segment information. Arya et al. (2013) develop a model to investigate the consequences of mandatory and voluntary compliance (aggregation of segments) of segment regulations in the short and in the long run. In the short run, they find that mandatory compliance improves transparency and is favourable for social welfare. The disclosure of segment information serves consumers as competition increases. Therefore, the firms attempt to keep segment details private in order to prevent losing their competitive position. In the long run, mandatory compliance results in a cutback of investment, as it constrains the firms' competitive edge. This suppresses competition and leads to inefficiency in the market. Therefore, in the long-run, voluntary compliance could be beneficial for the firm, the competitors and the consumers (Arya et al., 2013, p.489, p.497). Furthermore, Arya et al. (2013) argue that firms may exercise other harmful practices to keep their competitive edge if discretion in reporting is not possible. Also, Schneider and Scholze (2015) look at the interplay between the production of internal segment details and mandatory disclosure. They establish a model with Cournot competition and cost uncertainty. Their findings imply that firms prefer to be unaware of complete segment information for two motives. The firm has either a large or a small cost advantage over the competitor. If it is large, aggregated reporting can inhibit the competitor's market entry. If it is small, the firm still prefers aggregated information even if it enhances the attractiveness of market entry. In this situation the rival is aware of his efficiency disadvantage and thus, the intensity of competition will be lowered (Schneider and Scholze, 2015, p.1369). Furthermore, they expand their model by considering the quality of the information system. They find that the firm opts for the information system with less precision and an aggregated reporting system. With these two conditions the firm can maximize its profits (Schneider und Scholze, 2015, p.1369).

2.1.2. Agency costs

Although most papers focus on proprietary costs as the main reason to withhold information, agency costs are another crucial factor to consider (Muiño and Núñez-Nickel, 2016, p.300). Agency costs are related to low abnormal profits that expose unsettled agency problems (e.g., Berger and Hann, 2007, p.871; Bens et al., 2011, p.447; Muiño and Núñez-Nickel, 2016, p.325) and therefore, increase external monitoring (Berger and Hann, 2007, p.871). Hence, segment aggregation is performed as a consequence of conflicts of interests between managers and shareholders (Berger and Hann, 2007, p.870). Wang et al. (2011, p.391) show that besides proprietary costs, agency costs are also motives to withhold information about earning growth rates. Additionally, they argue that managers who exploit higher agency costs to engage in empire-building are more likely to withhold segment differences in growth. This can be explained by the fact that increased disclosure reduces the agency problem via intensified external monitoring (Murakami and Shiiba, 2021, p.2). Also, Blanco et al. (2015, p.402) mention empire-building strategies by managers as a reason to not disclose segment data, even if this means larger cost of capital and doing so at the expense of firm value maximization.

2.1.3. Other factors

Ettredge et al. (2002, p.107) who analysed firms' responses to the exposure draft of SFAS 131 find that firms regarded the potential gain of bargaining power of customers and suppliers as an additional risk of the new requirements in disclosure. Since the new disclosure would disclose delicate profit information to customers and suppliers. Arya et al. (2019) establish a model in which they do not only consider competition but also the presence of suppliers in the market. Generally, they find that the presence of suppliers does not mitigate the conflicts between the firm and a competitor, but it does have a significant impact on the conflicts. More specifically, they show that the greater the firm relies on suppliers with pricing power, the less the firm is likely to disclose (Arya et al., 2019, p.760).

2.2. Incentives to reveal

This subchapter elaborates on the incentives to reveal segment information. First, the incentives from the firms' point of view, like lower cost of capital, improved capital allocation and information gain, are discussed. Then, the incentives from the point of view of external parties, like investors, creditors, analysts, suppliers and consumers, are examined.

2.2.1. The firms' point of view

It seems that firms have only reasons to conceal segment information, but the revelation of segment information to third parties can also be beneficial to the firm (Muiño and Núñez-Nickel 2016, p.301). For example, Blanco et al. (2015) investigate the effects of disclosure on cost of capital. They find that firms who provide enhanced disclosure benefit from lower cost of equity capital (Blanco et al., 2015, p.369). However, they provide empirical evidence that the benefit of segment disclosure regarding lower cost of capital is reduced by the presence of competitors (Blanco et al., 2015, p.402). Some studies also prove that there is a connection between the disclosure of segments' profits and external financing (e.g., Ettredge et al., 2006; Wang et al., 2011). Wang et al. (2011, p.384) find that firms which operate in an industry with entry barriers are more likely to disclose earning growth variability. Moreover, they demonstrate the same for companies that are more dependent on external financing. This could be due to the desire to decrease information asymmetry and consequently, lower cost of external capital (Wang et al. 2011, p.391). Cho (2015) investigates the relationship between segment disclosure and internal capital market efficiency. He discovers that capital allocation efficiency improved after the adoption of SFAS 131 (Cho, 2015, p.716). Overall, lower external capital results from the opportunity of investors and financial analysts to observe a firm's activities more precisely and with reduced costs (Blanco et al., 2015, p.371). Consequently, investors are more prone to grant lower returns on capital loans and this results in the reduction of the firm's cost of capital (Blanco et al., 2015, p.371).

As already mentioned above, there are several studies that investigate the connection of the firm's preference of its disclosure policy and competition. Depending on the type of competition, disclosure could be favourable for the firm. Königsberger et al. (2021, p.19) who examine the differences in disclosure policy and the type of competition find that an increase of existing competition favours disclosure as abnormal profits are less likely and proprietary costs shrink. Moreover, analyst following can have an impact on a firm's disclosure decision (Arya and Mittendorf, 2007). Analyst following refers to financial analysts tracking firms' information, like financial reports, in order to provide forecasts and analyses for external parties, like investors (Yu, 2010, p.1). Arya and Mittendorf (2007, p.321) examine the influence of analyst following on the firms' disclosure policy. They show that, although competition could be a reason not to disclose, when competition is not that fierce analyst following can be the reason for mutual disclosure of the incumbent firm and the competitor (Arya and Mittendorf, 2007, p.323). A benefit of analyst following is that it can enhance firm profitability (Arya and Mittendorf, 2007, p.333). Muiño and Núñez-Nickel (2016, p.323) who analyse firm-level and industry-level competition measures, find that industry-level competition measures encourage firms to disclose segment information to better monitor managers in high profit industries and to prevent competitors from entering the market in low profit industries. However, both factors are influenced by the level of entry barriers (Muiño and Núñez-Nickel 2016, p.325). Arya et al. (2019, p.758) show with their model that integrates competition and suppliers that low intra-industry correlation in demand and little dependence of the firm on suppliers supports disclosure.

Another important incentive for firms to reveal their segment information could be the information gain from their competitors' disclosure. Firms are reluctant to recognize that they in fact could also benefit from the disclosure of their rivals (Ettredge et al., 2006, p.94). Berger and Hann (2007, p.873) argue that increased mandatory disclosure comes with a lower probability of placing net proprietary costs on a company. That is attributable to the trade-off between the benefit from the competitor's disclosure and the impairment of its own disclosure. In the analysis of the responses to the exposure draft of SFAS 131 Ettredge et al. (2002) show that public firms are afraid to lose their competitive position as they are forced to provide more segment information than private firms or rivals from abroad. In fact, Muiño and Núñez-Nickel (2016, pp.303-304) find that if all firms are required to reveal the same amount of information, every firm is informed about their competitors in a comparable way. But, if there exists a high number of firms in an industry that are more flexible in their disclosure requirements, e.g., private companies, the benefit is not equal. Such firms exploit their favourable situation because they can benefit from the disclosed data by public companies while at the same time keeping the information of their performance to themselves (Muiño and Núñez-Nickel, 2016, pp.303-304).

2.2.2. External parties' point of view

The segment disclosure of firms provides a series of benefits especially to external parties. The assessment of the firm's performance by investors, creditors and analysts is facilitated by the additional information accompanied by segment disclosure (Franco et al., 2016). Investors are able to take improved decisions about capital allocation. Furthermore, segment details help to estimate future earnings and cashflows in a better manner (Blanco et al., 2015, p.371). Berger and Hann (2003, p.212) also find that segment disclosure affects the monitoring of the firm in a positive way.

Another important aspect of segment disclosure is the benefit to social welfare and consumers. Although the enhanced bargaining power of customers and suppliers and the potential competitive harm could be very costly for the firm, social welfare would clearly benefit from these circumstances (Ettredge et al., 2002, p.107). Arya et al. (2013, p.488) demonstrate in their model that in the short run, mandatory compliance improves transparency and is favourable for social welfare. The disclosure of segment information encourages increasing competition and in addition, favours consumers. Consumers benefit from the firms' transparency as it induces lower prices from the improved approximation of production and demand (Arya et al., 2013, p.493). Likewise, Arya and Mittendorf (2007, p.321) show in their model that mutual disclosure, i.e., disclosure of the firm and the competitor, does not only benefit the firm, but is also favourable for consumers as better-fitted products can be created. Suijs and Wielhouwer (2014) take a look at disclosure and the effects on social welfare in their model. They analyse the effects considering the type of competition (Cournot or Bertrand) and the type of uncertainty (cost or demand) (Suijs and Wielhouwer, 2014, p.229, p.238). Specifically, they examine when social welfare dominates proprietary costs. The results show that mandatory disclosure can be socially beneficial. On the one hand, when welfare exceeds proprietary costs and on the other hand, when it settles the prisoners' dilemma that companies are confronted with. In Cournot and Bertrand competition the results differ depending on whether consumer surplus or total surplus are maximised. In Cournot competition, disclosure is more often beneficial when consumer surplus is maximised, whereas in Bertrand competition, it is more often beneficial when total surplus is maximised (Suijs and Wielhouwer, 2014, p.228). Furthermore, Suijs and Wielhouwer (2014, p.229) argue that setters of accounting standards should also consider the changes in the product market, as disclosure regulations could have an impact on firm supply and the prices imposed on products and thus, in turn may have an influence on consumers.

3. The model

The model in this thesis is based on the models from Arya et al. (2013) and Schneider and Scholze (2015). In both models the consumer demand is represented by a linear, downward-sloping inverse demand function. Furthermore, in both models the firms compete over quantities (Cournot competition) and the incumbent firm operates in two markets. They differ in that in Arya et al. (2013) the competitor is always present in both markets and in Schneider and Scholze (2015) the incumbent firm is a monopolist in market 1 and faces the threat of a potential entry of a competitor in market 2. Furthermore, in Arya et al. (2013) the demand is uncertain whereas in Schneider and Scholze (2015) the costs are uncertain.

3.1. Setup

A firm operates in two markets $i \in \{1, 2\}$. In market 1 the firm acts as a monopolist and in market 2 the firm faces a potential Cournot competitor C. The demand in market *i* (from the firm's point of view) is represented by a linear, downward-sloping, inverse demand function $P_i = a_i - q_i - q_i^C$. Where P_i is the product price, a_i represents the demand intercept, q_i is the quantity produced by the firm and q_i^C is the quantity produced by the competitor. In the rest of the model the superscript C denotes the competitor. The demand intercept $a_i \in \{a + \delta,\ a - \delta\}$ is stochastic and can either be labelled as "high", $a + \delta$, or "low", $a - \delta$. Each realization is independently and identically distributed and has the probability of $\frac{1}{2}$.

The firms' expected profit functions in market *i* are:

$$\pi_i = q_i\big(E[\tilde{a}_i] - q_i - q_i^C\big) - k\, q_i \tag{1}$$

$$\pi_i^C = q_i^C\big(E[\tilde{a}_i] - q_i^C - q_i\big) - \gamma k\, q_i^C. \tag{2}$$

Where π_i is the profit of the incumbent firm in market i, π_i^C is the profit of the competitor in market i and k are marginal production costs. $\gamma > 1$ represents the cost advantage of the incumbent firm due to high production efficiency in both markets. In other words, the competitor faces higher marginal production costs than the incumbent firm. A higher value of γ implies greater efficiency of the incumbent firm. The marginal production costs of the competitor increase with γ.

3.2. Information systems

The firm discloses information on the demand intercept with a report $y \in \{y_{D_i}, y_A\}$ produced by the internal accounting system of the incumbent firm. The report is assumed to be truthful. The choice of information system is a delicate one as the firm has to keep in mind that all the information gained by the internal accounting system will also be at the disposal of the competitor. The firm can choose either a disaggregated or an aggregated information system. In the **disaggregated** information system, the firm reveals $\tilde{a}_1$ and $\tilde{a}_2$ separately with $y_{D_i} \in \{a+\delta,\ a-\delta\}$. It can either reveal a_i is high, $(a+\delta)$ or a_i is low, $(a-\delta)$. In the **aggregated** information system, the firm reveals the sum of the demand intercepts $\tilde{a}_1 + \tilde{a}_2$ with $y_A \in \{2\,(a+\delta),\ 2\,(a-\delta),\ 2a\}$. It can reveal 3 possible signals:

- $\tilde{a}_1 + \tilde{a}_2 = 2\,(a+\delta)$
- $\tilde{a}_1 + \tilde{a}_2 = 2\,(a-\delta)$ or
- $\tilde{a}_1 + \tilde{a}_2 = (a+\delta) + (a-\delta) = 2a$.

$\tilde{a}_1 + \tilde{a}_2 = 2\,(a+\delta)$ means that a_i is high in both markets. $\tilde{a}_1 + \tilde{a}_2 = 2\,(a-\delta)$ would imply that a_i is low in both markets. $\tilde{a}_1 + \tilde{a}_2 = (a+\delta) + (a-\delta) = 2a$ would refer to the case when a_i is high in one market and low in the other one. When $2\,(a+\delta)$ or $2\,(a-\delta)$ is reported the real value of the demand intercept in each market can be concluded. However, this is not applicable when $2a$ is reported. Then it remains unclear which of the two market segments' demand intercepts is high and which is low.

3.3. Timeline

The timeline is adopted from Schneider and Scholze (2015). In $t = 0$ the reporting structure is chosen by the manager of the firm. In $t = 1$ the report $y \in \{y_{D_i}, y_A\}$ on the demand intercept is obtained by the manager of the firm and the manager of the competitor. Furthermore, the competitor decides whether to enter market 2. Finally, in $t = 2$ the firm and the competitor make production decisions and their profits are realized.

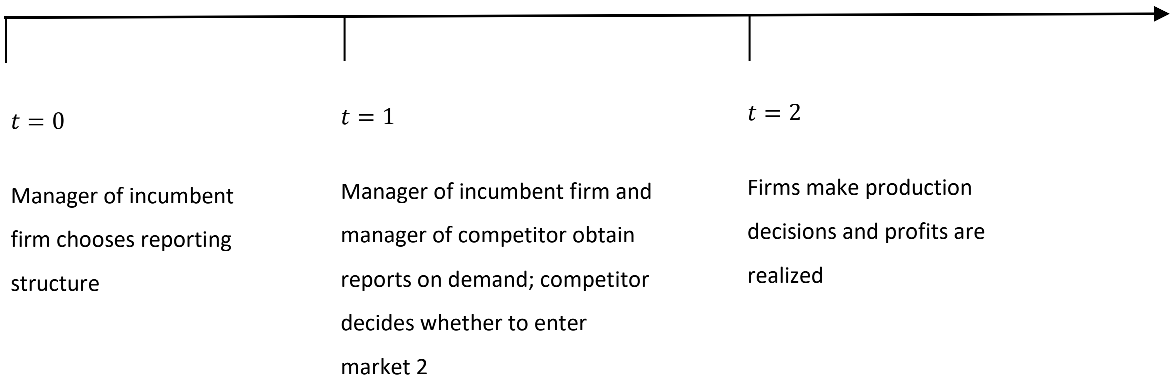

Figure 1: Timeline of the model **Adapted from Schneider and Scholze, 2015, p.1358**

4. Results

4.1. Monopoly

In the monopoly there is no potential competitor that enters market 2. Therefore, the profits in market 1 and market 2 are identical. The firm selects the production quantity that maximizes its profits. To distinguish the monopoly and the duopoly setting, the superscript M is used to denote the monopoly setting.

ASSUMPTION 1. *The incumbent firm always covers both markets. Thus, even in the bad state, the incumbent firm is profitable in both markets, i.e.,* $a - \delta > k$. *Furthermore,* $0 < \delta < a$ *must be fulfilled so that the firm does not operate a loss.*

The firm optimizes its expected profit from (1)

$$\pi_i^M = q_i^M(E[\tilde{a}_i] - q_i^M - k),$$

because $q_i^C = 0$, as in the monopoly the firm faces no competitor. By solving the first-order condition of the firm's profit function (1) for the quantities q_i^M, the equilibrium quantities are obtained that are produced in the monopoly in each market i:

$$\frac{\partial \pi_i^M}{\partial q_i^M} = 0 \quad \Rightarrow \quad E[\tilde{a}_i] - 2q_i^M - k = 0 \quad \Rightarrow \quad q_i^M = \frac{1}{2}\,(E[\tilde{a}_i] - k). \tag{3}$$

The equilibrium quantities in the monopoly increase in $E[\tilde{a}_i]$ and decrease in k. The choice of the reporting system is important to the firm as the production decision depends on the reporting system. By substituting the equilibrium quantities from (3) in (1), the expected profits in both information systems are obtained.

In the **disaggregated** information system, the good state, i.e., $y_{D_i} = a + \delta$ and the bad state, i.e., $y_{D_i} = a - \delta$, occur each with a probability of $\frac{1}{2}$. Hence, the firm's expected profit in market *i* under disaggregated reporting equals

$$\pi_{i,D}^M = \frac{1}{2}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4}\,. \tag{4}$$

In the **aggregated** information system, the good state, i.e., $y_A = 2\,(a + \delta)$ and the bad state, i.e., $y_A = 2\,(a - \delta)$, occur with a probability of $\frac{1}{4}$. The third possibility, a good state in one market segment and a bad state in the other, i.e., $y_A = 2a$, occurs with a probability of $\frac{1}{2}$. Consequently, the firm's expected profit in market *i* yields

$$\pi_{i,A}^M = \frac{1}{4}\;\frac{(a+\delta-k)^2}{4} + \frac{1}{4}\;\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\;\frac{(a-k)^2}{4}. \tag{5}$$

By adding up the incumbent firm's profit $\pi_{\mathrm{i,D}}$ of market 1 and market 2, it can be seen that the total profit under **disaggregated** reporting yields

$$\pi_D^M = \pi_{1,D}^M + \pi_{2,D}^M = 2\left(\frac{1}{2}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4}\right)$$

$$\Rightarrow \pi_D^M = \frac{(a+\delta-k)^2}{4} + \frac{(a-\delta-k)^2}{4}. \tag{6}$$

Similarly, by adding up the incumbent firm's profit $\pi_{i,A}$ of market 1 and market 2, the total profit under **aggregated** reporting is obtained:

$$\pi_A^M = \pi_{1,A}^M + \pi_{2,A}^M = 2\left(\frac{1}{4}\;\frac{(a+\delta-k)^2}{4} + \frac{1}{4}\;\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\;\frac{(a-k)^2}{4}\right)$$

$$\Rightarrow \pi_A^M = \frac{(a+\delta-k)^2}{8} + \frac{(a-\delta-k)^2}{8} + \frac{(a-k)^2}{4}. \tag{7}$$

When having a look on the profit functions (4) and (5), and (6) and (7) under each reporting system, it can be noticed that due to the probabilities in each case the information under disaggregated reporting is more precise than under aggregated reporting. In both reporting systems the profits increase in a and decrease in k.

To proof that the firm prefers the disaggregated over the aggregated reporting system it is necessary to compare π_D^M and π_A^M:[1]

$$\pi_D^M > \pi_A^M \tag{8}$$

$$\Leftrightarrow 2\left(\frac{1}{2}\frac{(a+\delta-k)^2}{4}+\frac{1}{2}\frac{(a-\delta-k)^2}{4}\right) > 2\left(\frac{1}{4}\ \frac{(a+\delta-k)^2}{4}+\frac{1}{4}\ \frac{(a-\delta-k)^2}{4}+\frac{1}{2}\ \frac{(a-k)^2}{4}\right)$$

$$\Leftrightarrow 2\delta^2 > 0$$

Comparing the expected profits shows that $\pi_{i,D}^M > \pi_{i,A}^M$ for all $\delta > 0$. Consequently, that means that the disaggregated reporting system yields higher profits for the incumbent firm. This holds always because δ^2 is always positive. Only for $\delta = 0$ the profits of both information systems are the same and therefore, the choice of the reporting system would not matter.

PROPOSITION 1. *In the monopoly the incumbent firm prefers the disaggregated information system.*

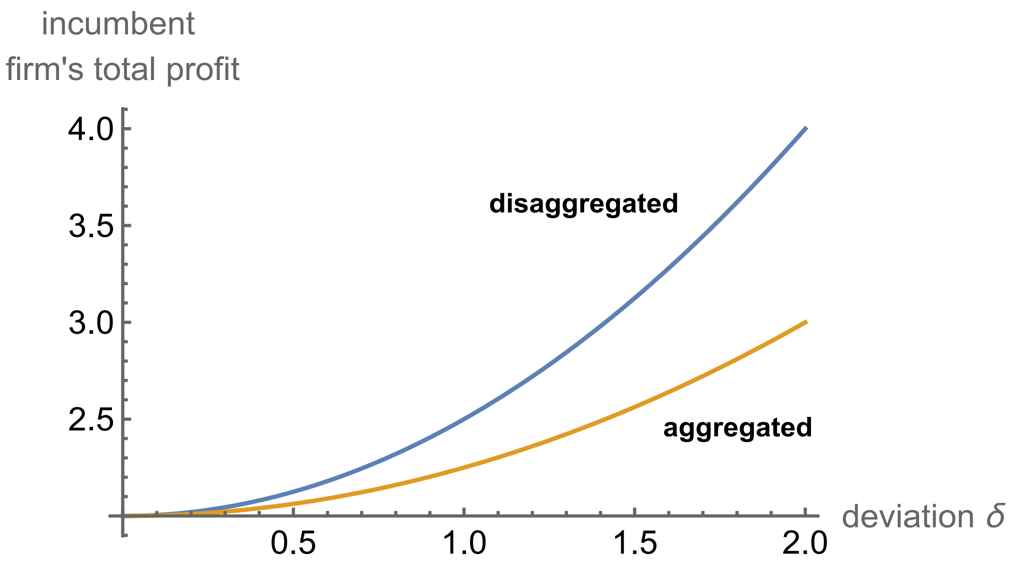

Figure 2: Monopoly – total profit - disaggregated vs. aggregated reporting, a=3, k=1. The incumbent firm secures higher total profit under disaggregated reporting than under aggregated reporting. Furthermore, the total profit of the incumbent increases in δ and the firm gains more from higher δ-values.

[1] The whole proof is shown in the appendix. This applies to all proofs in this thesis.

Figure 2 shows the incumbent firm's total profit under both information systems for different values of δ. It is observable that the total profit of the incumbent firm increases in δ. In addition, the graph represents the fact that the firm gains more from higher δ-values.

PROPOSITION 2. *In the monopoly the incumbent firm's profits increase in δ.*

In equilibrium, a monopolist will always choose disaggregated reporting according to Proposition 1. Thus, to verify Proposition 2, it is necessary to look at the first derivative of π_D^M with respect to δ.

$$\pi_D^M = \frac{(a+\delta-\mathrm{k})^2}{4} + \frac{(a-\delta-\mathrm{k})^2}{4}$$

$$\frac{\partial \pi_D^M}{\partial \delta} = \frac{2a+2\delta-2\mathrm{k}-2a+2\delta+2\mathrm{k}}{4} = \delta > 0 \tag{9}$$

Hence, in the monopoly, the profit under disaggregated reporting increases in δ, the deviation of the demand intercept.

To summarize, the firm prefers the disaggregated information system in the monopoly as it provides more precise information than the aggregated information system.

4.2. Duopoly

In the duopoly, the firm faces a potential competitor in market 2. In market 1, the incumbent firm always acts as a monopolist and produces the equilibrium quantities from (3)

$$q_1 = \frac{1}{2}\,(E[\tilde{a}_1] - k) \tag{10}$$

and realizes the expected profits (4) and (5) depending on the information system.

Therefore, the expected profits of the incumbent firm in market 1 under **disaggregated** reporting equal

$$\pi_{1,\mathrm{D}} = \frac{1}{2}\frac{(a+\delta-\mathrm{k})^2}{4} + \frac{1}{2}\frac{(a-\delta-\mathrm{k})^2}{4}. \tag{11}$$

Under **aggregated** reporting the incumbent firm yields the following profits in market 1:

$$\pi_{1,\mathrm{A}} = \frac{1}{4}\ \frac{(a+\delta-\mathrm{k})^2}{4} + \frac{1}{4}\ \frac{(a-\delta-\mathrm{k})^2}{4} + \frac{1}{2}\ \frac{(a-\mathrm{k})^2}{4}. \tag{12}$$

In market 2, both parties' expected profits depend on the expected demand intercept $E[\tilde{a}_2]$ which hinges on the report y. More precisely, the incumbent firm and the competitor optimize

$$\pi_2 = q_2(E[\tilde{a}_2] - q_2 - q_2^C - k\ ) \qquad \text{and} \tag{13}$$

$$\pi_2^C = q_2^C(E[\tilde{a}_2] - q_2^C - q_2 - \gamma k). \tag{14}$$

In order to calculate the equilibrium quantities, it is necessary to determine the reaction functions of the incumbent firm and the competitor. The first-order conditions of (13) and (14) yield the reaction functions

$$\frac{\partial \pi_2}{\partial q_2} = 0 \ \Rightarrow \ E[\tilde{a}_2] - 2q_2 - q_2^C - k = 0 \ \Rightarrow \ q_2(q_2^C) = \frac{1}{2}(E[\tilde{a}_2] - q_2^C - k) \qquad \text{and} \tag{15}$$

$$\frac{\partial \pi_2^C}{\partial q_2^C} = 0 \ \Rightarrow \ E[\tilde{a}_2] - 2q_2^C - q_2 - \gamma k = 0 \ \Rightarrow \ q_2^C(q_2) = \frac{1}{2}(E[\tilde{a}_2] - q_2 - \gamma k). \tag{16}$$

Substituting $q_2^C(q_2)$ from (16) in (15), yields the equilibrium quantities for the incumbent firm

$$q_2(q_2^C) = \frac{1}{2}\left[E[\tilde{a}_2] - \frac{1}{2}(E[\tilde{a}_2] - q_2 - \gamma k) - k\right] \tag{17}$$

$$\Rightarrow \ q_2 = \frac{E[\tilde{a}_2] - (2-\gamma)\ k}{3}. \tag{18}$$

Substituting $q_2(q_2^C)$ from (15) in (16), yields the equilibrium quantities for the competitor

$$q_2^C(q_2) = \frac{1}{2}\left[E[\tilde{a}_2] - \frac{1}{2}(E[\tilde{a}_2] - q_2^C - k) - \gamma k\right] \tag{19}$$

$$\Rightarrow \ q_2^C = \frac{E[\tilde{a}_2] - (2\gamma-1)\ k}{3}. \tag{20}$$

The competitor will always enter market 2 if his expected profits are positive. This is the case as long as $q_2^C \geq 0$. Consequently, the competitor will always enter the market if

$$E[\tilde{a}_2] \geq (2\gamma - 1)\ k. \tag{21}$$

To eliminate the case where the competitor always enters market 2, it is assumed that the competitor stays out of the market when the report y indicates a bad state, i.e., $y_{D_2} = (a - \delta)$ or $y_A = 2\,(a - \delta)$, in market 2. Thus, the competitor does not enter the market under a bad signal if

$$a - \delta < (2\gamma - 1)\,k \qquad \Leftrightarrow \qquad \gamma > \frac{1}{2} + \frac{a-\delta}{2k} =: \underline{\gamma}, \tag{22}$$

note that $\underline{\gamma} > 1$ which follows from Assumption 1.

ASSUMPTION 2. *The cost advantage for the incumbent firm is sufficiently high,* $\gamma > \underline{\gamma}$.

Assumption 2 implies that the competitor does not enter the market when the bad state is reported, i.e., $y_{D_2} = (a - \delta)$ or $y_A = 2\,(a - \delta)$. Nevertheless, the competitor might enter the market when the aggregated signal indicates neither a good nor a bad state, but $E[\tilde{a}_2] = a$. For $q_2^C \geq 0$, (20) requires

$$a - (2\gamma - 1)\,k \geq 0 \qquad \Leftrightarrow \qquad \gamma < \frac{1}{2} + \frac{a}{2k} =: \hat{\gamma}, \tag{23}$$

where $1 < \underline{\gamma} < \hat{\gamma}$.

Similarly, when the aggregated signal indicates the good state, i.e., $y_A = 2\,(a + \delta)$, the competitor will enter market 2 if $q_2^C \geq 0$. That is the case if

$$a + \delta - (2\gamma - 1)\,k \geq 0 \qquad \Leftrightarrow \qquad \gamma < \frac{1}{2} + \frac{a+\delta}{2k} =: \overline{\gamma}, \tag{24}$$

where $1 < \underline{\gamma} < \hat{\gamma} < \overline{\gamma}$.

To summarize, the entry decision of the competitor depends on the report y and the production advantage γ. On the one hand, in the **disaggregated** reporting setting, the competitor will enter market 2, if the report indicates the good state, i.e., $y_{D_i} = a + \delta$ and $\gamma \in [\underline{\gamma}, \overline{\gamma}]$. On the other hand, in the **aggregated** reporting setting, the competitor enters if the report signals the good state, $y_A = 2\,(a + \delta)$ and $\gamma \in [\underline{\gamma}, \overline{\gamma}]$, or if the report signals neither the good state nor the bad state, but $y_A = 2a$ and $\gamma \in [\underline{\gamma}, \hat{\gamma}]$. If $y_A = 2a$ and $\gamma > \hat{\gamma}$, the competitor does not enter market 2. In both reporting settings the competitor will not enter market 2 if $\gamma > \overline{\gamma}$. Table 1 shows a summary of the entry decision of the competitor depending on the reporting system, the report y and the production advantage γ.

Reporting system	Report y	Production advantage γ	Entry of competitor
disaggregated	$y_{D_i} = a + \delta$	$\gamma \in [\underline{\gamma}, \overline{\gamma}]$	**YES**
disaggregated	$y_{D_2} = (a - \delta)$		NO
aggregated	$y_A = 2\,(a + \delta)$	$\gamma \in [\underline{\gamma}, \overline{\gamma}]$	**YES**
aggregated	$y_A = 2a$	$\gamma \in [\underline{\gamma}, \hat{\gamma}]$	**YES**
aggregated	$y_A = 2\,(a - \delta)$		NO

Table 1: Entry decision of competitor

4.2.1. Disaggregated reporting

According to Assumption 2 the incumbent firm remains a monopolist in market 2 under disaggregated reporting, when the report y indicates the bad state, i.e., $y_{D_2} = a - \delta$, thus, implying profits of $(a - \delta - \mathrm{k})^2/4$ with a probability of $\frac{1}{2}$. The incumbent firm faces a competitor when the report y indicates the good state, i.e., $y_{D_2} = a + \delta$ and $\gamma \in [\underline{\gamma}, \overline{\gamma}]$. By solving the reaction functions (15) and (16) from above, the equilibrium quantities are obtained

$$q_2 = \frac{a+\delta-(2-\gamma)\,k}{3} \quad \text{and} \tag{25}$$

$$q_2^C = \frac{a+\delta-(2\gamma-1)\,k}{3}. \tag{26}$$

In the case of a good state, i.e., $y_{D_2} = a + \delta$, the incumbent firm produces expected profits of $[a + \delta - (2 - \gamma)k]^2/9$ with a probability of $\frac{1}{2}$. Hence, the incumbent firm's expected profits in market 2 under **disaggregated** reporting yield

$$\pi_{2,D} = \frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-\delta-k)^2}{4}. \tag{27}$$

As the competitor only enters when the good state, i.e., $y_{D_2} = a + \delta$, is reported, he secures the following expected profits in market 2 under **disaggregated** reporting:

$$\pi_{2,D}^{C} = \frac{1}{2}\frac{(a+\delta-(2\gamma-1)\,k)^2}{9} \tag{28}$$

By adding up the profit functions (11) and (27), the total profit of the incumbent firm under **disaggregated** reporting in the duopoly is obtained:

$$\pi_D = \pi_{1,D} + \pi_{2,D} = \frac{1}{2}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-\delta-k)^2}{4}$$

$$\Rightarrow \pi_{\mathrm{D}} = \frac{1}{2}\frac{(a+\delta-\mathrm{k})^2}{4} + \frac{(a-\delta-\mathrm{k})^2}{4} + \frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9}. \tag{29}$$

4.2.2. Aggregated reporting

As in the disaggregated reporting setting, also in the aggregated reporting setting the competitor will not enter market 2 when the information system indicates a bad state, i.e., $y_A = 2\,(a - \delta)$. Hence, the incumbent firm generates profits of $(a - \delta - \mathrm{k})^2/4$ with a probability of $\frac{1}{4}$ when the bad state is reported. When the accounting signal implies the good state, i.e., $y_A = 2\,(a + \delta)$, for all $\gamma \in [\underline{\gamma}, \overline{\gamma}]$, the incumbent firm's profits are the same as described under the duopoly with disaggregated information, i.e., $[a + \delta - (2 - \gamma)k]^2/9$ with a probability of $\frac{1}{4}$. When the report signals neither a good nor a bad state, but $y_A = 2a$ with the expected demand intercept $E[\tilde{a}_2] = a$, the competitor will only enter market 2 if $\gamma \in [\underline{\gamma}, \hat{\gamma}]$. In that case, the reaction functions in (15) and (16) yield equilibrium quantities of

$$q_2 = \frac{a-(2-\gamma)\,k}{3} \quad \text{and} \tag{30}$$

$$q_2^C = \frac{a-(2\gamma-1)\,k}{3}. \tag{31}$$

Consequently, the incumbent firm's generates profits of $[a-(2-\gamma)k]^2/9$ with a probability of $\frac{1}{2}$. Thus, if and only if $\gamma \in [\underline{\gamma}, \hat{\gamma}]$ the incumbent firm's expected profits in market 2 under **aggregated** reporting are

$$\pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}} = \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9}. \quad (32)$$

In the case that γ is too large for the competitor to enter market 2 when $E[\tilde{a}_2] = a$ is reported, i.e., $\gamma > \hat{\gamma}$, the incumbent firm secures profits of $(a-k)^2/4$ with a probability of $\frac{1}{2}$. Hence, if $\gamma \in [\hat{\gamma}, \overline{\gamma}]$ the incumbent's expected profits in market 2 under **aggregated** reporting are

$$\pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}} = \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4}. \quad (33)$$

The competitor's expected profits in market 2 in the aggregated reporting setting also depend on the value of γ and on the report y_A. When the report indicates a good signal, i.e., $y_A = 2\,(a+\delta)$, and $\gamma \in [\hat{\gamma}, \overline{\gamma}]$, the expected profits of the competitor yield

$$\pi^C_{2,A_{[\hat{\gamma},\overline{\gamma}]}} = \frac{1}{4}\frac{(a+\delta-(2\gamma-1)\,k)^2}{9}. \quad (34)$$

But, when the report indicates neither a good nor a bad signal, but $y_A = 2a$ and $\gamma \in [\underline{\gamma}, \hat{\gamma}]$ the competitor's expected profits in market 2 under aggregated reporting yield

$$\pi^C_{2,A_{[\underline{\gamma},\hat{\gamma}]}} = \frac{1}{4}\frac{(a+\delta-(2\gamma-1)\,k)^2}{9} + \frac{1}{2}\frac{(a-(2\gamma-1)\,k)^2}{9} \quad (35)$$

When the incumbent firm chooses disaggregated over aggregated reporting the competitor can gain the following benefit for $\gamma = \underline{\gamma}$:

$$\pi^C_{2,D} - \pi^C_{2,A_{[\underline{\gamma},\hat{\gamma}]}} = \frac{\delta^2}{18}. \quad (36)$$

Whereas when $\gamma = \hat{\gamma}$ the benefit to the competitor yields

$$\pi^C_{2,D} - \pi^C_{2,A} = \frac{\delta^2}{36}. \quad (37)$$

When $\gamma = \overline{\gamma}$ the competitor cannot generate profits under any of the reporting systems anymore. Therefore, the benefit in this case is zero. Shown by the following equation:

$$\pi^C_{2,D} - \pi^C_{2,A_{[\hat{\gamma},\overline{\gamma}]}} = 0. \quad (38)$$

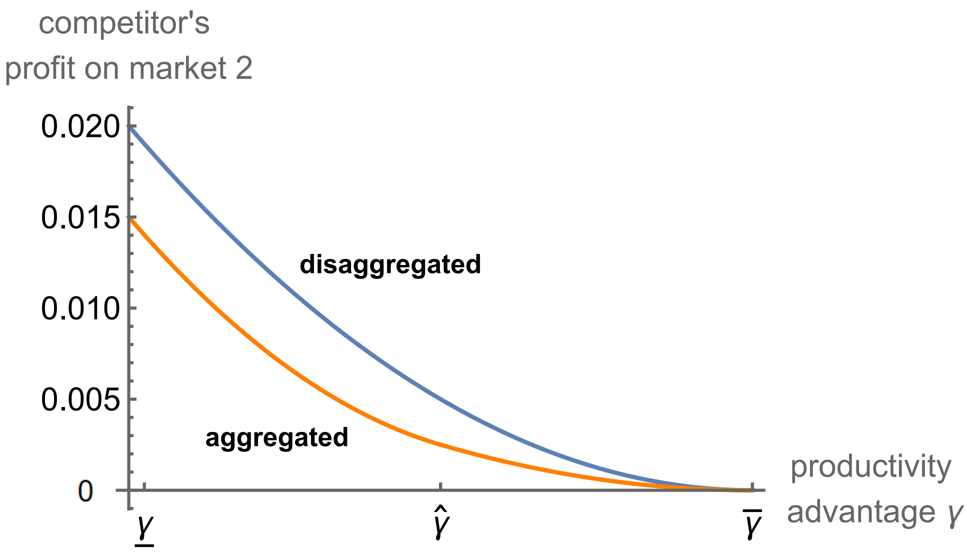

Figure 3: Duopoly – competitor's profits – disaggregated vs. aggregated reporting, a=2, k=0.75, δ=0.3.
The competitor secures higher profits under disaggregated reporting than under aggregated reporting in market 2 for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$. Furthermore, the competitor's profits decrease with an increasing γ.

Figure 3 illustrates the competitor's profits in market 2 in the two information settings for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$. It can be observed that the competitor gains higher profits in the disaggregated setting. This can be explained due to the more precise information the competitor obtains from the disaggregated report. Furthermore, the competitor's profits decrease with an increasing γ. When γ is too high, i.e., $\gamma > \overline{\gamma}$., the competitor does not enter market 2 because $q^C_2 < 0$. For $\gamma = \overline{\gamma}$ the profits of the competitor are zero in both reporting settings.

By adding up the profit functions (12) and (32), the total profit of the incumbent firm under **aggregated** reporting in the duopoly when $\gamma \in [\underline{\gamma}, \hat{\gamma}]$ is obtained:

$$\pi_{A_{[\underline{\gamma},\hat{\gamma}]}} = \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4} + \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9}$$

$$\Rightarrow \pi_{A_{[\underline{\gamma},\hat{\gamma}]}} = \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4} + \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9} \tag{39}$$

Similarly, by adding up the profit functions (12) and (33), the total profit of the incumbent firm under **aggregated** reporting in the duopoly when $\gamma \in [\hat{\gamma}, \overline{\gamma}]$ is obtained:

$$\pi_{A_{[\hat{\gamma},\overline{\gamma}]}} = \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4} + \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4}$$

$$\Rightarrow \pi_{A_{[\hat{\gamma},\overline{\gamma}]}} = \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} + \frac{(a-k)^2}{4} + \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} \tag{40}$$

To see which information system dominates in market 2, it is needed to compare $\pi_{2,D}$ and $\pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ for $\gamma = \hat{\gamma}$ and for $\gamma = \underline{\gamma}$. Furthermore, it is necessary to compare $\pi_{2,D}$ and $\pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ for $\gamma = \overline{\gamma}$.[2]

For $\gamma = \hat{\gamma}$, $\pi_{2,D} > \pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ if (41)

$$\frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} > \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9}$$

When substituting $\gamma = \hat{\gamma} = \frac{1}{2} + \frac{a}{2k}$ the following outcome is obtained:

$$6(k-a) + 13\delta > 0$$

$$\Leftrightarrow \; 13\delta > 6(a-k).$$

From $a - \delta > k$ it can be derived that $a - k > \delta$, but $13\delta > 6(a-k)$ does not always hold. Therefore, disaggregated reporting is preferred over aggregated reporting if $6(k-a) + 13\delta > 0$ for $\gamma = \hat{\gamma}$. Whereas aggregated reporting is the preferred reporting system if $6(k-a) + 13\delta < 0$.

Comparing $\pi_{2,D}$ and $\pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ for $\gamma = \hat{\gamma}$ yields the same result. This demonstrates that for $\gamma = \hat{\gamma}$ disaggregated reporting is only favourable under a certain condition. More precisely, when $6(k-a) + 13\delta > 0$.

[2] The proof that $\pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ and $\pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ are monotonic in γ is shown in the appendix.

And in the following, $\pi_{2,D}$ and $\pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ for $\gamma = \underline{\gamma}$ are compared:

For $\gamma = \underline{\gamma}$, $\pi_{2,D} > \pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ if (42)

$$\frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} > \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9}$$

Substituting $\gamma = \underline{\gamma} = \frac{1}{2} + \frac{a-\delta}{2k}$ the following result is obtained:

$8\delta^2 > 0.$

The result shows that for $\gamma = \underline{\gamma}$ disaggregated is the preferred information system for all $\delta > 0$. This holds as $\delta^2 > 0$. Only for $\delta = 0$ the profits under both information systems are the same.

By comparing $\pi_{2,D}$ and $\pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ for $\gamma = \overline{\gamma}$ a similar result is realized:

For $\gamma = \overline{\gamma}$, $\pi_{2,D} > \pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ if (43)

$$\frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} > \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4}$$

Substituting $\gamma = \overline{\gamma} = \frac{1}{2} + \frac{a+\delta}{2k}$ provides the ensuing result:

$18\delta^2 > 0.$

These results indicate that there exists a region where aggregated reporting is beneficial for the incumbent firm if $6\,(k-a) + 13\delta < 0$.

PROPOSITION 3. *Aggregated reporting is beneficial for the incumbent firm in market 2, if* $6\,(k-a) + 13\delta < 0$ *and* $\gamma \in [\gamma_1, \gamma_2]$.

Comparing $\pi_{2,\mathrm{D}}$ and $\pi_{2,\mathrm{A}}$ in the duopoly setting shows that aggregated reporting can be beneficial for the incumbent firm in market 2. But, only under certain conditions. In the duopoly setting, for $6\,(k-a) + 13\delta > 0$, disaggregated reporting secures higher profits for the incumbent firm in market 2. If $6\,(k-a) + 13\delta < 0$, disaggregated reporting benefits the incumbent firm for $\gamma \in [\underline{\gamma}, \gamma_1]$ and $[\gamma_2, \overline{\gamma}]$, else aggregated reporting yields higher profits in market 2.

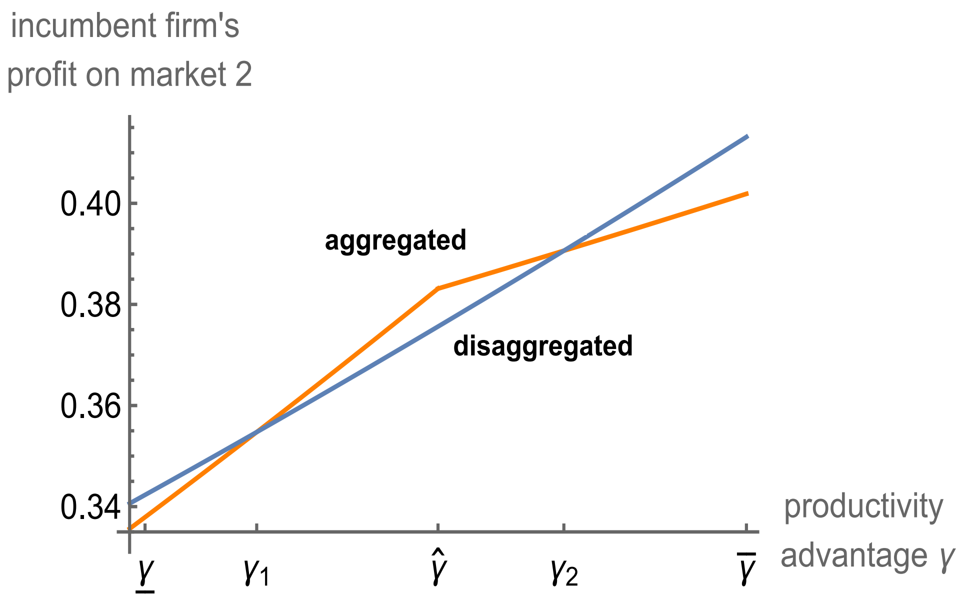

Figure 4: Duopoly – firm's profits in market 2 – disaggregated vs. aggregated reporting, a=2, k=0.75, δ=0.3. The incumbent firm secures higher profits under aggregated reporting than under disaggregated reporting in market 2 for $\gamma \in [\gamma_1, \gamma_2]$. For $\gamma \in [\underline{\gamma}, \gamma_1]$ and $\gamma \in [\gamma_2, \overline{\gamma}]$, disaggregated reporting is more beneficial for the incumbent firm.

Figure 4 shows the incumbent firm's profits in market 2 under both reporting systems for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$. Contrary, to the competitor's profits in market 2, it can be observed that the incumbent firm's profits in market 2 increase in γ. Which is intuitive as the marginal production costs of the competitor increase with γ and a higher value of γ indicates greater efficiency of the incumbent firm. Furthermore, the graph displays that aggregated reporting is beneficial in market 2 not only for $\gamma = \hat{\gamma}$ but for all $\gamma \in [\gamma_1, \gamma_2]$. The existence of the two points of intersection can be explained due to the characteristics of the profit functions. The profit functions are quadratic functions which open upwards. The first point of intersection γ_1 is the point of intersection of $\pi_{2,D}$ and $\pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ and can be displayed by

$$\gamma_1 = \frac{-2ak+4k^2+2\delta k+k\sqrt{9a^2-18ak+9k^2-18a\delta+18\delta k+17\delta^2}}{2k^2}. \tag{44}$$

Similarly, γ_2 is the point of intersection of $\pi_{2,D}$ and $\pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ and can be displayed by

$$\gamma_2 = \frac{-2ak+4k^2-2\delta k+3k\sqrt{a^2-2ak+k^2+2a\delta-2\delta k-\delta^2}}{2k^2}. \tag{45}$$

The proof of Proposition 3 shows that γ_1 and γ_2 are unique thresholds, where profits in market 2 under both reporting regimes are identical.

When $\gamma = \hat{\gamma}$ the difference of the profits under aggregated and disaggregated reporting is the biggest.

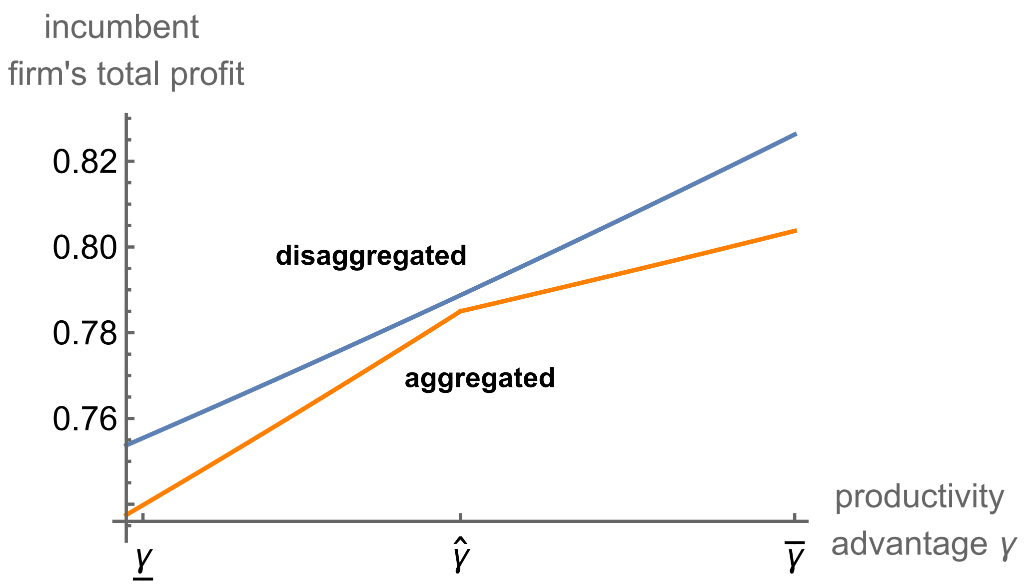

Figure 5: Duopoly – firm's total profits – disaggregated vs. aggregated reporting, a=2, k=0.75, δ=0.3. Although the parameters fulfil the condition $6\ (k-a)+13\delta<0,$ the incumbent firm's total profits are higher under disaggregated reporting than under aggregated reporting for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$.

Figure 5 illustrates the incumbent firm's total profit for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$. The chosen values for the parameters a, k and δ fulfil the condition $6\ (k-a)+13\delta<0.$ It can be observed that there are no points of intersection and therefore, disaggregated reporting is better than aggregated reporting concerning total profits for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$ even if $6\ (k-a)+13\delta<0$. This allows the conclusion that under this condition aggregated reporting is only beneficial in market 2 but not in total.

To examine if aggregated reporting can be beneficial for the firm concerning total profits, the total profits for the different values of γ, i.e., $\gamma = \underline{\gamma}$, $\gamma = \hat{\gamma}$ and $\gamma = \overline{\gamma}$, are compared.

First, the comparison between π_D and $\pi_{,A_{[\underline{\gamma},\hat{\gamma}]}}$ for $\gamma = \hat{\gamma}$ is conducted:

For $\gamma = \hat{\gamma}$, $\pi_D > \pi_{A_{[\underline{\gamma},\hat{\gamma}]}}$ if (46)

$$\frac{1}{2}\frac{(a+\delta-k)^2}{4} + \frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} > \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4} + \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9}$$

When substituting for $\gamma = \hat{\gamma} = \frac{1}{2} + \frac{a}{2k}$ the following condition is obtained:

$$6(k-a) + 31\delta > 0$$

$$\Leftrightarrow\ 31\delta > 6(a-k).$$

Disaggregated reporting is preferred over aggregated reporting if $6(k-a)+31\delta > 0$ for $\gamma = \hat{\gamma}$. Whereas aggregated reporting is the preferred reporting system if $6(k-a)+31\delta < 0$.

Next, π_D and $\pi_{A_{[\underline{\gamma},\hat{\gamma}]}}$ for $\gamma = \underline{\gamma}$ are compared:

For $\gamma = \underline{\gamma}$, $\pi_D > \pi_{A_{[\underline{\gamma},\hat{\gamma}]}}$ if (47)

$$\frac{1}{2}\frac{(a+\delta-k)^2}{4} + \frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} > \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4} + \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9}$$

When substituting $\gamma = \underline{\gamma} = \frac{1}{2} + \frac{a-\delta}{2k}$ the following result is obtained:

$$26\delta^2 > 0.$$

This demonstrates that for $\gamma = \underline{\gamma}$ disaggregated is the preferred information system for all $\delta > 0$. This holds as $\delta^2 > 0$. Only for $\delta = 0$ the profits under both information systems are the same.

When comparing π_D and $\pi_{A_{[\hat{\gamma},\overline{\gamma}]}}$ for $\gamma = \overline{\gamma}$ a similar result is obtained:

$\pi_D > \pi_{A_{[\hat{\gamma},\overline{\gamma}]}}$ for $\gamma = \overline{\gamma}$ (48)

$$\frac{1}{2}\frac{(a+\delta-k)^2}{4}+\frac{(a-\delta-k)^2}{4}+\frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9}>\frac{1}{4}\ \frac{(a+\delta-k)^2}{4}+\frac{1}{2}\ \frac{(a-\delta-k)^2}{4}+\frac{(a-k)^2}{4}+\frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9}$$

Substituting $\gamma=\overline{\gamma}=\frac{1}{2}+\frac{a+\delta}{2k}$ provides the ensuing result:

$36\delta^2>0.$

Similar to market 2, aggregated reporting is beneficial for the incumbent firm concerning total profits, only under a slightly different condition. The condition $6\,(k-a)+31\delta<0$ must hold.

PROPOSITION 4. *Aggregated reporting is beneficial for the incumbent firm overall, if* $6\,(k-a)+31\delta<0$ *and* $\gamma\in[\gamma_3,\gamma_4]$.

As Proposition 3 only discusses for market 2, the total profits of the incumbent firm are reviewed in this section. Comparing the incumbent firm's total profits π_{D} and π_{A} in the duopoly setting reveals that aggregated reporting can also be beneficial for the incumbent firm overall. But, as well as for Proposition 3 certain conditions must be fulfilled. The disaggregated reporting setting still generates higher profits for $\gamma=\underline{\gamma}$ and $\gamma=\overline{\gamma}$.

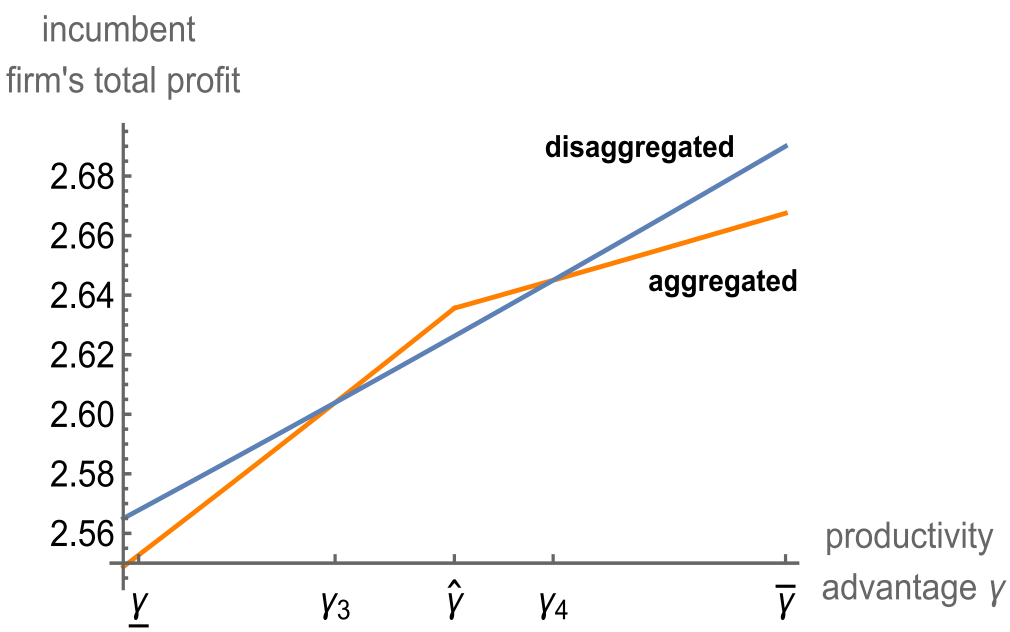

Figure 6: Duopoly – firm's total profits – disaggregated vs. aggregated reporting, a=3, k=0.7, δ=0.3. If the condition $6\,(k-a)+31\delta<0$ is fulfilled, the incumbent firm secures higher total profit under aggregated reporting than under disaggregated reporting for $\gamma\in[\gamma_3,\gamma_4]$. For $\gamma\in[\underline{\gamma},\gamma_3]$ and $\gamma\in[\gamma_4,\overline{\gamma}]$, disaggregated reporting is more beneficial for the incumbent firm.

Nevertheless, higher profits under the aggregated reporting system can be secured if $6\,(k - a) + 31\delta < 0$.

Figure 6 illustrates the incumbent firm's total profit under both reporting systems for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$. It can be clearly seen that aggregated reporting is beneficial for the incumbent firm overall. But only if $6\,(k - a) + 31\delta < 0$ and $\gamma \in [\gamma_3, \gamma_4]$. The two points of intersection can be obtained by intersecting π_D and $\pi_{A_{[\underline{\gamma},\hat{\gamma}]}}$ for γ_3, and π_D and $\pi_{A_{[\hat{\gamma},\overline{\gamma}]}}$ for γ_4.

The point of intersection of π_{D} and $\pi_{A_{[\underline{\gamma},\hat{\gamma}]}}$ is denoted as γ_3 and can be expressed as

$$\gamma_3 = \frac{-2ak+4k^2+2\delta k+k\sqrt{9a^2-18ak+9k^2-18a\delta+18\delta k+35\delta^2}}{2k^2}. \tag{49}$$

The point of intersection of π_{D} and $\pi_{A_{[\hat{\gamma},\overline{\gamma}]}}$ is denoted as γ_4 and can be represented by

$$\gamma_4 = \frac{-2ak+4k^2-2\delta k+3k\sqrt{a^2-2ak+k^2+2a\delta-2\delta k-3\delta^2}}{2k^2}. \tag{50}$$

The results shown in the analysis of the duopoly are contrary to the conclusion of the monopoly that more precise information is better. Under certain conditions less precise information can be beneficial for the incumbent firm. In the monopoly the incumbent firm faces no competitor and its profits are not affected by the productivity advantage γ. However, in the duopoly the profits of the incumbent firm depend on the entry decision of the competitor and the productivity advantage γ. More precisely, the incumbent firm's profits in the duopoly increase in γ. For $\gamma \in [\gamma_3, \gamma_4]$ and if $6\,(k - a) + 31\delta < 0$ the incumbent firm gains higher total profits under aggregated reporting than under disaggregated reporting.

4.3. Implications on welfare

In this section, the impact of the incumbent firm's reporting system on welfare is analysed. More specifically, two aspects of welfare are examined. First, consumer surplus is investigated and second, total welfare is evaluated.

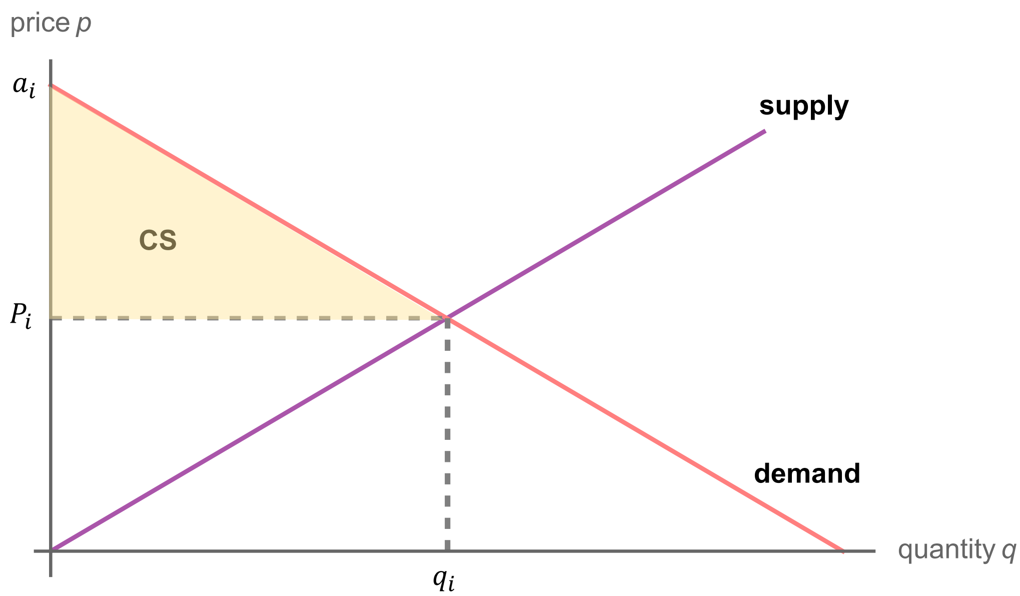

Figure 7: Consumer Surplus

Figure 7 illustrates consumer surplus which is symbolized by the yellow triangle. On the x-axis the quantity q is shown and on the y-axis the price p is portrayed. Furthermore, Figure 7 displays the point of intersection of the supply and demand curve. The point of intersection represents allocative efficiency meaning that the quantity and the price are in equilibrium. To obtain the formula of consumer surplus, the area of the triangle has to be calculated. In general, areas of a triangles are calculated by the following formula:

$$\frac{1}{2} \times base \times height \tag{51}$$

The base of the consumer surplus triangle is q_i and the height is $a_i - P_i$. Consequently, the formula of consumer surplus of the firm in market i in the monopoly equals

$$CS^M = \frac{1}{2} q_i (a_i - P_i). \tag{52}$$

To obtain the consumer surplus in market i in the duopoly, it is necessary to add the consumer surplus of the competitor, and therefore, is given by the following equation:

$$CS = \frac{1}{2} q_i (a_i - P_i) + \frac{1}{2} q_i^C (a_i - P_i). \tag{53}$$

Next, $P_i = a_i - q_i - q_i^C$ must be inserted in the equation above and subsequently, it yields the following:

$$CS = \frac{1}{2} q_i \left(a_i - \left(a_i - q_i - q_i^C\right)\right) + \frac{1}{2} q_i^C \left(a_i - \left(a_i - q_i - q_i^C\right)\right)$$

$$\Rightarrow \mathrm{CS} = \frac{1}{2} q_i \left(q_i + q_i^C\right) + \frac{1}{2} q_i^C \left(q_i + q_i^C\right)$$

$$\Rightarrow \mathrm{CS} = \frac{1}{2} \left(q_i^2 + q_i q_i^C + {q_i^C}^2 + q_i q_i^C\right)$$

$$\Rightarrow \mathrm{CS} = \frac{1}{2} \left(q_i + q_i^C\right)^2 \tag{54}$$

The consumer surplus for both markets consists of the expected quantities of the firm and the rival and equals

$$CS = \frac{1}{2} \sum_{i=1,2} \left(q_i + q_i^C\right)^2 \tag{55}$$

Total welfare is calculated by adding the consumer surplus to the expected profits of the incumbent firm and the profits of the competitor in both markets and equals

$$W = CS + \sum_{i=1,2} \pi_i + \pi_2^C \tag{56}$$

4.3.1. Consumer surplus monopoly

In the monopoly the incumbent firm does not face a competitor, therefore, the consumer surplus consists of the expected quantities of the incumbent firm in market 1 and 2.

First, the consumer surplus in the monopoly under disaggregated reporting is analysed. In the case of a good state, i.e., $y_{D_i} = a + \delta$, the incumbent firm produces the expected quantities $(a + \delta - k)/2$ with a probability of $\frac{1}{4}$ in both markets. When the report indicates the bad state, i.e., $y_{D_i} = a - \delta$, the incumbent firm produces $(a - \delta - k)/2$ with a probability of $\frac{1}{4}$ in both markets. However, when the report indicates high demand in one market and low demand in the other market, i.e., $y_{D_1} = a + \delta$ and $y_{D_2} = a - \delta$ or $y_{D_1} = a - \delta$ and $y_{D_2} = a + \delta$, the incumbent firm produces $(a + \delta - k)/2$ in the market with high demand and $(a - \delta - k)/2$ in the market with low demand, each with a probability of $\frac{1}{4}$. Consequently, under **disaggregated** reporting the expected consumer surplus in the monopoly equals

$$E[CS_D^M] = \frac{1}{2}\left\{\frac{1}{4}\left[2\left(\frac{a+\delta-k}{2}\right)^2\right] + \frac{1}{4}\left[2\left(\frac{a-\delta-k}{2}\right)^2\right] + \frac{1}{2}\left[\left(\frac{a+\delta-k}{2}\right)^2 + \left(\frac{a-\delta-k}{2}\right)^2\right]\right\}$$

$$\Rightarrow E[CS_D^M] = \frac{1}{2}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4}. \tag{57}$$

Under aggregated reporting when the report signals the good state, i.e., $y_A = 2(a + \delta)$, the incumbent firm produces the expected quantities of $(a + \delta - k)/2$ with a probability of $\frac{1}{4}$ in both markets. Whereas when the report indicates the bad state, i.e., $y_A = 2(a - \delta)$, the incumbent firm produces $(a - \delta - k)/2$ with a probability of $\frac{1}{4}$ in both markets. When neither the good state nor the bad state is reported, but $y_A = 2a$, the expected quantities yield $(a - k)/2$ with a probability of $\frac{1}{2}$ in both markets. Therefore, the expected consumer surplus under **aggregated reporting** in the monopoly equals

$$E[CS_A^M] = \frac{1}{2}\left\{\frac{1}{4}\left[2\left(\frac{a+\delta-k}{2}\right)^2\right] + \frac{1}{4}\left[2\left(\frac{a-\delta-k}{2}\right)^2\right] + \frac{1}{2}\left[2\left(\frac{a-k}{2}\right)^2\right]\right\}$$

$$\Rightarrow E[CS_A^M] = \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4}. \tag{58}$$

It is necessary to compare $E[CS_D^M]$ and $E[CS_A^M]$ in order to find out which of the reporting systems yields higher consumer surplus.

$$E[CS_D^M] > E[CS_A^M] \tag{59}$$

$$\Leftrightarrow \frac{1}{2}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} > \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4}$$

$\Leftrightarrow 2\delta^2 > 0$

As δ^2 is always positive, this always holds true. Only when $\delta = 0$ the consumer surplus would be the same in both reporting settings. Therefore, the result shows that under disaggregated reporting consumer surplus is higher than under aggregated reporting in the monopoly.

4.3.2. Total welfare monopoly

The total welfare is calculated by adding the consumer surplus to the profits of the incumbent firm and the competitor. The incumbent firm does not face a competitor in the monopoly, therefore, only the profits of the incumbent firm are considered.

Under **disaggregated** reporting the expected total welfare in the monopoly equals

$$E[W_D^M] = \frac{1}{2}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} + \frac{(a+\delta-k)^2}{4} + \frac{(a-\delta-k)^2}{4}. \tag{60}$$

Under **aggregated** reporting the expected total welfare in the monopoly equals

$$E[W_A^M] = \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4} + \frac{(a+\delta-k)^2}{8} + \frac{(a-\delta-k)^2}{8} + \frac{(a-k)^2}{4}. \tag{61}$$

Similarly to the consumer surplus in the monopoly, it is necessary to compare the total welfare $E[W_D^M]$ and $E[W_A^M]$ to examine which reporting system is better in terms of total welfare:

$$E[W_D^M] > E[W_A^M] \tag{62}$$

$$\Leftrightarrow \frac{1}{2}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} + \frac{(a+\delta-k)^2}{4} + \frac{(a-\delta-k)^2}{4} > \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4} + \frac{(a+\delta-k)^2}{8} + \frac{(a-\delta-k)^2}{8} + \frac{(a-k)^2}{4}$$

$\Leftrightarrow 6\delta^2 > 0$

As δ^2 is always positive, this always holds true. Only when $\delta = 0$ the total welfare would be the same in both reporting settings. The comparison shows that also total welfare is higher in the disaggregated information setting.

PROPOSITION 5. *In the monopoly consumer surplus and total welfare is higher in the disaggregated information system.*

Comparing the expected consumer surplus under disaggregated and aggregated reporting in the monopoly demonstrates that $E[CS_D^M] > E[CS_A^M]$ for all $\delta > 0$. Similarly, the comparison of the expected total welfare in the two reporting settings shows that $E[W_D^M] > E[W_A^M]$ for all $\delta > 0$. In both cases, consumer surplus and total welfare, one reporting system is not better than the other when $\delta = 0$. Furthermore, the benefit of choosing disaggregated over aggregated reporting to consumers and to total welfare increases in δ.

4.3.3. Consumer surplus duopoly

In the duopoly the incumbent firm does not face a competitor in market 1, but in market 2 a potential competitor could enter the market. Therefore, in market 1 the consumer surplus only consists of the expected quantities of the incumbent firm. In market 2 it consists of the expected quantities of the incumbent firm and the expected quantities of the competitor depending on his entry decision.

Under disaggregated reporting in the duopoly when the report indicates the good state, i.e., $y_{D_i} = a + \delta$, the firm produces $(a + \delta - k)/2$ in market 1 and $[a + \delta - (2 - \gamma)k]/3$ in market 2. Furthermore, the competitor produces $[a + \delta - (2\gamma - 1)k]/3$ in market 2. Each of these quantities are produced with a probability of $\frac{1}{4}$. When the report signals the bad state, i.e., $y_{D_i} = a - \delta$, the incumbent firm produces $(a - \delta - k)/2$ in market 1 and $[a - \delta - (2 - \gamma)k]/3$ in market 2, each with a probability of $\frac{1}{4}$. Whereas the competitor does not produce anything since he does not enter the market when the bad state is reported. When the report indicates high demand in one market and low demand in the other market, i.e., $y_{D_1} = a + \delta$ and $y_{D_2} = a - \delta$ or $y_{D_1} = a - \delta$ and $y_{D_2} = a + \delta$, the expected quantities differ depending on in which market the demand is high and in which it is low. When the demand is high in market 1 and low in market 2, i.e., $y_{D_1} = a + \delta$ and $y_{D_2} = a - \delta$, the incumbent firm produces $(a + \delta - k)/2$ with a probability of $\frac{1}{4}$ in market 1 and $[a - \delta - (2 - \gamma)k]/3$ with a probability of $\frac{1}{4}$ in market 2. The competitor does not produce anything in this case. Contrary to this, when the demand is low in market 1 and high in market 2, i.e., $y_{D_1} = a - \delta$ and $y_{D_2} = a + \delta$, the incumbent firm produces $(a - \delta - k)/2$ with a probability of $\frac{1}{4}$ in market 1 and $[a + \delta - (2 - \gamma)k]/3$ with a probability of $\frac{1}{4}$ in market 2. Additionally, the competitor produces $[a+\delta-(2\gamma-1)k]/3$ with a probability of $\frac{1}{4}$ in market 2. Consequently, the expected consumer surplus in the duopoly under **disaggregated** reporting is shown by the following equation:

$$E[CS_D]=\frac{1}{2}\left\{\frac{1}{4}\left[\left(\frac{a+\delta-k}{2}\right)^2+\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2\right]+\frac{1}{4}\left[\left(\frac{a-\delta-k}{2}\right)^2+\left(\frac{a-\delta-(2-\gamma)\,k}{3}\right)^2\right]+\frac{1}{4}\left[\left(\frac{a+\delta-k}{2}\right)^2+\left(\frac{a-\delta-(2-\gamma)\,k}{3}\right)^2\right]+\frac{1}{4}\left[\left(\frac{a-\delta-k}{2}\right)^2+\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2\right]\right\}.$$

$$\Rightarrow E[CS_D]=\frac{1}{4}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{1}{4}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{1}{4}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2+\frac{1}{4}\frac{(a-\delta-(2-\gamma)k)^2}{9} \tag{63}$$

Considering the aggregated reporting in the duopoly, the expected quantities are the same as under disaggregated reporting when report signals the good, i.e., $y_A=2(a+\delta)$, and the bad state, i.e., $y_A=2(a-\delta)$. However, when the report indicates neither the good nor the bad state, but $y_A=2a$, the incumbent firm produces $(a-k)/2$ with a probability of $\frac{1}{2}$ in market 1 and $[a-(2-\gamma)k]/3$ with a probability of $\frac{1}{2}$ in market 2. In this case, the competitor only enters the market when $\gamma\in[\underline{\gamma},\hat{\gamma}]$ and therefore, the competitor produces $[a-(2\gamma-1)k]/3$ with a probability of $\frac{1}{2}$ in market 2 when $\gamma\in[\underline{\gamma},\hat{\gamma}]$. Subsequently, under **aggregated** reporting when $\gamma\in[\underline{\gamma},\hat{\gamma}]$ the expected consumer surplus in the duopoly equals

$$E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]=\frac{1}{2}\left\{\frac{1}{4}\left[\left(\frac{a+\delta-k}{2}\right)^2+\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2\right]+\frac{1}{4}\left[\left(\frac{a-\delta-k}{2}\right)^2+\left(\frac{a-\delta-(2-\gamma)\,k}{3}\right)^2\right]+\frac{1}{2}\left[\left(\frac{a-k}{2}\right)^2+\left(\frac{a-(2-\gamma)\,k}{3}+\frac{a-(2\gamma-1)\,k}{3}\right)^2\right]\right\}$$

$$\Rightarrow E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]=\frac{1}{8}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{1}{8}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{1}{4}\frac{(a-\mathrm{k})^2}{4}+\frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2+\frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9}+\frac{1}{4}\left(\frac{a-(2-\gamma)\,k}{3}+\frac{a-(2\gamma-1)\,k}{3}\right)^2 \tag{64}$$

When $\gamma\in[\hat{\gamma},\overline{\gamma}]$ the competitor does not enter the market when the report signals $y_A=2a$, consequently, he does not produce anything in market 2. He only enters the market when the good state, i.e., $y_A = 2(a+\delta)$, is reported. Therefore, the expected consumer surplus in the duopoly under **aggregated** reporting equals

$$E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}] = \frac{1}{2}\left\{\frac{1}{4}\left[\left(\frac{a+\delta-k}{2}\right)^2 + \left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2\right] + \frac{1}{4}\left[\left(\frac{a-\delta-k}{2}\right)^2 + \left(\frac{a-\delta-(2-\gamma)\,k}{3}\right)^2\right] + \frac{1}{2}\left[\left(\frac{a-k}{2}\right)^2 + \left(\frac{a-(2-\gamma)\,k}{3}\right)^2\right]\right\}.$$

$$\Rightarrow E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}] = \frac{1}{8}\frac{(a+\delta-\mathrm{k})^2}{4} + \frac{1}{8}\frac{(a-\delta-\mathrm{k})^2}{4} + \frac{1}{4}\frac{(a-\mathrm{k})^2}{4} + \frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-(2-\gamma)\,k)^2}{9} \quad (65)$$

To examine which reporting system yields higher consumer surplus, it is necessary to compare $E[CS_D]$ and $E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ for $\gamma = \hat{\gamma}$ and for $\gamma = \underline{\gamma}$, and $E[CS_D]$ and $E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ for $\gamma = \overline{\gamma}$.[3]

For $\gamma = \hat{\gamma}$, $E[CS_D] > E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ if (66)

$$\frac{1}{4}\frac{(a+\delta-\mathrm{k})^2}{4} + \frac{1}{4}\frac{(a-\delta-\mathrm{k})^2}{4} + \frac{1}{4}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{4}\frac{(a-\delta-(2-\gamma)k)^2}{9} > \frac{1}{8}\frac{(a+\delta-\mathrm{k})^2}{4} + \frac{1}{8}\frac{(a-\delta-\mathrm{k})^2}{4} + \frac{1}{4}\frac{(a-\mathrm{k})^2}{4} + \frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\left(\frac{a-(2-\gamma)\,k}{3}+\frac{a-(2\gamma-1)\,k}{3}\right)^2$$

By substituting $\gamma = \hat{\gamma} = \frac{1}{2} + \frac{a}{2k}$ the following condition can be obtained:

$$6(a-k) + 19\delta > 0.$$

This is true as $a > 0$, $\delta > 0$ and $a > k$. Therefore, $6a > 6k$. Comparing $E[CS_D] > E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ for $\gamma = \hat{\gamma}$ yields the same result.

For $\gamma = \underline{\gamma}$, $E[CS_D] > E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ if (67)

[3] The proof that consumer surplus and total welfare are monotonic in γ is shown in the appendix.

$$\frac{1}{4}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{1}{4}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{1}{4}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2+\frac{1}{4}\frac{(a-\delta-(2-\gamma)k)^2}{9}>\frac{1}{8}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{1}{8}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{1}{4}\frac{(a-\mathrm{k})^2}{4}+\frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2+\frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9}+\frac{1}{4}\left(\frac{a-(2-\gamma)\,k}{3}+\frac{a-(2\gamma-1)\,k}{3}\right)^2$$

By substituting $\gamma=\underline{\gamma}=\frac{1}{2}+\frac{a-\delta}{2k}$ the following condition can be obtained:

$50\delta^2>0.$

This is true as δ^2 is always positive.

For $\gamma=\overline{\gamma}$, $E[CS_D]>E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ if (68)

$$\frac{1}{4}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{1}{4}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{1}{4}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2+\frac{1}{4}\frac{(a-\delta-(2-\gamma)k)^2}{9}>\frac{1}{8}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{1}{8}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{1}{4}\frac{(a-\mathrm{k})^2}{4}+\frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2+\frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9}+\frac{1}{4}\frac{(a-(2-\gamma)\,k)^2}{9}$$

By substituting $\gamma=\overline{\gamma}=\frac{1}{2}+\frac{a+\delta}{2k}$ the following condition can be obtained:

$13\delta^2>0.$

This is true as δ^2 is always positive. Only for $\delta=0$ the reporting system would not matter.

As in the monopoly, also in the duopoly disaggregated reporting is the information system that yields higher consumer surplus.

4.3.4. Total welfare duopoly

Total welfare in the duopoly is determined by the consumer surplus and the expected profits of the incumbent firm in both markets and the expected profits of the competitor in market 2.

The expected total welfare in the duopoly under **disaggregated** reporting yields

$$E[W_D]=E[CS_D]+\frac{1}{2}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9}+\frac{1}{2}\frac{(a+\delta-(2\gamma-1)\,\mathrm{k})^2}{9}. \quad (69)$$

Under **aggregated** reporting the expected total welfare in the duopoly for $\gamma \in [\underline{\gamma}, \hat{\gamma}]$ equals

$$E[W_{A_{[\underline{\gamma},\hat{\gamma}]}}] = E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}] + \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4} + \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a+\delta-(2\gamma-1)\,k)^2}{9} + \frac{1}{2}\frac{(a-(2\gamma-1)\,k)^2}{9}. \quad (70)$$

Whereas for $\gamma \in [\hat{\gamma}, \overline{\gamma}]$ the expected total welfare in the duopoly under **aggregated** reporting yields

$$E[W_{A_{[\hat{\gamma},\overline{\gamma}]}}] = E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}] + \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} + \frac{(a-k)^2}{4} + \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a+\delta-(2\gamma-1)\,k)^2}{9}. \quad (71)$$

To examine which reporting system yields higher total welfare, it is necessary to compare $E[W_D]$ and $E[W_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ for $\gamma = \hat{\gamma}$ and for $\gamma = \underline{\gamma}$, and $E[W_D]$and$E[W_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ for $\gamma = \overline{\gamma}$.

Substituting $\gamma = \hat{\gamma} = \frac{1}{2} + \frac{a}{2k}$ yields that

$E[W_D] > E[W_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ if (72)

$108\delta^2 > 0.$

This is always true as δ^2 is always positive. Only for $\delta = 0$ the reporting system would not matter. Furthermore, the same result is obtained when comparing $E[W_D] > E[W_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ for $\gamma = \hat{\gamma}$.

Substituting $\gamma = \underline{\gamma} = \frac{1}{2} + \frac{a-\delta}{2k}$ yields that

$E[W_D] > E[W_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ if (73)

$118\delta^2 > 0.$

This is true as δ^2 is always positive. Only for $\delta = 0$ the reporting system would not matter.

Substituting $\gamma = \overline{\gamma} = \frac{1}{2} + \frac{a+\delta}{2k}$ yields that

$$E[W_D] > E[W_{A_{[\hat{\gamma},\overline{\gamma}]}}] \text{ if} \tag{74}$$

$$98\delta^2 > 0.$$

This is true as δ^2 is always positive. Only for $\delta = 0$ the reporting system would not matter. The results from (80), (81) and (82) prove that for all $\gamma \in [\underline{\gamma}, \overline{\gamma}]$ disaggregated reporting yields higher total welfare than aggregated reporting.

PROPOSITION 6. *In the duopoly consumer surplus and total welfare is higher in the disaggregated information system for all $\gamma \in [\underline{\gamma}, \overline{\gamma}]$.*

Comparing the expected consumer surplus under disaggregated and aggregated reporting in the duopoly demonstrates that $E[CS_D] > E[CS_A]$ for all $\delta > 0$. Similarly, the comparison of the expected total welfare in the two reporting settings shows that $E[W_D] > E[W_A]$ for all $\delta > 0$. These results are represented in Figure 8 and 9.

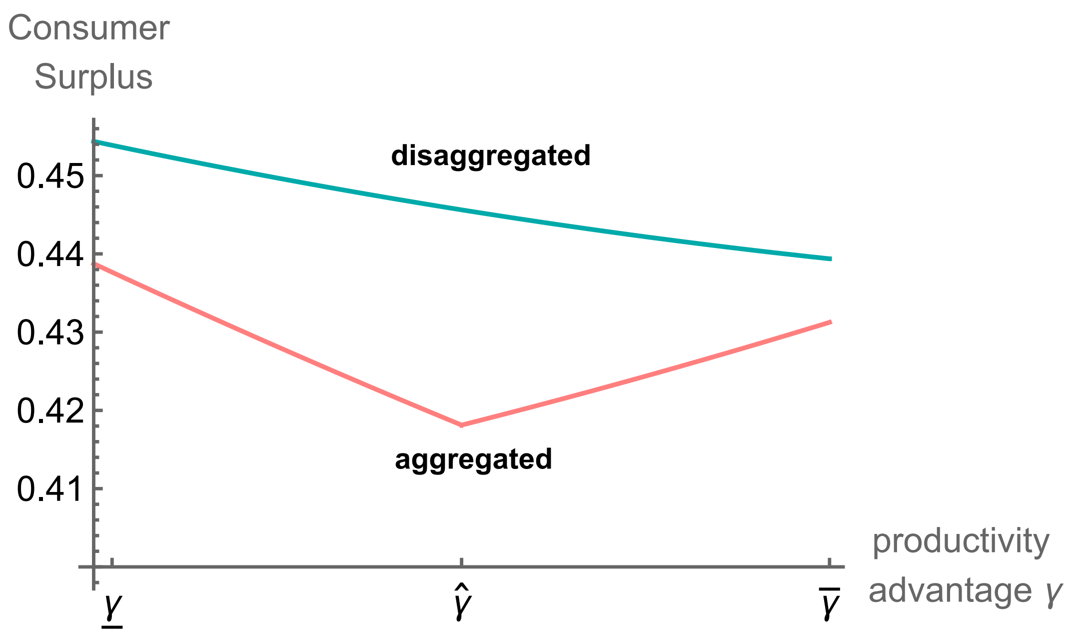

Figure 8: Duopoly – Consumer Surplus – disaggregated vs. aggregated reporting, a=2, k=0.75, δ=0.3. Disaggregated reporting yields higher consumer surplus than aggregated reporting for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$.

Figure 8 shows the consumer surplus under disaggregated and aggregated reporting in the duopoly for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$. It can be observed that the consumer surplus in the duopoly is higher under disaggregated reporting. Furthermore, the consumer surplus in the disaggregated reporting system decreases in γ. Whereas under aggregated reporting the consumer surplus decreases in γ for $\gamma \in [\underline{\gamma}, \hat{\gamma}]$. But, for $\gamma \in [\hat{\gamma}, \overline{\gamma}]$ it increases in γ. This can be explained due to the expected quantities produced of the incumbent firm and the competitor. For $\gamma \in [\underline{\gamma}, \hat{\gamma}]$ the competitor produces quantities when the report indicates the good state, i.e., $y_A = 2\,(a + \delta)$, and when the report indicates neither a good nor a bad state, i.e., $y_A = 2a$. The competitor's expected quantities decrease in γ. Therefore, the consumer surplus decreases as well. But, for $\gamma \in [\hat{\gamma}, \overline{\gamma}]$ the competitor only produces when the good state is reported, i.e., $y_A = 2\,(a + \delta)$. However, the incumbent firm's expected quantities increase in γ. Furthermore, it can be detected that consumer surplus is the lowest for $\gamma = \hat{\gamma}$. This is due to the fact that under aggregated reporting the consumer surplus is monotonically decreasing in γ for $\gamma \in [\underline{\gamma}, \hat{\gamma}]$, but is monotonically increasing in γ for $\gamma \in [\hat{\gamma}, \overline{\gamma}]$.

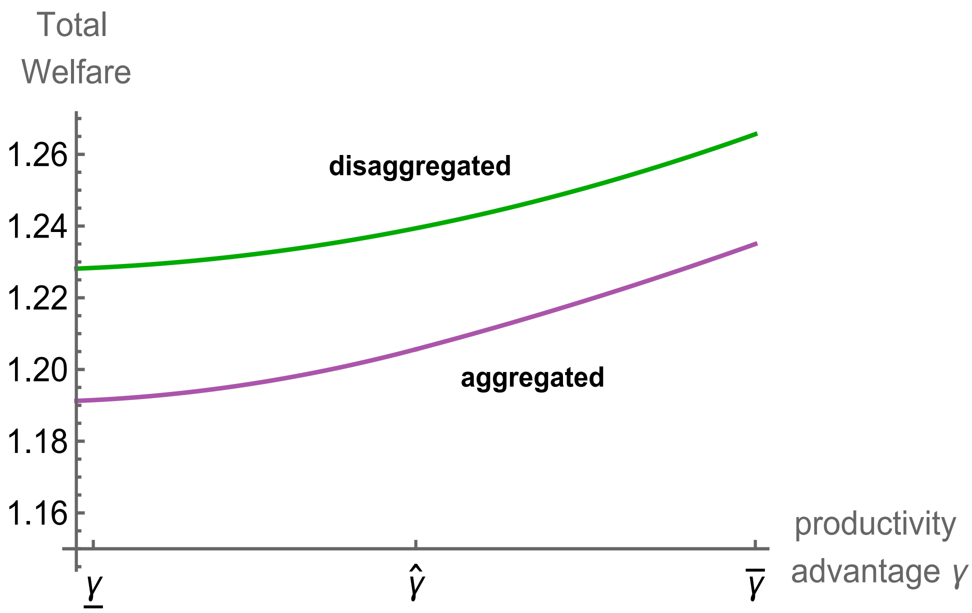

Figure 9: Duopoly – Total Welfare – disaggregated vs. aggregated reporting, a=2, k=0.75, δ=0.3. Disaggregated reporting yields higher total welfare than aggregated reporting for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$.

Figure 9 shows the comparison of total welfare under both reporting systems in the duopoly. It can be observed that total welfare is higher under disaggregated reporting than under aggregated reporting for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$. Furthermore, it is noticeable that total welfare increases with a higher value of γ.

Although the incumbent firm chooses aggregated over disaggregated reporting in the duopoly under some conditions, disaggregated reporting achieves higher consumer surplus and total welfare in both market settings, monopoly and duopoly. Consequently, transparency leads to higher consumer surplus and total welfare. Therefore, policies from the government that encourage or even force disaggregated reporting would affect consumer surplus and total welfare positively.

5. Summary and concluding remarks

Firms that operate in more than one segment are faced with the decision whether to disclose segment information by segment reporting or not. However, not all firms are able to choose if they want to disclose these details. Publicly traded companies are obligated to do so by international regulations. SFAS 131 and IFRS 8 are the most important regulations regarding segment reporting. They apply the management approach, which requires firms to disclose segment information in the same way as it is generated and used internally. This provides the firms with a form of discretion over their reporting system.

The results of the literature review show that there exist incentives to conceal and incentives to reveal segment information. Firms face a trade-off between those incentives when the decision of segment disclosure is present. On the one hand, segment disclosure imposes proprietary and agency costs on the firm and on the other hand, firms can benefit from disclosing segment information by lower cost of equity and external capital. Furthermore, segment reporting reveals unsolved agency problems, but it also facilitates monitoring. Another benefit for the firm is the increase in its profitability by analyst following that comes with segment reporting. Additionally, it is important to mention that the disclosure decision can depend on the type of competition. Existing competition favours disclosure, whereas potential competition supports aggregation of segment details. The disclosure of competitors is also a factor that should be taken into account, as it can reduce the net proprietary costs of the firm.

Regarding the view of external parties, it can be observed that segment reporting is always beneficial for them. Since the bargaining power of suppliers and consumers increases with segment reporting, consumers benefit from better-fitted products and lower prices. Overall, external parties, like investors, creditors and analysts, gain information that facilitates the assessment of the firm’s performance. Therefore, capital allocation, the estimation of future earnings and cashflows improves with segment reporting. Furthermore, segment reporting generates higher consumer surplus and total welfare. This can be observed in the literature, but also in the model in this thesis. The literature review indicates that segment reporting can be beneficial for all parties. However, the firm is the only party that can also be affected negatively.

The model in this thesis includes a firm that operates in two markets. In market 1 the firm is always a monopolist and in market 2 it faces the threat of a potential Cournot competitor. The demand in the model is uncertain. The incumbent firm has to choose its reporting system in advance and consequently, decides what information is made available for the firm itself and the competitor. The results of the model show that in the monopoly the firm prefers disaggregated over aggregated reporting, as higher profits can be obtained under disaggregated reporting. Whereas in the duopoly aggregation is beneficial for the firm under certain conditions. This is contrary to claim that firms always benefit from more information. The results concerning welfare demonstrate that disaggregated reporting yields higher consumer surplus and higher total welfare in both settings, the monopoly and the duopoly. This shows that transparency is more beneficial for welfare.

The implications of the literature review and the model should be considered by regulators when they set and evaluate reporting standards. However, models have to be applied with caution, as factors that are held constant in the model are often not constant in the real world (Berger, 2011, p.214).

The model in this thesis could be expanded in various ways. Hereafter, only some suggestions are made. First, it could be examined if the results changed when the competitor would have the opportunity to choose which market to enter or the competitor is present in both markets. Second, other factors, like costs of disclosure for the firm, could be included. Finally, other entry barriers apart from the competitor’s cost disadvantage could be considered. Future empirical research should focus on the interplay between the different incentives to disclose segment information, as existing research mostly focuses on the motives separately.

References

Ali, A., Klasa, S., & Yeung, E. (2014). Industry concentration and corporate disclosure policy. *Journal of Accounting and Economics*, 58, 240-264.

Alvarez, M. (2004). *Segmentberichterstattung und Segmentanalyse* (1.Auflage). Wiesbaden: Deutscher Universitätsverlag.

André, P., Filip, A., & Moldovan, R. (2016). Segment disclosure quantity and quality under IFRS 8: Determinants and the effect on financial analysts' earnings forecast errors. *The International Journal of Accounting*, 1-19, doi: 10.1016/j.intacc.2016.10.008

Arya, A., & Mittendorf, B. (2007). The interaction among disclosure, competition between firms, and analyst following. *Journal of Accounting and Economics*, 43, 321-339.

Arya, A., Frimor, H., & Mittendorf, B. (2013). Compliance with segment disclosure initiatives: Implications for the short and long run. *Managerial and Decision Economics*, 34, 488-501.

Arya, A., Mittendorf, B., & Yoon, D. (2019). Public disclosures in the presence of suppliers and competitors. *Contemporary Accounting Research*, 36(2), 758-772.

Bens, D. A., Berger, P. G., & Monahan, S. J. (2011). Discretionary disclosure in financial reporting: An examination comparing internal firm data to externally reported segment data. *The Accounting Review*, 86(2), 417-449.

Berger, P. G., & Hann, R. (2003). The impact of SFAS No. 131 on information and monitoring. *Journal of Accounting Research*, 41(2), 163-223.

Berger, P. G., & Hann, R. N. (2007). Segment profitability and the proprietary and agency costs of disclosure. *The Accounting Review*, 82(4), 869-906.

Blanco, B., Garcia Lara, J. M., & Tribo, J. A. (2015). Segment disclosure and cost of capital. *Journal of Business Finance & Accounting*, 42(3) & (4), 367-411.

Botosan, C. A., & Stanford, M. (2005). Managers‘ motives to withhold segment disclosures and the effect of SFAS no. 131 on analysts’ information environment. *The Accounting Review*, 80(3), 751-771.

Cho, Y. J. (2015). Segment disclosure transparency and internal capital market efficiency: Evidence from SFAS No. 131. *Journal of Accounting Research*, 53(4), 669-723.

Deloitte. (2006). IAS Plus. IFRS 8 Operating Segments. Online: https://www.iasplus.com/de/binary/iasplus/0612ifrs8.pdf (retrieved: 15.05.2022)

Epstein, M. J., & Palepu, K. G. (1999). What financial analysts want. *Strategic Finance*, 80, 48-52.

Ettredge, M., Kwon, S. Y., & Smith, D. (2002). Competitive harm and companies’ positions on SFAS No. 131. *Journal of Accounting, Auditing & Finance*, 17(2), 93-109.

Ettredge, M. L., Kwon, S. Y., Smith, D. B., & Stone, M. S. (2006). The effect of SFAS No. 131 on the cross-segment variability of profits reported by multiple segment firms. *Review of Accounting Studies*, 17, 91-117.

Fields, T. D., Lys, T. Z., & Vincent, L. (2001). Empirical research in accounting choice. *Journal of Accounting and Economics*, 31, 255–307.

Financial Accounting Standards Board (FASB). (1976). Statement of Financial Accounting Standards No. 14.

Financial Accounting Standards Board (FASB). (1997). Statement of Financial Accounting Standards No. 131.

Franco, F., Urcan, O., & Vasvari, F. P. (2016). Corporate diversification and the cost of debt: The role of segment disclosures. *The Accounting Review*, 91(4), 1139-1165.

Franzen, N., & Weißenberger, B. E. (2018). Capital market effects of mandatory IFRS 8 adoption: An empirical analysis of German firms. *Journal of International Accounting, Auditing and Taxation*. 31, 1-19.

Healy, P., & Palepu, K. (2001). Information asymmetry, corporate disclosure, and the capital markets: A review of the empirical disclosure literature. *Journal of Accounting & Economics*, 31, 405-440.

Herrmann, D., & Thomas, W. B. (2000). A model of forecast precision using segment disclosures: Implications for SFAS No. 131. *Journal of International Accounting, Auditing & Taxation*, 9(1), 1-18.

Hund, J., Monk, D., & Tice, S. (2010). Uncertainty about average profitability and the diversification discount. *Journal of Financial Economics*, 96(3), 463-484.

IFRS. (2012). Request for Information, Post-implementation Review: IFRS 8 Operating Segments.

IFRS. (2022). IFRS 8 Operating Segments. Online: https://www.ifrs.org/issued-standards/list-of-standards/ifrs-8-operating-segments/ (retrieved: 15.05.2022)

Königsgruber, R., Perotti, P., Schinnerl, O., Tsoligkas, F. & Windisch, D. (2021). Product market competition and firms' disclosure of cross-segment differences in performance. *Abacus*, 1–28. doi: 10.1111/abac.12212

Mande, V., & Ortman, R. (2002). The effect of Japanese business segment reporting on analysts' forecasts: implications for US investors and the SEC. *Journal of Accounting and Public Policy*, 21, 31-70.

Muiño, F., & Núñez-Nickel, M. (2016). Multidimensional competition and corporate disclosure. *Journal of Business Finance & Accounting*, 43(3) & (4), 298-328.

Murakami, Y., & Shiiba, A. (2021). Under what conditions does the manager withhold segment information? *Journal of Accounting, Auditing & Finance*, 1-30. doi: 10.1177/0148558X211036248

Schneider, G. T., & Scholze, A. (2015). Mandatory disclosure, generation of decision-relevant information, and market entry. *Contemporary Accounting Research*, 32(4), 1353-1372.

Suijs, J., & Wielhouwer, J. L. (2014). Disclosure regulation in duopoly markets: Proprietary costs and social welfare. *European Accounting Review*, 23(2), 227-255.

Tsakumis, G. T., Doupnik, T. S., & Seese, L. P. (2006). Competitive harm and geographic area disclosure under SFAS 131. *Journal of International Accounting, Auditing and Taxation*, 15, 32-47.

Wang, Q., Ettredge, M., Huang, Y., & Sun, L. (2011). Strategic revelation of differences in segment earnings growth. *Journal of Accounting and Public Policy*, 30, 383-392.

Wiederhold, P. (2008). *Segmentberichterstattung und Corporate Governance. Grenzen des Management Approach* (1.Auflage). Wiesbaden: Gabler Edition Wissenschaft.

Yu, M. (2010). Analyst forecast properties, analyst following and governance disclosures: A global perspective. *Journal of International Accounting, Auditing and Taxation*, 19, 1-15.

Appendix

Proofs of Propositions

Proof of Proposition 1

PROPOSITION 1. *In the monopoly the incumbent firm prefers the disaggregated information system.*

To proof that the firm prefers the disaggregated over the aggregated reporting system it is necessary to compare π_D^M and π_A^M:

$$\boldsymbol{\pi_D^M > \pi_A^M} \quad \text{(A1)}$$

$$\Leftrightarrow 2\left(\frac{1}{2}\frac{(a+\delta-k)^2}{4}+\frac{1}{2}\frac{(a-\delta-k)^2}{4}\right) > 2\left(\frac{1}{4}\frac{(a+\delta-k)^2}{4}+\frac{1}{4}\frac{(a-\delta-k)^2}{4}+\frac{1}{2}\frac{(a-k)^2}{4}\right)$$

$$\Leftrightarrow \frac{(a+\delta-k)^2}{8}+\frac{(a-\delta-k)^2}{8} > \frac{(a-k)^2}{4}$$

$$\Leftrightarrow (a+\delta-k)^2+(a-\delta-k)^2 > 2(a-k)^2$$

$$\Leftrightarrow (a+\delta)^2-2(a+\delta)k+k^2+(a-\delta)^2-2(a-\delta)k+k^2 > 2\,(a^2-2ak+k^2)$$

$$\Leftrightarrow\ a^2+2a\delta+\delta^2-2ak-2\delta k+k^2+a^2-2a\delta+\delta^2-2ak+2\delta k+k^2 > 2a^2-4ak+2k^2$$

$$\Leftrightarrow 2a\delta+\delta^2-2\delta k-2a\delta+\delta^2+2\delta k > 0$$

$$\Leftrightarrow 2\delta^2 > 0$$

This is always true as δ^2 is always positive. Only when $\delta = 0$ the reporting system would not matter. ■

Proof of Proposition 2

PROPOSITION 2. *In the monopoly the incumbent firm's profits increase in δ.*

In the text. ■

Proof of Proposition 3

PROPOSITION 3. *Aggregated reporting is beneficial for the incumbent firm in market 2, if* $6\,(k-a)+13\delta<0$ *and* $\gamma \in [\gamma_1, \gamma_2]$.

Before it is possible to compare $\pi_{2,D} > \pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ and $\pi_{2,D} > \pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$, it is necessary to show that $\pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ is monotonically increasing in γ for $\gamma \in [\underline{\gamma}, \hat{\gamma}]$ and $\pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ is monotonically increasing in γ for $\gamma \in [\hat{\gamma}, \overline{\gamma}]$.

Proof that $\boldsymbol{\pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}}$ is monotonically increasing in $\boldsymbol{\gamma}$ for $\boldsymbol{\gamma \in [\underline{\gamma}, \hat{\gamma}]}$:

To proof that, it is necessary to show that $\frac{\partial \pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}}{\partial \gamma} > 0$.

$$\pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}} = \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9}$$

$$\frac{\partial \pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}}{\partial \gamma} = \frac{k}{18}(3a+\delta+3\gamma k-6k) \tag{A2}$$

As $\frac{k}{18}$ remains constant it is only necessary look at the rest of the equation. Thus, the first derivative is positive if

$$3a+\delta+3\gamma k-6k>0 \qquad \Leftrightarrow \qquad 3a+\delta>6k-3\gamma k. \tag{A3}$$

The right-hand side of the last inequality is decreasing in γ. Thus, the inequality holds for all $\gamma \in [\underline{\gamma}, \hat{\gamma}]$ if it holds for the lowest value of the interval, i.e., for $\gamma = \underline{\gamma}$. Substituting $\underline{\gamma}$ in (A3), yields

$$3a+\delta>6k-3\left(\frac{1}{2}+\frac{a-\delta}{2k}\right)k \qquad \Leftrightarrow \qquad 9a-\delta>9k, \tag{A4}$$

which holds by Assumption 1. Therefore, $3a+\delta>6k-3\gamma k$ is true and it is proven that $\frac{\partial \pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}}{\partial \gamma} > 0$.

Proof that $\pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ is monotonically increasing in γ for $\gamma \in [\hat{\gamma},\overline{\gamma}]$:

To proof that, it is necessary to show that $\frac{\partial \pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}}{\partial \gamma} > 0$.

$$\pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}} = \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4}$$

$$\frac{\partial \pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}}{\partial \gamma} = \frac{k}{18}(a + \delta + \gamma k - 2k) \qquad \text{(A5)}$$

As $\frac{k}{18}$ remains constant it is only necessary look at the rest of the equation. Thus, the first derivative is positive if

$$a + \delta + \gamma k - 2k > 0 \qquad \Leftrightarrow \qquad a + \delta > 2k - \gamma k. \qquad \text{(A6)}$$

The right-hand side of the last inequality is decreasing in γ. Thus, the inequality holds for all $\gamma \in [\hat{\gamma},\overline{\gamma}]$ if it holds for the lowest value of the interval, i.e., for $\gamma = \hat{\gamma}$. Substituting $\hat{\gamma}$ in (A6), yields

$$a + \delta > 2k - \left(\frac{1}{2} + \frac{a}{2k}\right)k \qquad \Leftrightarrow \qquad \frac{3}{2}a + \delta > \frac{3}{2}k, \qquad \text{(A7)}$$

which holds by Assumption 1 and because $\delta \geq 0$. Therefore, $a + \delta > 2k - \gamma k$ is true and it is proven that $\frac{\partial \pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}}{\partial \gamma} > 0$.

Now it is possible to examine which reporting system yields higher profit in market 2. For this, it is necessary to compare $\pi_{2,D}$ and $\pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ in $\gamma = \hat{\gamma}$ and in $\gamma = \underline{\gamma}$, and $\pi_{2,D}$ and $\pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ in $\gamma = \hat{\gamma}$ and in $\gamma = \overline{\gamma}$. Note that $\pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}} = \pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ for $\gamma = \hat{\gamma}$.

For $\gamma = \hat{\gamma}$, $\pi_{2,D} > \pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ if (A8)

$$\frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} > \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9}$$

$$\Leftrightarrow \frac{(a+\delta-(2-\gamma)k)^2}{36} + \frac{(a-\delta-k)^2}{16} > \frac{(a-(2-\gamma)k)^2}{18}$$

$$\Leftrightarrow 4[a + \delta - (2-\gamma)k]^2 + 9(a - \delta - k)^2 > 8[a - (2-\gamma)k]^2$$

$\Leftrightarrow 4a^2 + 8a\delta + 4\delta^2 - 16ak - 16\delta k + 8a\gamma k + 8\delta\gamma k + 16k^2 - 16\gamma k^2 + 4\gamma^2k^2 + 9a^2 - 18a\delta + 9\delta^2 - 18ak + 18\delta k + 9k^2 > 8a^2 - 32ak + 16a\gamma k + 32k^2 - 32\gamma k^2 + 8\gamma^2k^2$

$\Leftrightarrow 5a^2 - 10a\delta + 13\delta^2 - 2ak + 2\delta k - 8a\gamma k + 8\delta\gamma k - 7k^2 + 16\gamma k^2 - 4\gamma^2k^2 > 0$

Substituting $\gamma = \hat{\gamma} = \frac{1}{2} + \frac{a}{2k}$, yields

$5a^2 - 10a\delta + 13\delta^2 - 2ak + 2\delta k - 7k^2 - 8ak\left(\frac{1}{2} + \frac{a}{2k}\right) + 8\delta k\left(\frac{1}{2} + \frac{a}{2k}\right) + 16k^2\left(\frac{1}{2} + \frac{a}{2k}\right) - 4k^2\left(\frac{1}{2} + \frac{a}{2k}\right)^2 > 0.$

$\Leftrightarrow\ 5a^2 - 10a\delta + 13\delta^2 - 2ak + 2\delta k - 7k^2 - 4ak - 4a^2 + 4\delta k + 4a\delta + 8k^2 + 8ak - k^2 - 2ak - a^2 > 0$

$\Leftrightarrow\ -6a\delta + 13\delta^2 + 6\delta k > 0$

$\Leftrightarrow\ 13\delta > 6(a-k).$

From $a - \delta > k$ it can be derived that $a - k > \delta$, but $13\delta > 6(a-k)$ does not always hold. Therefore, disaggregated reporting is preferred over aggregated reporting if $6(k-a) + 13\delta > 0$ for $\gamma = \hat{\gamma}$. Whereas aggregated reporting is the preferred reporting system if $6(k-a) + 13\delta < 0$.

For $\boldsymbol{\gamma = \underline{\gamma}}$, $\boldsymbol{\pi_{2,D} > \pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}}$ if (A9)

$\frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} > \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9}$

$\Leftrightarrow \frac{(a+\delta-(2-\gamma)k)^2}{36} + \frac{(a-\delta-k)^2}{16} > \frac{(a-(2-\gamma)k)^2}{18}$

$\Leftrightarrow 4[a + \delta - (2-\gamma)k]^2 + 9(a-\delta-k)^2 > 8(a-(2-\gamma)k)^2$

$\Leftrightarrow 4a^2 + 8a\delta + 4\delta^2 - 16ak - 16\delta k + 8a\gamma k + 8\delta\gamma k + 16k^2 - 16\gamma k^2 + 4\gamma^2k^2 + 9a^2 - 18a\delta + 9\delta^2 - 18ak + 18\delta k + 9k^2 > 8a^2 - 32ak + 16a\gamma k + 32k^2 - 32\gamma k^2 + 8\gamma^2k^2$

$\Leftrightarrow 5a^2 - 10a\delta + 13\delta^2 - 2ak + 2\delta k - 8a\gamma k + 8\delta\gamma k - 7k^2 + 16\gamma k^2 - 4\gamma^2k^2 > 0$

Substituting $\gamma = \underline{\gamma} = \frac{1}{2} + \frac{a-\delta}{2k}$, yields

$5a^2 - 10a\delta + 13\delta^2 - 2ak + 2\delta k - 7k^2 - 8ak\left(\frac{1}{2} + \frac{a-\delta}{2k}\right) + 8\delta k\left(\frac{1}{2} + \frac{a-\delta}{2k}\right) + 16k^2\left(\frac{1}{2} + \frac{a-\delta}{2k}\right) - 4k^2\left(\frac{1}{2} + \frac{a-\delta}{2k}\right)^2 > 0$

$\Leftrightarrow\ 5a^2 - 10a\delta + 13\delta^2 - 2ak + 2\delta k - 7k^2 - 4ak - 4a^2 + 4a\delta + 4\delta k + 4a\delta - 4\delta^2 + 8k^2 + 8ak - 8\delta k - k^2 - 2ak - a^2 + 2a\delta + 2\delta k - \delta^2 > 0$

$\Leftrightarrow\ 8\delta^2 > 0.$

This is always true as δ^2 is always positive. Only when $\delta = 0$ the reporting system would not matter.

For $\gamma = \overline{\gamma}$, $\pi_{2,D} > \pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ if (A10)

$\frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} > \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4}$

$\Leftrightarrow\ \frac{(a+\delta-(2-\gamma)k)^2}{36} + \frac{(a-\delta-k)^2}{16} > \frac{(a-k)^2}{8}$

$\Leftrightarrow 4[a + \delta - (2-\gamma)k]^2 + 9(a - \delta - k)^2 > 18(a - k)^2$

$\Leftrightarrow 4a^2 + 8a\delta + 4\delta^2 - 16ak - 16\delta k + 8a\gamma k + 8\delta\gamma k + 16k^2 - 16\gamma k^2 + 4\gamma^2 k^2 + 9a^2 - 18a\delta + 9\delta^2 - 18ak + 18\delta k + 9k^2 > 18a^2 - 36ak + 18k^2$

$\Leftrightarrow -5a^2 - 10a\delta + 13\delta^2 + 2ak + 2\delta k + 7k^2 + 8a\gamma k + 8\delta\gamma k - 16\gamma k^2 + 4\gamma^2 k^2 > 0$

Substituting $\gamma = \overline{\gamma} = \frac{1}{2} + \frac{a+\delta}{2k}$, yields

$-5a^2 - 10a\delta + 13\delta^2 + 2ak + 2\delta k + 7k^2 + 8ak\left(\frac{1}{2} + \frac{a+\delta}{2k}\right) + 8\delta k\left(\frac{1}{2} + \frac{a+\delta}{2k}\right) - 16k^2\left(\frac{1}{2} + \frac{a+\delta}{2k}\right) + 4k^2\left(\frac{1}{2} + \frac{a+\delta}{2k}\right)^2 > 0$

$\Leftrightarrow\ -5a^2 - 10a\delta + 13\delta^2 + 2ak + 2\delta k + 7k^2 + 4ak + 4a^2 + 4a\delta + 4\delta k + 4a\delta + 4\delta^2 - 8k^2 - 8ak - 8\delta k + k^2 + 2ak + a^2 + 2a\delta + 2\delta k + \delta^2 > 0$

$\Leftrightarrow\ 18\delta^2 > 0.$

This is always true as δ^2 is always positive. Only when $\delta = 0$ the reporting system would not matter.

Comparing $\pi_{2,\mathrm{D}}$ and $\pi_{2,\mathrm{A}}$ in the duopoly setting shows that aggregated reporting can be beneficial for the incumbent firm in market 2. But, only under certain conditions. For $\gamma = \underline{\gamma}$ and $\gamma = \overline{\gamma}$ the disaggregated reporting setting generates higher profits. Yet, for $\gamma = \hat{\gamma}$ and if $6\,(k-a) + 13\delta < 0$ the aggregated reporting secures higher profits for the firm than the disaggregated reporting.

Furthermore, it is necessary to prove that there exist only two points of intersection for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$. This is possible by comparing the first derivatives of the profits with respect to the parameter of the productivity advantage γ. The comparison yields that

$$\frac{\partial \pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}}{\partial \gamma} > \frac{\partial \pi_{2,D}}{\partial \gamma} \qquad \text{iff} \qquad \frac{k}{18}(3a + \delta + 3\gamma k - 6k) > \frac{k}{9}(a + \delta + \gamma k - 2k) \tag{A11}$$

$$\Leftrightarrow 3a + \delta + 3\gamma k - 6k > 2a + 2\delta + 2\gamma k - 4k \qquad \Leftrightarrow \qquad a - \delta > 2k - \gamma k, \tag{A12}$$

where the right-hand side of the last inequality is decreasing in γ. Thus, the inequality holds for all $\gamma \in [\underline{\gamma}, \hat{\gamma}]$ if it holds for the lowest value of the interval, i.e., for $\gamma = \underline{\gamma}$. Substituting $\underline{\gamma}$ in (A12), yields

$$a - \delta > 2k - \left(\frac{1}{2} + \frac{a-\delta}{2k}\right)k \qquad \Leftrightarrow \qquad \frac{3}{2}(a - \delta) > \frac{3}{2}k, \tag{A13}$$

which follows from Assumption 1.

Hence, $\pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ is lower than $\pi_{2,D}$ at $\gamma = \underline{\gamma}$, but its marginal increase is higher as γ increases, for all $\gamma \in [\underline{\gamma}, \hat{\gamma}]$. However, as $\pi_{2,A_{[\underline{\gamma},\hat{\gamma}]}}$ is larger than $\pi_{2,D}$ at $\gamma = \hat{\gamma}$, if and only if

$$6\,(k-a) + 13\delta < 0, \tag{A14}$$

this implies that there exists exactly one value of γ (denoted γ_1), where the profits under both reporting regimes are equal for $\gamma \in [\underline{\gamma}, \hat{\gamma}]$.

Contrarily, for $\gamma \in [\hat{\gamma}, \overline{\gamma}]$, the first derivative of $\pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}$ with respect to γ is lower than that of $\pi_{2,D}$, i.e.,

$$\frac{\partial \pi_{2,A_{[\hat{\gamma},\overline{\gamma}]}}}{\partial \gamma} < \frac{\partial \pi_{2,D}}{\partial \gamma} \qquad \text{iff} \qquad \frac{k}{18}(a + \delta + \gamma k - 2k) < \frac{k}{9}(a + \delta + \gamma k - 2k) \tag{A15}$$

$$\Leftrightarrow a+\delta+\gamma k-2k<2a+2\delta+2\gamma k-4k \qquad \Leftrightarrow \qquad 2k-\gamma k<a+\delta, \tag{A16}$$

where the left-hand side of the last inequality is decreasing in γ. Thus, if (A16) holds for the lowest value of $\gamma \in [\hat{\gamma},\overline{\gamma}]$, i.e., $\gamma=\hat{\gamma}$, it has to hold for all $\gamma \in [\hat{\gamma},\overline{\gamma}]$. Substituting $\hat{\gamma}$ in (A16) yields

$$2k-\left(\frac{1}{2}+\frac{a}{2k}\right)k<a+\delta \qquad \Leftrightarrow \qquad \frac{3}{2}k<\frac{3}{2}a+\delta, \tag{A17}$$

which holds by Assumption 1 and because $\delta \geq 0$. As profits under aggregated reporting are higher at $\gamma=\hat{\gamma}$ if $6\,(k-a)+13\delta<0$ holds, but lower for $\gamma=\overline{\gamma}$, this implies that there exists exactly one value of γ (denoted γ_2), where the profits under both reporting regimes are identical for $\gamma \in [\hat{\gamma},\overline{\gamma}]$. Consequently, aggregated reporting implies higher profits in market 2 for the incumbent firm if $6\,(k-a)+13\delta<0$ holds and if the competitor's cost disadvantage is on a medium level, i.e., $\gamma \in [\gamma_1,\gamma_2]$. ■

Proof of Proposition 4

PROPOSITION 4. *Aggregated reporting is beneficial for the incumbent firm overall, if* $6\,(k-a)+31\delta<0$ *and* $\gamma \in [\gamma_3,\gamma_4]$.

To examine if aggregated reporting can be beneficial for the firm concerning total profits, the total profits for the different values of γ, i.e., $\gamma=\underline{\gamma}$, $\gamma=\hat{\gamma}$ and $\gamma=\overline{\gamma}$, are compared. Note that $\pi_{A_{[\underline{\gamma},\hat{\gamma}]}}=\pi_{A_{[\hat{\gamma},\overline{\gamma}]}}$ for $\gamma=\hat{\gamma}$.

For $\boldsymbol{\gamma=\hat{\gamma}, \pi_D>\pi_{A_{[\underline{\gamma},\hat{\gamma}]}}}$ if (A18)

$$\frac{1}{2}\frac{(a+\delta-k)^2}{4}+\frac{(a-\delta-k)^2}{4}+\frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9}>\frac{1}{4}\frac{(a+\delta-k)^2}{4}+\frac{1}{2}\frac{(a-\delta-k)^2}{4}+\frac{1}{2}\frac{(a-k)^2}{4}+$$
$$\frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9}+\frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9}$$

$$\Leftrightarrow \frac{(a+\delta-k)^2}{16}+\frac{(a-\delta-k)^2}{8}+\frac{(a+\delta-(2-\gamma)k)^2}{36}>\frac{(a-k)^2}{8}+\frac{(a-(2-\gamma)k)^2}{18}$$

$$\Leftrightarrow 9(a+\delta-k)^2+18(a-\delta-k)^2+4[a+\delta-(2-\gamma)k]^2>18(a-k)^2+8[a-(2-\gamma)k]^2$$

$\Leftrightarrow 9a^2 + 18a\delta + 9\delta^2 - 18ak - 18\delta k + 9k^2 + 18a^2 - 36a\delta + 18\delta^2 - 36ak + 36\delta k + 18k^2 + 4a^2 + 8a\delta + 4\delta^2 - 16ak - 16\delta k + 8a\gamma k + 8\delta\gamma k + 16k^2 - 16\gamma k^2 + 4\gamma^2 k^2 > 18a^2 - 36ak + 18k^2 + 8a^2 - 32ak + 16a\gamma k + 32k^2 - 32\gamma k^2 + 8\gamma^2 k^2$

$\Leftrightarrow\ 5a^2 - 10a\delta + 31\delta^2 - 2ak + 2\delta k - 7k^2 - 8a\gamma k + 8\delta\gamma k + 16\gamma k^2 - 4\gamma^2 k^2 > 0$

Substituting $\gamma = \hat{\gamma} = \frac{1}{2} + \frac{a}{2k}$, yields

$5a^2 - 10a\delta + 31\delta^2 - 2ak + 2\delta k - 7k^2 - 8ak\left(\frac{1}{2} + \frac{a}{2k}\right) + 8\delta k\left(\frac{1}{2} + \frac{a}{2k}\right) + 16k^2\left(\frac{1}{2} + \frac{a}{2k}\right) - 4k^2\left(\frac{1}{2} + \frac{a}{2k}\right)^2 > 0$

$\Leftrightarrow\ 5a^2 - 10a\delta + 31\delta^2 - 2ak + 2\delta k - 7k^2 - 4ak - 4a^2 + 4\delta k + 4a\delta + 8k^2 + 8ak - k^2 - 2ak - a^2 > 0$

$\Leftrightarrow -6a\delta + 31\delta^2 + 6\delta k > 0$

$\Leftrightarrow\ 6(k - a) + 31\delta > 0$

$\Leftrightarrow\ 31\delta > 6(a - k).$

From $a - \delta > k$ it can be derived that $a - k > \delta$, but $31\delta > 6(a - k)$ does not always hold. Therefore, disaggregated reporting is preferred over aggregated reporting if $6(k - a) + 31\delta > 0$ for $\gamma = \hat{\gamma}$. Whereas aggregated reporting is the preferred reporting system if $6(k - a) + 31\delta < 0$.

For $\boldsymbol{\gamma = \underline{\gamma}, \pi_D > \pi_{A_{[\underline{\gamma},\hat{\gamma}]}}}$ if (A19)

$\frac{1}{2}\frac{(a+\delta-k)^2}{4} + \frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} > \frac{1}{4}\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a-k)^2}{4} + \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9}$

$\Leftrightarrow \frac{(a+\delta-k)^2}{16} + \frac{(a-\delta-k)^2}{8} + \frac{(a+\delta-(2-\gamma)k)^2}{36} > \frac{(a-k)^2}{8} + \frac{(a-(2-\gamma)k)^2}{18}$

$\Leftrightarrow 9(a + \delta - k)^2 + 18(a - \delta - k)^2 + 4[a + \delta - (2 - \gamma)k]^2 > 18(a - k)^2 + 8(a - (2 - \gamma)k)^2$

$\Leftrightarrow 9a^2 + 18a\delta + 9\delta^2 - 18ak - 18\delta k + 9k^2 + 18a^2 - 36a\delta + 18\delta^2 - 36ak + 36\delta k + 18k^2 + 4a^2 + 8a\delta + 4\delta^2 - 16ak - 16\delta k + 8a\gamma k + 8\delta\gamma k + 16k^2 - 16\gamma k^2 + 4\gamma^2 k^2 > 18a^2 - 36ak + 18k^2 + 8a^2 - 32ak + 16a\gamma k + 32k^2 - 32\gamma k^2 + 8\gamma^2 k^2$

$\Leftrightarrow \; 5a^2 - 10a\delta + 31\delta^2 - 2ak + 2\delta k - 7k^2 - 8a\gamma k + 8\delta\gamma k + 16\gamma k^2 - 4\gamma^2 k^2 > 0$

Substituting $\gamma = \underline{\gamma} = \frac{1}{2} + \frac{a-\delta}{2k}$, yields

$5a^2 - 10a\delta + 31\delta^2 - 2ak + 2\delta k - 7k^2 - 8ak\left(\frac{1}{2} + \frac{a-\delta}{2k}\right) + 8\delta k\left(\frac{1}{2} + \frac{a-\delta}{2k}\right) + 16k^2\left(\frac{1}{2} + \frac{a-\delta}{2k}\right) - 4k^2\left(\frac{1}{2} + \frac{a-\delta}{2k}\right)^2 > 0$

$\Leftrightarrow \; 5a^2 - 10a\delta + 31\delta^2 - 2ak + 2\delta k - 7k^2 - 4ak - 4a^2 + 4a\delta + 4\delta k + 4a\delta - 4\delta^2 + 8k^2 + 8ak - 8\delta k - k^2 - 2ak - a^2 + 2a\delta + 2\delta k - \delta^2 > 0$

$\Leftrightarrow \; 26\delta^2 > 0.$

This is always true as δ^2 is always positive. Only when $\delta = 0$ the reporting system would not matter.

For $\boldsymbol{\gamma = \overline{\gamma}, \pi_D > \pi_{A_{[\hat{\gamma},\overline{\gamma}]}}}$ if (A20)

$$\frac{1}{2}\frac{(a+\delta-k)^2}{4} + \frac{(a-\delta-k)^2}{4} + \frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} > \frac{1}{4}\;\frac{(a+\delta-k)^2}{4} + \frac{1}{2}\;\frac{(a-\delta-k)^2}{4} + \;\frac{(a-k)^2}{4} + \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9}$$

$$\Leftrightarrow \frac{(a+\delta-k)^2}{16} + \frac{(a-\delta-k)^2}{8} + \frac{(a+\delta-(2-\gamma)k)^2}{36} > \frac{(a-k)^2}{4}$$

$\Leftrightarrow 9(a + \delta - k)^2 + 18(a - \delta - k)^2 + 4[a + \delta - (2 - \gamma)k]^2 > 36(a - k)^2$

$\Leftrightarrow 9a^2 + 18a\delta + 9\delta^2 - 18ak - 18\delta k + 9k^2 + 18a^2 - 36a\delta + 18\delta^2 - 36ak + 36\delta k + 18k^2 + 4a^2 + 8a\delta + 4\delta^2 - 16ak - 16\delta k + 8a\gamma k + 8\delta\gamma k + 16k^2 - 16\gamma k^2 + 4\gamma^2 k^2 > 36a^2 - 72ak + 36k^2$

$\Leftrightarrow \; -5a^2 - 10a\delta + 31\delta^2 + 2ak + 2\delta k + 7k^2 + 8a\gamma k + 8\delta\gamma k - 16\gamma k^2 + 4\gamma^2 k^2 > 0$

Substituting $\gamma = \overline{\gamma} = \frac{1}{2} + \frac{a+\delta}{2k}$, yields

$-5a^2 - 10a\delta + 31\delta^2 + 2ak + 2\delta k + 7k^2 + 8ak\left(\frac{1}{2} + \frac{a+\delta}{2k}\right) + 8\delta k\left(\frac{1}{2} + \frac{a+\delta}{2k}\right) - 16k^2\left(\frac{1}{2} + \frac{a+\delta}{2k}\right) + 4k^2\left(\frac{1}{2} + \frac{a+\delta}{2k}\right)^2 > 0$

$\Leftrightarrow\ -5a^2 - 10a\delta + 31\delta^2 + 2ak + 2\delta k + 7k^2 + 4ak + 4a^2 + 4a\delta + 4\delta k + 4a\delta + 4\delta^2 - 8k^2 - 8ak - 8\delta k + k^2 + 2ak + a^2 + 2a\delta + 2\delta k + \delta^2 > 0$

$\Leftrightarrow\ 36\delta^2 > 0.$

This is always true as δ^2 is always positive. Only when $\delta = 0$ the reporting system would not matter.

Similar to market 2, aggregated reporting is beneficial for the incumbent firm concerning total profits, only under a slightly different condition. The condition must hold $6\,(k-a) + 31\delta < 0$ and the cost disadvantage of the competitor must be on a medium level, i.e., $\gamma \in [\gamma_3, \gamma_4]$. The disaggregated reporting setting still generates higher profits for $\gamma = \underline{\gamma}$ and $\gamma = \overline{\gamma}$. The total profits consist of the profits of market 1 and 2, as the first derivative of the profits in market 1 are independent from γ, it is not necessary to compare the total profits' derivative concerning the parameter of the productivity advantage γ to prove that there exist only two points of intersection for $\gamma \in [\underline{\gamma}, \overline{\gamma}]$. From the proof of Proposition 3 it can be concluded that the first derivative of $\pi_{A_{[\underline{\gamma},\hat{\gamma}]}}$ is always larger than the first derivative of π_D with respect to γ for $\gamma \in [\underline{\gamma}, \hat{\gamma}]$. Whereas the first derivative of $\pi_{A_{[\hat{\gamma},\overline{\gamma}]}}$ is always smaller than the first derivative of π_D with respect to γ for $\gamma \in [\hat{\gamma}, \overline{\gamma}]$. Therefore, there exist only two points of intersection, i.e., γ_3 and γ_4. ■

Proof of Proposition 5

PROPOSITION 5. *In the monopoly consumer surplus and total welfare is higher in the disaggregated information system.*

Consumer Surplus

It is necessary to compare $E[CS_D^M]$ and $E[CS_A^M]$ in order to find out which of the reporting systems yields higher consumer surplus.

$$\boldsymbol{E\left[CS_D^M\right] > E\left[CS_A^M\right]} \tag{A21}$$

$$\Leftrightarrow \frac{1}{2}\left\{\frac{1}{4}\left[2\left(\frac{a+\delta-k}{2}\right)^2\right]+\frac{1}{4}\left[2\left(\frac{a-\delta-k}{2}\right)^2\right]+\frac{1}{2}\left[\left(\frac{a+\delta-k}{2}\right)^2+\left(\frac{a-\delta-k}{2}\right)^2\right]\right\} >$$
$$\frac{1}{2}\left\{\frac{1}{4}\left[2\left(\frac{a+\delta-k}{2}\right)^2\right]+\frac{1}{4}\left[2\left(\frac{a-\delta-k}{2}\right)^2\right]+\frac{1}{2}\left[2\left(\frac{a-k}{2}\right)^2\right]\right\}$$

$$\Leftrightarrow \left(\frac{a+\delta-k}{2}\right)^2+\left(\frac{a-\delta-k}{2}\right)^2 > 2\left(\frac{a-k}{2}\right)^2$$

$$\Leftrightarrow (a+\delta-\mathrm{k})^2+(a-\delta-\mathrm{k})^2 > 2(a-\mathrm{k})^2$$

$$\Leftrightarrow a^2+2a\delta+\delta^2-2ak-2\delta k+k^2+a^2-2a\delta+\delta^2-2ak+2\delta k+k^2 > 2a^2-4ak+2k^2$$

$$\Leftrightarrow 2a\delta+\delta^2-2\delta k-2a\delta+\delta^2+2\delta k > 0$$

$$\Leftrightarrow 2\delta^2 > 0$$

This is always true as δ^2 is always positive. Only when $\delta = 0$ the reporting system would not matter. The comparison shows that in the monopoly disaggregated reporting yields higher consumer surplus than aggregated reporting.

Total welfare

Similarly to the consumer surplus in the monopoly, it is necessary to compare the total welfare $E[W_D^M]$ and $E[W_A^M]$ to examine which reporting system is better in terms of total welfare:

$$\boldsymbol{E\left[W_D^M\right] > E\left[W_A^M\right]} \tag{A22}$$

$$\Leftrightarrow \frac{1}{2}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{1}{2}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{(a-\delta-\mathrm{k})^2}{4} > \frac{1}{4}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{1}{4}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{1}{2}\frac{(a-\mathrm{k})^2}{4}+$$
$$\frac{(a+\delta-\mathrm{k})^2}{8}+\frac{(a-\delta-\mathrm{k})^2}{8}+\frac{(a-\mathrm{k})^2}{4}$$

$$\Leftrightarrow \frac{3(a+\delta-k)^2}{16} + \frac{3(a-\delta-k)^2}{16} > \frac{3(a-k)^2}{8}$$

$$\Leftrightarrow 3(a+\delta-k)^2 + 3(a-\delta-k)^2 > 6(a-k)^2$$

$$\Leftrightarrow 3a^2 + 6a\delta + 3\delta^2 - 6ak - 6\delta k + 3k^2 + 3a^2 - 6a\delta + 3\delta^2 - 6ak + 6\delta k + 3k^2 > 6a^2 - 12ak + 6k^2$$

$$\Leftrightarrow 6a\delta + 3\delta^2 - 6\delta k - 6a\delta + 3\delta^2 + 6\delta k > 0$$

$$\Leftrightarrow 6\delta^2 > 0$$

This is always true as δ^2 is always positive. Only when $\delta = 0$ the reporting system would not matter. The comparison shows that in the monopoly disaggregated reporting yields higher total welfare than aggregated reporting. ■

Proof of Proposition 6

PROPOSITION 6. *In the duopoly consumer surplus and total welfare is higher in the disaggregated information system for all* $\gamma \in [\underline{\gamma}, \overline{\gamma}]$.

Consumer Surplus

Before it is possible to compare $E[CS_D] > E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ and $E[CS_D] > E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]$, it is necessary to show that $E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ is monotonically decreasing in γ for $\gamma \in [\underline{\gamma}, \hat{\gamma}]$ and $E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ is monotonically increasing in γ for $\gamma \in [\hat{\gamma}, \overline{\gamma}]$.

Proof that $E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ is monotonically decreasing in γ for $\gamma \in [\underline{\gamma}, \hat{\gamma}]$:

To proof that, it is necessary to show that $\frac{\partial E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]}{\partial \gamma} < 0$.

$$E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}] = \frac{1}{8}\frac{(a+\delta-k)^2}{4} + \frac{1}{8}\frac{(a-\delta-k)^2}{4} + \frac{1}{4}\frac{(a-k)^2}{4} + \frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3} + \frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\left(\frac{a-(2-\gamma)\,k}{3} + \frac{a-(2\gamma-1)\,k}{3}\right)^2$$

$$\frac{\partial E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]}{\partial \gamma} = \frac{k}{36}(-5a - 3\delta + k + 4\gamma k) \tag{A23}$$

As $\frac{k}{36}$ remains constant it is only necessary look at the rest of the equation. Thus, the first derivative is negative if

$$-5a - 3\delta + k + 4\gamma k < 0 \quad \Leftrightarrow \quad k + 4\gamma k < 5a + 3\delta. \tag{A24}$$

The left-hand side of the last inequality is increasing in γ. Thus, the inequality holds for all $\gamma \in [\underline{\gamma}, \hat{\gamma}]$ if it holds for the highest value of the interval, i.e., for $\gamma = \hat{\gamma}$. Substituting $\hat{\gamma}$ in (A24), yields

$$k + 4\left(\frac{1}{2} + \frac{a}{2k}\right)k < 5a + 3\delta \qquad \Leftrightarrow \qquad 3k < 3(a + \delta), \tag{A25}$$

which holds by Assumption 1 and because $\delta \geq 0$. Therefore, $k + 4\gamma k < 5a + 3\delta$ is true and this means that $\frac{\partial E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]}{\partial \gamma} < 0$ is true.

Proof that $E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ is monotonically increasing in γ for $\gamma \in [\hat{\gamma}, \overline{\gamma}]$:

To proof that, it is necessary to show that $\frac{\partial E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]}{\partial \gamma} > 0$.

$$E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}] = \frac{1}{8}\frac{(a+\delta-k)^2}{4} + \frac{1}{8}\frac{(a-\delta-k)^2}{4} + \frac{1}{4}\frac{(a-k)^2}{4} + \frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3} + \frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a-(2-\gamma)\,k)^2}{3}$$

$$\frac{\partial E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]}{\partial \gamma} = \frac{k}{36}(a - 3\delta - 5k + 4\gamma k) \tag{A26}$$

As $\frac{k}{36}$ remains constant it is only necessary to look at the rest of the equation. Thus, the first derivative is positive if

$$a - 3\delta - 5k + 4\gamma k > 0 \quad \Leftrightarrow \quad 5k - 4\gamma k < a - 3\delta. \tag{A27}$$

The left-hand side of the last inequality is decreasing in γ. Thus, the inequality holds for all $\gamma \in [\hat{\gamma}, \overline{\gamma}]$ if it holds for the lowest value of the interval, i.e., for $\gamma = \hat{\gamma}$. Substituting $\hat{\gamma}$ in (A27), yields

$$5k - 4\left(\frac{1}{2} + \frac{a}{2k}\right)k < 5a - 3\delta \qquad \Leftrightarrow \qquad 3k < 7a - 3\delta, \tag{A28}$$

which holds by Assumption 1. Therefore, $5\mathrm{k} - 4\gamma k < a - 3\delta$ is true and it is proven that $\frac{\partial E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]}{\partial \gamma} > 0$.

Now it is possible to examine which reporting system yields higher consumer surplus. For this, it is necessary to compare $E[CS_D]$ and $E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ for $\gamma = \hat{\gamma}$ and for $\gamma = \underline{\gamma}$, and $E[CS_D]$ and $E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ for $\gamma = \overline{\gamma}$. Note that $E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}] = E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ for $\gamma = \hat{\gamma}$.

For $\boldsymbol{\gamma = \hat{\gamma}}$, $\boldsymbol{E[CS_D] > E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]}$ if (A29)

$$\frac{1}{4}\frac{(a+\delta-\mathrm{k})^2}{4} + \frac{1}{4}\frac{(a-\delta-\mathrm{k})^2}{4} + \frac{1}{4}\left(\frac{a+\delta-(2-\gamma)\,k}{3} + \frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{4}\frac{(a-\delta-(2-\gamma)k)^2}{9} > \frac{1}{8}\frac{(a+\delta-\mathrm{k})^2}{4} + \frac{1}{8}\frac{(a-\delta-\mathrm{k})^2}{4} + \frac{1}{4}\frac{(a-\mathrm{k})^2}{4} + \frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3} + \frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\left(\frac{a-(2-\gamma)\,k}{3} + \frac{a-(2\gamma-1)\,k}{3}\right)^2$$

$$\Leftrightarrow \frac{(a+\delta-\mathrm{k})^2}{32} + \frac{(a-\delta-\mathrm{k})^2}{32} + \frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3} + \frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9} > \frac{(a-\mathrm{k})^2}{16} + \frac{1}{4}\left(\frac{a-(2-\gamma)\,k}{3} + \frac{a-(2\gamma-1)\,k}{3}\right)^2$$

$$\Leftrightarrow 9(a+\delta-\mathrm{k})^2 + 9(a-\delta-\mathrm{k})^2 + 4\{[a+\delta-(2-\gamma)\,k]^2 + 2[a+\delta-(2-\gamma)\,k][a+\delta-(2\gamma-1)\,k] + [a+\delta-(2\gamma-1)\,k]^2\} + 4[a-\delta-(2-\gamma)k]^2 > 18(a-\mathrm{k})^2 + 8\{[a-(2-\gamma)\,k]^2 + 2[a-(2-\gamma)\,k][a-(2\gamma-1)\,k] + [a-(2\gamma-1)\,k]^2\}$$

$$\Leftrightarrow 9a^2 + 18a\delta + 9\delta^2 - 18ak - 18\delta k + 9k^2 + 9a^2 - 18a\delta + 9\delta^2 - 18ak + 18\delta k + 9k^2 + 4a^2 + 8a\delta + 4\delta^2 - 16ak - 16\delta k + 8a\gamma k + 8\delta\gamma k + 16k^2 - 16\gamma k^2 + 4\gamma^2k^2 + 8a^2 + 16a\delta - 8a\gamma k - 8ak + 8\delta^2 - 8\delta\gamma k - 8\delta k + 40\gamma k^2 - 16k^2 - 16\gamma^2k^2 + 4a^2 + 8a\delta + 4\delta^2 - 16a\gamma k + 8ak + 16\gamma^2k^2 - 16\gamma k^2 + 4k^2 - 16\delta\gamma k + 8\delta k + 4a^2 - 8a\delta + 4\delta^2 - 16ak + 16\delta k + 8a\gamma k - 8\delta\gamma k + 16k^2 - 16\gamma k^2 + 4\gamma^2k^2 > 18a^2 - 36ak + 18k^2 + 8a^2 - 32ak + 16a\gamma k + 32k^2 - 32\gamma k^2 + 8\gamma^2k^2 + 16a^2 - 32a\gamma k + 16ak - 32ak + 16a\gamma k + 64\gamma k^2 - 32k^2 - 32\gamma^2k^2 + 16\gamma k^2 + 8a^2 - 32a\gamma k + 16ak + 32\gamma^2k^2 - 32\gamma k^2 + 8k^2$$

$\Leftrightarrow 38a^2 + 24a\delta + 38\delta^2 - 68ak + 38k^2 - 8a\gamma k - 8\gamma k^2 + 8\gamma^2k^2 - 24\delta\gamma k > 50a^2 - 68ak + 26k^2 + 16\gamma k^2 + 8\gamma^2k^2 - 32a\gamma k$

$\Leftrightarrow -12a^2 + 24a\delta + 38\delta^2 + 12k^2 + 24a\gamma k - 24\gamma k^2 - 24\delta\gamma k > 0$

Substituting $\gamma = \hat{\gamma} = \frac{1}{2} + \frac{a}{2k}$, yields

$-12a^2 + 24a\delta + 38\delta^2 + 12k^2 + 24ak\left(\frac{1}{2} + \frac{a}{2k}\right) - 24k^2\left(\frac{1}{2} + \frac{a}{2k}\right) - 24\delta k\left(\frac{1}{2} + \frac{a}{2k}\right) > 0$

$\Leftrightarrow -12a^2 + 24a\delta + 38\delta^2 + 12k^2 + 12ak + 12a^2 - 12k^2 - 12ak - 12\delta k - 12a\delta > 0.$

$\Leftrightarrow 6a\delta + 19\delta^2 - 6\delta k > 0$

$\Leftrightarrow 6(a - k) + 19\delta > 0.$

This is true as $a > 0$, $\delta > 0$ and $a > k$.

For $\gamma = \underline{\gamma}$, $E[CS_D] > E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ if (A30)

$\frac{1}{4}\frac{(a+\delta-\mathrm{k})^2}{4} + \frac{1}{4}\frac{(a-\delta-\mathrm{k})^2}{4} + \frac{1}{4}\left(\frac{a+\delta-(2-\gamma)\,k}{3} + \frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{4}\frac{(a-\delta-(2-\gamma)k)^2}{9} > \frac{1}{8}\frac{(a+\delta-\mathrm{k})^2}{4} + \frac{1}{8}\frac{(a-\delta-\mathrm{k})^2}{4} + \frac{1}{4}\frac{(a-\mathrm{k})^2}{4} + \frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3} + \frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\left(\frac{a-(2-\gamma)\,k}{3} + \frac{a-(2\gamma-1)\,k}{3}\right)^2$

To avoid repeating calculations, the intermediate results are copied from (A29).

$-12a^2 + 24a\delta + 38\delta^2 + 12k^2 + 24a\gamma k - 24\gamma k^2 - 24\delta\gamma k > 0$

Substituting $\gamma = \underline{\gamma} = \frac{1}{2} + \frac{a-\delta}{2k}$, yields

$-12a^2 + 24a\delta + 38\delta^2 + 12k^2 + 24ak\left(\frac{1}{2} + \frac{a-\delta}{2k}\right) - 24k^2\left(\frac{1}{2} + \frac{a-\delta}{2k}\right) - 24\delta k\left(\frac{1}{2} + \frac{a-\delta}{2k}\right) > 0$

$\Leftrightarrow -12a^2 + 24a\delta + 38\delta^2 + 12k^2 + 12ak + 12a^2 - 12a\delta - 12k^2 - 12ak + 12\delta k - 12\delta k - 12a\delta + 12\delta^2 > 0$

$\Leftrightarrow 50\delta^2 > 0.$

This is true as δ^2 is always positive. Only when $\delta = 0$ the consumer surplus would be the same under both reporting systems.

For $\boldsymbol{\gamma = \overline{\gamma}}$, $\boldsymbol{E[CS_D] > E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]}$ if (A31)

$$\frac{1}{4}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{1}{4}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{1}{4}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2+\frac{1}{4}\frac{(a-\delta-(2-\gamma)k)^2}{9}>\frac{1}{8}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{1}{8}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{1}{4}\frac{(a-\mathrm{k})^2}{4}+\frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2+\frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9}+\frac{1}{4}\frac{(a-(2-\gamma)\,k)^2}{9}$$

$$\Leftrightarrow \frac{(a+\delta-\mathrm{k})^2}{32}+\frac{(a-\delta-\mathrm{k})^2}{32}+\frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2+\frac{(a-\delta-(2-\gamma)k)^2}{72}>\frac{(a-\mathrm{k})^2}{16}+\frac{1}{4}\frac{(a-(2-\gamma)\,k)^2}{9}$$

To avoid repeating calculations, the intermediate results of the left side are copied from (A29).

$$38a^2+24a\delta+38\delta^2-68ak+38k^2-8a\gamma k-8\gamma k^2+8\gamma^2k^2-24\delta\gamma k>18(a-k)^2+8[a-(2-\gamma)\,k]^2$$

$$\Leftrightarrow 38a^2+24a\delta+38\delta^2-68ak+38k^2-8a\gamma k-8\gamma k^2+8\gamma^2k^2-24\delta\gamma k>18a^2-36ak+18k^2+8a^2-32ak+16a\gamma k+32k^2-32\gamma k^2+8\gamma^2k^2$$

$$\Leftrightarrow 6a^2+12a\delta+19\delta^2-6k^2-12a\gamma k+12\gamma k^2-12\delta\gamma k>0$$

Substituting $\gamma = \overline{\gamma} = \frac{1}{2}+\frac{a+\delta}{2k}$, yields

$$6a^2+12a\delta+19\delta^2-6k^2-12ak\left(\frac{1}{2}+\frac{a+\delta}{2k}\right)+12k^2\left(\frac{1}{2}+\frac{a+\delta}{2k}\right)-12\delta k\left(\frac{1}{2}+\frac{a+\delta}{2k}\right)>0$$

$$\Leftrightarrow 6a^2+12a\delta+19\delta^2-6k^2-6ak-6a^2-6a\delta+6k^2+6ak+6\delta k-6\delta k-6a\delta-6\delta^2>0$$

$$\Leftrightarrow 13\delta^2>0.$$

This is true as δ^2 is always positive.

The results show that disaggregated reporting yields higher consumer surplus than aggregated reporting in the duopoly for all $\gamma \in [\underline{\gamma},\overline{\gamma}]$ if $\delta > 0$. Only for $\delta = 0$ the consumer surplus would be the same under both reporting systems. As consumer surplus is higher under disaggregated reporting for the various values of γ, i.e., $\gamma = \underline{\gamma}$, $\gamma = \hat{\gamma}$ and $\gamma = \overline{\gamma}$, it can be concluded that there exist no points of intersection of $E[CS_D]$ and $E[CS_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ for $\gamma \in [\underline{\gamma}, \hat{\gamma}]$, and $E[CS_D]$ and $E[CS_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ for $\gamma \in [\hat{\gamma}, \overline{\gamma}]$.

Total welfare

To examine which reporting system yields higher total welfare, it is necessary to compare $E[W_D]$ and $E[W_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ for $\gamma = \hat{\gamma}$ and for $\gamma = \underline{\gamma}$, and $E[W_D]$and$E[W_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ for $\gamma = \overline{\gamma}$. Note that $E[W_{A_{[\underline{\gamma},\hat{\gamma}]}}] = E[W_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ for $\gamma = \hat{\gamma}$.

For $\boldsymbol{\gamma = \hat{\gamma}}$, $\boldsymbol{E[W_D] > E[W_{A_{[\underline{\gamma},\hat{\gamma}]}}]}$ if (A32)

$$\frac{3}{4}\frac{(a+\delta-k)^2}{4} + \frac{5}{4}\frac{(a-\delta-k)^2}{4} + \frac{1}{4}\left(\frac{a+\delta-(2-\gamma)\,k}{3} + \frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{4}\frac{(a-\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a+\delta-(2\gamma-1)\,k)^2}{9} > \frac{3}{8}\frac{(a+\delta-k)^2}{4} + \frac{5}{8}\frac{(a-\delta-k)^2}{4} + \frac{3}{4}\frac{(a-k)^2}{4} + \frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3} + \frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\left(\frac{a-(2-\gamma)\,k}{3} + \frac{a-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a+\delta-(2\gamma-1)\,k)^2}{9} + \frac{1}{2}\frac{(a-(2\gamma-1)\,k)^2}{9}$$

$$\Leftrightarrow \frac{3}{8}\frac{(a+\delta-k)^2}{4} + \frac{5}{8}\frac{(a-\delta-k)^2}{4} + \frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3} + \frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9} + \frac{1}{4}\frac{(a+\delta-(2\gamma-1)\,k)^2}{9} > \frac{3}{4}\frac{(a-k)^2}{4} + \frac{1}{4}\left(\frac{a-(2-\gamma)\,k}{3} + \frac{a-(2\gamma-1)\,k}{3}\right)^2 + \frac{1}{2}\frac{(a-(2-\gamma)k)^2}{9} + \frac{1}{2}\frac{(a-(2\gamma-1)\,k)^2}{9}$$

$$\Leftrightarrow 27(a+\delta-k)^2 + 45(a-\delta-k)^2 + 4[a+\delta-(2-\gamma)\,k + a+\delta-(2\gamma-1)\,k]^2 + 4[a-\delta-(2-\gamma)k]^2 + 8[a+\delta-(2-\gamma)k]^2 + 8[a+\delta-(2\gamma-1)k]^2 > 54(a-k)^2 + 8[a-(2-\gamma)\,k + a-(2\gamma-1)\,k]^2 + 16[a-(2-\gamma)k]^2 + 16[a-(2\gamma-1)k]^2$$

$$\Leftrightarrow 108a^2 + 20a\delta + 108\delta^2 - 192ak + 20\delta k + 132k^2 - 24a\gamma k - 40\delta\gamma k - 72\gamma k^2 + 48\gamma^2k^2 > 118a^2 - 172ak + 142k^2 - 64a\gamma k - 112\gamma k^2 + 88\gamma^2k^2$$

$$\Leftrightarrow -10a^2 + 20a\delta + 108\delta^2 - 20ak + 20\delta k - 10k^2 + 40a\gamma k - 40\delta\gamma k + 40\gamma k^2 - 40\gamma^2k^2 > 0$$

Substituting $\gamma = \hat{\gamma} = \frac{1}{2} + \frac{a}{2k}$, yields

$$-10a^2 + 20a\delta + 108\delta^2 - 20ak + 20\delta k - 10k^2 + 40ak\left(\frac{1}{2} + \frac{a}{2k}\right) - 40k\delta\left(\frac{1}{2} + \frac{a}{2k}\right) + 40k^2\left(\frac{1}{2} + \frac{a}{2k}\right) - 40k^2\left(\frac{1}{2} + \frac{a}{2k}\right)^2 > 0$$

$$\Leftrightarrow -10a^2 + 20a\delta + 108\delta^2 - 20ak + 20\delta k - 10k^2 + 20ak + 20a^2 - 20k\delta - 20a\delta + 20k^2 + 20ak - 10k^2 - 20ak - 10a^2 > 0$$

$$\Leftrightarrow 108\delta^2 > 0.$$

This is always true as δ^2 is always positive. Only when $\delta = 0$ the total welfare would be the same under both reporting systems.

For $\boldsymbol{\gamma = \underline{\gamma}}$, $\boldsymbol{E[W_D] > E[W_{A_{[\underline{\gamma},\hat{\gamma}]}}]}$ if (A33)

To avoid repeating calculations, the intermediate results are copied from (A32).

$$-10a^2 + 20a\delta + 108\delta^2 - 20ak + 20\delta k - 10k^2 + 40a\gamma k - 40\delta\gamma k + 40\gamma k^2 - 40\gamma^2 k^2 > 0$$

Substituting $\gamma = \underline{\gamma} = \frac{1}{2} + \frac{a-\delta}{2k}$, yields

$$-10a^2 + 20a\delta + 108\delta^2 - 20ak + 20\delta k - 10k^2 + 40ak\left(\frac{1}{2} + \frac{a-\delta}{2k}\right) - 40k\delta\left(\frac{1}{2} + \frac{a-\delta}{2k}\right) + 40k^2\left(\frac{1}{2} + \frac{a-\delta}{2k}\right) - 40k^2\left(\frac{1}{2} + \frac{a-\delta}{2k}\right)^2 > 0$$

$$\Leftrightarrow -10a^2 - 20ak - 10k^2 + 20a\delta + 20k\delta + 108\delta^2 + 20ak + 20a^2 - 20a\delta - 20k\delta - 20a\delta + 20\delta^2 + 20k^2 + 20ak - 20k\delta - 10k^2 - 20ak + 20k\delta - 10a^2 + 20a\delta - 10\delta^2 > 0$$

$$\Leftrightarrow 118\delta^2 > 0.$$

This is always true as δ^2 is always positive. Only when $\delta = 0$ the total welfare would be the same under both reporting systems.

For $\boldsymbol{\gamma = \overline{\gamma}}$, $\boldsymbol{E[W_D] > E[W_{A_{[\hat{\gamma},\overline{\gamma}]}}]}$ if (A34)

$$\frac{3}{4}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{5}{4}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{1}{4}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2+\frac{1}{4}\frac{(a-\delta-(2-\gamma)k)^2}{9}+\frac{1}{2}\frac{(a+\delta-(2-\gamma)k)^2}{9}+\frac{1}{2}\frac{(a+\delta-(2\gamma-1)\,\mathrm{k})^2}{9}>\frac{3}{8}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{5}{8}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{5}{4}\frac{(a-\mathrm{k})^2}{4}+\frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2+\frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9}+\frac{1}{4}\frac{(a-(2-\gamma)\,k)^2}{9}+\frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9}+\frac{1}{4}\frac{(a+\delta-(2\gamma-1)\,\mathrm{k})^2}{9}$$

$$\Leftrightarrow \frac{3}{8}\frac{(a+\delta-\mathrm{k})^2}{4}+\frac{5}{8}\frac{(a-\delta-\mathrm{k})^2}{4}+\frac{1}{8}\left(\frac{a+\delta-(2-\gamma)\,k}{3}+\frac{a+\delta-(2\gamma-1)\,k}{3}\right)^2+\frac{1}{8}\frac{(a-\delta-(2-\gamma)k)^2}{9}+\frac{1}{4}\frac{(a+\delta-(2-\gamma)k)^2}{9}+\frac{1}{4}\frac{(a+\delta-(2\gamma-1)\,\mathrm{k})^2}{9}>\frac{5}{4}\frac{(a-\mathrm{k})^2}{4}+\frac{1}{4}\frac{(a-(2-\gamma)\,k)^2}{9}$$

To avoid repeating calculations, the intermediate results of the left side are copied from (A32).

$$108a^2+20a\delta+108\delta^2-192ak+20\delta k+132k^2-24a\gamma k-40\delta\gamma k-72\gamma k^2+48\gamma^2k^2>90(a-\mathrm{k})^2+8[a-(2-\gamma)k]^2$$

$$\Leftrightarrow 108a^2+20a\delta+108\delta^2-192ak+20\delta k+132k^2-24a\gamma k-40\delta\gamma k-72\gamma k^2+48\gamma^2k^2>90a^2-180ak+90k^2+8a^2-32ak+16a\gamma k+32k^2-32\gamma k^2+8\gamma^2k^2$$

$$\Leftrightarrow 10a^2+20a\delta+108\delta^2+20ak+20\delta k+10k^2-40a\gamma k-40\delta\gamma k-40\gamma k^2+40\gamma^2k^2>0$$

Substituting $\gamma=\overline{\gamma}=\frac{1}{2}+\frac{a+\delta}{2k}$, yields

$$10a^2+20a\delta+108\delta^2+20ak+20\delta k+10k^2-40ak\left(\frac{1}{2}+\frac{a+\delta}{2k}\right)-40k\delta\left(\frac{1}{2}+\frac{a+\delta}{2k}\right)-40k^2\left(\frac{1}{2}+\frac{a+\delta}{2k}\right)+40k^2\left(\frac{1}{2}+\frac{a+\delta}{2k}\right)^2>0$$

$$\Leftrightarrow 10a^2+20a\delta+108\delta^2+20ak+20\delta k+10k^2-20ak-20a^2-20a\delta-20k\delta-20a\delta-20\delta^2-20k^2-20ak-20k\delta+10k^2+20ak+20k\delta+10a^2+20a\delta+10\delta^2>0$$

$$\Leftrightarrow 98\delta^2>0.$$

This is always true as δ^2 is always positive. Only when $\delta=0$ the total welfare would be the same under both reporting systems.

The results show that disaggregated reporting yields higher total welfare than aggregated reporting in the duopoly for all $\gamma\in[\underline{\gamma},\overline{\gamma}]$. As total welfare is higher under disaggregated reporting for the various values of γ, i.e., $\gamma = \underline{\gamma}$, $\gamma = \hat{\gamma}$ and $\gamma = \overline{\gamma}$, it can be concluded that there exist no points of intersection of $E[W_D]$ and $E[W_{A_{[\underline{\gamma},\hat{\gamma}]}}]$ for $\gamma \in [\underline{\gamma},\hat{\gamma}]$, and $E[W_D]$ and $E[W_{A_{[\hat{\gamma},\overline{\gamma}]}}]$ for $\gamma \in [\hat{\gamma},\overline{\gamma}]$. ■

Abstract

This master thesis reviews the theoretical and empirical literature on segment reporting. Furthermore, a simple theory model demonstrates implications of segment reporting under competition. The literature contributions are divided into incentives to conceal and incentives to reveal information. It can be observed that firms face a trade-off between those incentives. Consequently, it seems that in most cases the incentives to conceal are predominant. The results of the simple theory model demonstrate that aggregated reporting can be the preferred information system of the incumbent firm under certain conditions. Moreover, the implications of the welfare analysis show that disaggregated reporting provides higher consumer surplus and higher total welfare.

German abstract

Die vorliegende Masterarbeit beschäftigt sich mit Segmentberichterstattung im Wettbewerb. Einerseits soll sie einen Überblick der theoretischen und empirischen Literatur bieten und andererseits sollen anhand eines einfachen Modells die Auswirkungen von Segmentberichterstattung im Wettbewerb erläutert werden. Der Literaturüberblick gliedert sich in Anreize Informationen zu verbergen und Anreize Informationen zu enthüllen. Es kann beobachtet werden, dass zwischen diesen Anreizen ein Abwägen der Vor- und Nachteile herrscht. Folglich scheint es, dass in den meisten Fällen die Anreize Informationen zu verbergen vorherrschen. Die Ergebnisse des Modells zeigen, dass aggregierte Berichterstattung unter gewissen Umständen die bevorzugte Methode des etablierten Unternehmens ist. Weiters belegen die Schlussfolgerungen der Wohlfahrtsanalyse, dass durch Segmentberichterstattung eine höhere Konsumentenrente und Gesamtwohlfahrt erzielt werden kann.