The battle of the game consoles: Utilizing Chernoff faces in modelling competitive dynamics between MNCs

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Abstract of master's thesis

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Abstract

This thesis reviews the research on multimarket competition and competitive dynamics, and contributes to the literature by examining how competition can be modeled in the global game consoles market between Microsoft Xbox 360 and Sony PlayStation 3.

The empirical study is conducted by collecting data with the method of structured content analysis. The data is analyzed with quantitative methods. Specifically, I suggest that the visual statistical method of Chernoff faces can be used to help to counter some of the statistical issues related to data analysis.

This thesis includes a theoretical contribution in the form of a conceptual framework of competitive behavior between a rival multinational firm dyad. Additionally the thesis addresses the methodology of competitive dynamic modeling.

The empirical case suggests that the two game console manufacturers Sony and Microsoft compete with each other aggressively, concentrating especially on service and signaling actions. Although the first mover Microsoft has been more aggressive, Sony has been gaining on in sales volume, and the market is currently quite equally shared between the two companies.

The future of the two game console giants depends on how well they can keep up with the forces of creative destruction in their hypercompetitive environment. The managers in the multinational firms should consider the competitive dynamics with their main competitors closely in order to ensure the success of the firms in the long term.

Keywords Multinational corporations (MNCs), global strategy, firm behaviour, competitive dynamics modelling, Chernoff faces, game consoles, creative destruction

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Tiivistelmä

Tämä pro gradu-tutkielma keskittyy useamman markkinan kilpailuteorioihin ja dynaamisiin kilpailumalleihin, ja tutkii kuinka kilpailua voidaan mallintaa pelikonsolimarkkinoilla Microsoft Xbox 360:n ja Sony PlayStation 3:n välillä.

Tutkimuksessa käytetty data kerätään käyttämällä luokittelevan sisällönanalyysin menetelmää ja analysoidaan kvantitatiivisin menetelmin. Erityisesti ehdotan, että useiden muuttujien dynaamisten mallien yhteydessä voidaan käyttää Chernoffin naamojen graafista tilastomenetelmää selkeyttämässä data-analyysiä.

Tämän tutkimuksen teoreettinen kontribuutio on viitekehys, jolla esitetään kahden globaalin markkinapelaajan välistä kilpailukäyttäytymistä. Lisäksi pohditaan dynaamisten kilpailumallien metodologiaa.

Empiirisen tutkimuksen perusteella voidaan sanoa, että pelikonsolivalmistajat Sony ja Microsoft kilpailevat keskenään aggressiivisesti, ja käyttävät kilpailuun etenkin palvelu- ja signalointistrategioita. Vaikka markkinajohtaja Microsoft on ollut aggressiivisempi pelaaja, näyttää Sony kuroneen Microsoftin johtoaseman kiinni.

Näiden kahden monikansallisen pelikonsolijättiläisen tulevaisuus riippuu siitä, miten hyvin ne pysyvät mukana hyperkilpailullisessa ympäristössään luovan tuhon voimien keskellä. Tässä pro gradu –tutkielmassa painotetaan, että pitkän aikavälin menestyksen takaamiseksi monikansallisten yhtiöiden johtajien tulisi tarkkailla dynaamista kilpailua lähimpien kilpailijoidensa kanssa.

Avainsanat Monikansalliset yritykset, globaali strategia, yritysten käyttäytyminen, dynaamiset kilpailumallit, Chernoffin naamat, pelikonsolit, luova tuho

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1 INTRODUCTION

The bay-trees in our country all are wither'd
And meteors fright the fixed stars of heaven;
The pale-faced moon looks bloody on the earth
And leant-lookt prophets whisper fearful change;
Rich men look sad and ruffians dance and leap, -
The one in fear to lose what they enjoy,
The other to enjoy by rage and war:

These signs forerun the death or fall of kings.

Shakespeare, King Richard the Second, Act II, Scene IV[1]

1.1 Background

The beginning quote from the Shakespearean play King Richard the Second describes well the uncertainty met by the kings of the world market, the multinational firms, in the warfare they conduct with each other on the pursuit for market share dominance. The world market tolerates no weakness, and going on in total war with each other may be the end for both of the competing firms.

This Master's thesis focuses on competitive strategies of multinational firms. The key areas of interest are multinational competition, firm behaviour, and games that the firms play in order to win the most market space. The theories are tested in practise by examining the battle between Microsoft and Sony in the game consoles market. In this first section, I am explaining my motivation, my goals, and the structure for this thesis.

Competitive strategies of the firms are a concern for both antitrust regulators and business

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[1]Shakespeare, W. (1996). In *The complete works of William Shakespeare*, Wordsworth Editions Limited, Kent: UK, p. 372. Original work published approximately 1595.

managers (Scherer, 1980; Barney, 1986). The first party needs to make certain that the competition remains socially fair, whereas the second party is interested in maximizing profits (Scherer, 1980). Although this thesis is written in the spirit of strategic management, and therefore eventually aims to offer normative advice to the profit maximising managers, the knowledge of the firm behaviour provided in this thesis could as well be used by the antitrust regulators (Barney, 1986).

The literature on multimarket competition and firm behaviour draws mainly from three research traditions. The first school of thought is industrial organization, which examines supernormal profit opportunities for the firms in imperfectly structured markets (Scherer, 1980; Barney, 1986). Secondly, the relatively newer research stream of resource-based view of the firm adds firm's internal resources and capabilities to the analysis (Collis and Montgomery, 1995; Lieberman and Montgomery, 1998). Finally, the research tradition of international business explores opportunities and challenges for conducting business in the global scale (Hamel and Prahalad, 1985, 1989). The section 2.1 of this thesis reviews the historical context further.

The theories of multimarket competition and firm behaviour are addressed in the literature review in the section 2.2 of this thesis. Most notably, this thesis leans on the industrial organization -based research program of competitive dynamics, a school developed to model the interactions between a pair of aggressively competing firms (cf. Chen, 2009). A conceptual framework synthesizing the theories can be found from the section 2.3. The conceptual framework aims to fit the theories of multimarket competition to the global level, presenting a dynamic model for multinational firms from antecedents to competition to choices of competitive actions.

The conceptual framework is tested with the empirical game consoles example. The case examines the seventh generation of game consoles, which is usually seen to contain the American Microsoft with the Xbox 360 (from now on, Xbox), the Japanese Sony with the PlayStation 3 (PS3), and the Japanese Nintendo with the Wii (cf. ESRB, 2012). However, in my empirical study I concentrate only on the competitive actions between Microsoft and Sony as their game consoles and the target consumer segments differ significantly from Nin-

tendo's.

A product market is defined by Jayanchandran et al. (1999, p. 50) as a set of goods or services that serves similar functions, is created by the use of similar technology, and is used by similar consumers. Out of the three console makers in the market Microsoft's Xbox and Sony's PS3 are closest to each other in terms of the types of games offered for the consoles, and especially in terms of the gamers who buy the consoles. Hence, the two firms can be seen to form a pair of rivals, a dyad, which is the unit of analysis of the mainstream competitive dynamics research (Ferrier, 2001; Yu and Cannella, 2007; Chen, 2009).

The data used in this study comprises the game console market in its seventh generation from 2007 to 2012. Nintendo is already moving on to the eight generation with their Wii U launched in the fourth quarter of the year 2012 (Nintendo, 2013c). While Sony has recently announced the eight generation PS4 to be launched in the end of 2013 (Fitzimmons, 2013), Microsoft is still claiming they are not going to launch a new console any time soon (Chacksfield, 2012; Rivington, 2013). Differing product life cycles further justifies leaving Nintendo Wii outside the discussion in this thesis (cf. section 2.2.1). The empirical case study between the two companies conducted in this thesis is examined further in the chapter three.

I utilize the method of quantitative content analysis to collect primary data for the study following the previous research in the competitive dynamics stream (e.g. Ferrier, 2001; Derfus et al., 2008; Yu et al., 2009). This thesis also addresses the methodological issues related to modelling complex competitive data with several variables and non-normal variances (cf. Nair and Selover, 2012). Chernoff faces are a statistical tool used to depict data by a computer generated picture of a face (Chernoff, 1973). I suggest that the faces can be used in addition to the regular statistical tools in order to provide a more accurate and visually helpful picture of the complex data. The methodology of the empirical study is introduced in the chapter four of this thesis.

In this thesis I try to find evidence for recognizable patterns of firm behaviour by examining the strategy-formulation of the game consoles manufacturers. The results from the data analysis can be found from the chapter five, and the consequent synthesis of the theoretical

framework and the statistical evidence form the basis for the discussion in the chapter six. Finally, I summarize the findings and conclude the discussion in the seventh chapter of this thesis.

1.2   Gaps and research problem

This section discusses the trends in the current research, and tries to determine and justify the focus for this thesis by considering the main gaps in the literature. The research problem for this thesis is presented at the end of this section.

Because the research background of the competitive behaviour of global firms comes from several different streams as discussed above, it is important to try to further synthesise the research to form a cohesive theoretical basis (Ma, 1998; Chen and Stucker, 1997). Both Ma (1998) and Chen and Stucker (1997) call for studies combining the industrial organization -based competition dynamics stream and international business studies.

One major gap in the previous research of competitive strategy formulation has been in the scope of the research (Ma, 1998). Much research on the competitive interactions is conducted on the national level, concentrating on the firms functioning in the United States (Chen and Stucker, 1997; Yu and Cannella, 2007). Chen and Stucker (1997) further assess that in global studies the assumptions of homogenous markets and cultures can be problematic, and therefore the context of multinational firms should be studied more carefully. Global research on firm behaviour includes Ito and Rose (2002)'s study of the global tyre market (cf. also Rose and Ito, 2009). Yu et al. (2009) (cf. also Yu and Cannella, 2007) is an example of a study of the global car manufacturers. These studies are further examined in the following literature review.

Ma (1998) criticizes that the industrial organization -based literature tends to concentrate on market level variables such as concentration, and suggests that firm level variables such as firm resources should be looked at in more detail. Additionally, many of the studies consider multiple industries, multiple firms, and multiple products rather than any specific cases (Ma,

1998). Although the results can be generalizable to some extent, these studies may forego details that can be found from looking into specific cases (ibid.).

Some scholars call after finer-grained and finer-focused studies, which would look into specific firm and industry characteristics concentrating on the relative positions of the rival firms (Chen, 1996; Ma, 1998). A recent example moving away from the general direction of the inquiry in the competitive dynamics field is the study of the competition between Pepsi and Coca-Cola by Nair and Selover (2012). Nevertheless, the authors concentrate their analysis only on two domestic US markets, still displaying the tendency to look into the traditionally examined national markets (cf. Nair and Selover, 2012).

The studies discussing such heavy manufacturing goods as tyres and cars are more common (e.g. Ito and Rose, 2002; Yu and Cannella, 2007), whereas those studies related to high-tech products are still rare (cf. Young et al., 1996, for an exception). Services are considered often in the form of airlines or banking in the United States (e.g. Gimeno, 2002). These fields are often examined because of tradition and extensive and accessible databases collected over the years (cf. Gimeno and Woo, 1999). Thus looking into new types of product markets could be beneficial.

Gimeno and Woo (1999) warn that the global context poses major uncertainty factors and complications for modelling. For example, the authors trying to synthesize competitive dynamics and international business (Ma, 1998; Gimeno and Woo, 1999; Yu et al., 2009) question the corporate level examination of the strategies and suggest along with the networking theories of international business that the communication and control between the corporate level and the subsidiary level may be less smooth than expected. Consequently they suggest that competition between multinational firms should be looked on the subsidiary level (ibid.).

The usual method for the competitive dynamics researchers is to collect the data with structured content analysis, and then perform econometric data analysis with the data (e.g. Ferrier, 2001; Derfus et al., 2008; Yu et al., 2009). Another approach is to examine the interactions of the firms with a game theoretic model (Camerer, 1991; Bernheim and Whinston, 1990).

Game theory offers interesting basis for examining reactions and interactions of the firms, and could possibly help with a formulation of a better model for the study of strategic reactions (ibid.).

While the game theoretic approach has been criticized to be too difficult to use (Camerer, 1991), many econometric results are based on such statistical methods, which are biased for data with non-normal errors (e.g. Goldfeld-Quandt test in Nair and Selover, 2012). Also, the regular regression analyses are based on the central limit theorem, which states that there need to be enough well behaving observations in the data (Wooldridge, 2009). The issues with the data analysis mean that there is no single statistical procedure, which could be generally applied in the competitive analysis studies (cf. Yu and Cannella, 2007). The methods in the studies tend not to be comparable with each other, resulting in non-comparable results as well (ibid.).

This thesis bridges the theories of competitive dynamics and international business in studying a single global dyad Microsoft and Sony. The case market has not been used as an example of the competitive analysis previously, although the case is an excellent example of a global competitive pair of firms. This study continues the tradition to examine the firms in the global corporate level as there are no previous global studies on the game console market, but recognizes the need for further studies in the subsidiary level for the reasons reviewed above. Additionally, in order to produce more reliable statistical inferences, this thesis also introduces Chernoff faces as a new method for comparing the strategic reactions of the firms.

The main research problem can therefore be presented as

> How does the competition between Microsoft and Sony compare to the previous research on other types of businesses and market settings, and how could the data be presented so that the reliability of the statistical inferences would be improved?

1.3   Research objectives and questions

In order to find answers to the research problem formulated above, the research objectives outlining this thesis are to

Chapter two: Review the literature on multimarket competition and present a synthesized theoretical framework of competitive interactions for global firms based on the previous research.

Chapter three: Examine the game consoles market in order to study its characteristics and introduce the players, and form hypotheses based on the theoretical framework and the case.

Chapter four: Research the interactions between the players by conducting a structured content analysis, and introduce the methods used in the statistical data analysis.

Chapter five: Run a statistical data-analysis including Chernoff faces, and report the results.

Chapter six: Model the competition between Microsoft and Sony, and assess the usability of the Chernoff faces in the analysis of competitive interactions.

Based on the research problem and the objectives, I have formulated the following research questions for this thesis.

1. How do Microsoft and Sony compete against each other?

2. How could Chernoff faces be used to help to model player reactions in globally competitive markets?

In order to answer the first question, I plan to find out which strategies the game consoles manufacturers use in competing against each other, and how these strategies differ from those found in the previous research on strategic interactions. The second question is answered by examining the faces generated from the data, and comparing the results with the more generally used statistical tools.

This first chapter has introduced my thesis subject, and placed it in the fields of competitive dynamics and international business. I have presented my research problem, objectives of the study, and research questions in the sections 1.2 and 1.3. In the next chapter of this thesis, I review and compare the relevant literature, and at the end of the chapter I present my conceptual framework of the competitive actions for a multinational firm-dyad.

Figure 1: Literature review outline

2 LITERATURE REVIEW

In this thesis I look into competitive patterns between multinational corporations (MNCs). This is the domain of global strategy, where the previous researchers have found that corporate players engage in an endless but often very subtle war over market share (cf. Karnani and Wernerfelt, 1985; Upson et al., 2012). The competitive dynamics researchers suggest that competition between two multinationals in the same business area is a game of action and reaction, which occurs when the internal firm resources and the external industry factors for the companies align (e.g. Chen, 1996; Ferrier, 2001).

The purpose of this literature review is to synthesize and summarize the literature. On the basis of the previous research and my research problem, I aim to contribute to the literature by presenting a theoretical framework depicting competition between two multinational firms at the end of this chapter. In the following pages I attempt to uncover the subject of global competition in multiple markets by discussing the most relevant pieces of work from the fields of industrial organization, competitive dynamics, and international business.

Figure 1 describes the outline for the literature review. This chapter has been divided into three sections. The first section describes the historical background for the concepts of competition and strategy. The second section presents the literature on the subject of multimarket competition. The third section summarizes the findings from the literature and introduces my conceptual framework.

2.1 About competition and strategy

Before I deliberate the specific theories of competition and strategy in multiple markets, it is important to discuss the concepts of competition and strategy from a wider angle than my thesis subject in order to place my research in context with the different research streams.

As discussed in the introduction, the subject of multimarket competition leans mainly on three research traditions of industrial organization, resource-based view of the firm (RBV), and international business (Barney, 1986; Ma, 1998). Specifically, the research programs based on game theory (Bernheim and Whinston, 1990; Camerer, 1991), strategic groups (cf. Chen, 1996), and competitive dynamics (e.g. Chen, 1996; Ferrier, 2001) have been used to examine multimarket competition. In this section I briefly describe the ways in which each stream sees competition and strategy.

The classical economics literature explains firms and their formation as a channel for demand and supply conditions of national markets (Scherer, 1980). The discussion moved on from national markets to specific industry contexts in the 1960s, forming the basis for the industrial organization studies (Barney, 1986; John et al., 1997). The general consensus was that those markets where monopolistic or oligopolistic firms had market power needed to be regulated by the antitrust, finance, and other governmental authorities (Scherer, 1980; John et al., 1997; Ma, 1998).

The focus of the studies moved from government intervention to firm management and performance through the 1980s, when normative scholars such as Caves and Porter started giving out advice to firms on how to best succeed given their capabilities and industry conditions (Barney, 1986; John et al., 1997). The shift in focus was due to the early 1980s invasion of superior business models of the Japanese firms in the global markets, which had been previously dominated by the multinational companies from the United States (Hamel and Prahalad, 1985, 1989).

Industrial organization's structure-conduct-performance paradigm plays an important role in the multimarket literature (cf. Scherer, 1980; Barney, 1986; Camerer, 1991; Ferrier et al., 2002). The framework implies that firm's competitive position (strategy), and subsequent

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performance (financial returns) depend on the characteristics of the industry structure (Barney, 1986). These include barriers to entry, the number of the firms in the industry, the relative size of the firms in the industry, the degree of differentiation of the products, and the elasticity of demand for the products (ibid.).

Another important research stream influencing the multimarket literature is resource-based view of the firm (RBV) (Collis and Montgomery, 1995; Chen, 1996; Gimeno and Woo, 1999). Whereas classical economics discussed nations, and industrial economics considered industry, RBV concentrates on firm as the unit of analysis (Chen, 1996).

RBV combines the internal capabilities and resources of the firm with the external competitive environment of the industry (Collis and Montgomery, 1995). Any firm is built on its experiences, acquired skills, and organizational culture, which makes every firm unique even if their products are homogeneous (Barney, 1986; Collis and Montgomery, 1995; Street et al., 2010). According to RBV, a competitive advantage is any valuable resource that enables the company to offer their product in a better way than that of the competitors (Collis and Montgomery, 1995). However, competitive advantage is often dynamic, depreciating over time, and always related to a specific industry context (ibid.).

International business researchers apply the theories from industrial organization economics and RBV to the international business context (Ma, 1998). In the subject areas of competition and strategy, the researchers have been especially interested in network effects between international partners/competitors (ibid.), the subsidiary level (Yu et al., 2009), and entry strategies (Ito and Rose, 2002; Rose and Ito, 2009).

Game theory, popularized in the 1990s, offers a way of analysing competition and strategies (Brandenburger and Nalebuff, 1995). The purpose of a game theoretical analysis is to try to predict the moves of the other players as far as possible, and shape the game accordingly (ibid.). Traditional criticism of game theory has been that it is difficult to apply, it does not result in generalizable results, and it assumes too much rationality (Camerer, 1991). Camerer (1991) counters all of these, but amends that game theoretic strategy models are still not easy to come up with.

An alternative research program examining the competitiveness of the firms is the strategic group literature, which tries to challenge the firm-level analysis by moving on to strategic groups, where the players inside an industry are clustered into different groups according to their strategies (cf. Chen, 1996). However, Chen (1996) criticizes the strategic group research's assumptions of homogenous firms inside a group, and concludes that it should not be used for examining competition between firms.

The most crucial but notoriously difficult aspect of competitive markets is uncertainty (Barney, 1986). Schumpeterian competition states that competition is dynamic and uncertain, and that uncertainty means that luck determines which products and services are best received by the future generation (ibid.). Based on the ideas of Schumpeterian competition, Chen (1996, 2009) and his fellow scholars (e.g. Baum and Korn, 1999; Ferrier, 2001) have formed the competitive dynamics stream, which leads the recent advances in the strategy and competition research.

Competitive dynamics researchers study rivalry between pairs of firms drawing both from industrial economics and RBV (Chen, 1996). Out of the research streams discussed in this section, this thesis mostly leans on the research tradition of competitive dynamics.

2.2   Research on multimarket competition

Figure 2 below displays the outline for this section. The section starts by a review of the key concepts of the study. It is followed by an examination of the most prominent literature discussing competition in multiple markets highlighting and contrasting the most relevant theories. The section ends by a discussion of empirical examples.

2.2.1   Key concepts

The key concepts examined in this section are multimarket competition, competitive strategies, hypercompetition, and Schumpeter's creative destruction.
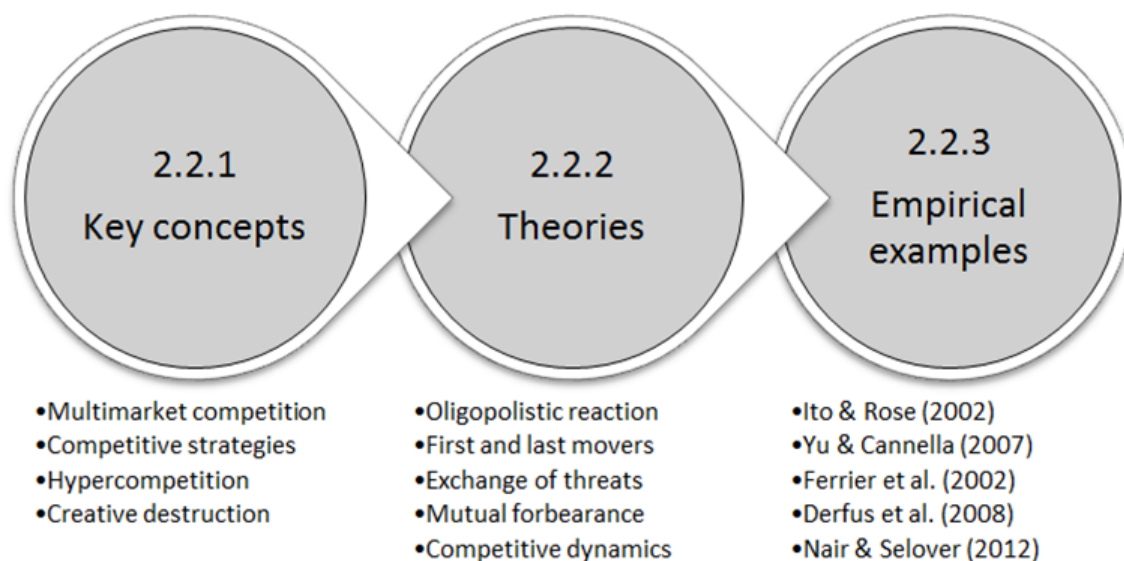
Figure 2: Multimarket competition literature outline

Multimarket competition defines the type of competition examined in this thesis. Instead of looking into the competition between multiple firms in one market, I am looking into cases where two firms meet and compete in more than one market cf. Karnani and Wernerfelt (1985). This study is also interested in how firms use competitive strategies to improve their competitive positions (Karnani and Wernerfelt, 1985; Upson et al., 2012), and what types of strategies exist in the global market for game consoles between Microsoft and Sony.

Hypercompetition is the term used of market settings, where competitive advantage is difficult to hold on to given the levels of uncertainty (D'Aveni and Gunther, 1995). The global market for technological products such as game consoles is a good candidate for a hyper-competitive market (ibid.). Finally, I look into the driving force behind the inquiry in the competitive dynamics research, Schumpeter's creative destruction, which states that firms need to innovate constantly in order to survive in the market place (Barney, 1986).

Multimarket competition

Karnani and Wernerfelt (1985) define multiple point competition as an instance where two

or more firms engage in competition simultaneously in multiple markets, for example with the same product in multiple geographic markets. The terms multiple point competition or multiple market competition are most often used by the international business and strategic management researchers, whereas the industrial organization researchers tend to use multi-market competition (Karnani and Wernerfelt, 1985; Ma, 1998). In this thesis the terms are used as synonyms, although multimarket competition is the preferred term.

Gimeno and Woo (1999) suggest that more alike the competing companies are, the more likely the multimarket contact as both companies seek economies of scope, and inevitably end up in the same markets due to limitations in the world's market space. However, it is important to notice that even if the companies are present in the same markets, it does not yet mean that they are engaging in competition with each other (Chen and Stucker, 1997; Ma, 1998).

In order to combine competition and multimarket contact, Chen and Stucker (1997) discuss the concept of cross-border competitive engagement. Cross-border competitive engagement occurs when two or more firms meet in multiple markets, and are both able and motivated to engage in retaliatory or collusive actions with each other (Chen and Stucker, 1997; Ma, 1998). Thus cross-border or multimarket competition requires that the firms are competitively aware of each other, which in right circumstances manifests as the use of strategies and the consequent effects on performance (Chen and Stucker, 1997; Ito and Rose, 2002).

Chen (1996) theorizes the antecedents to rivalry with the concepts of market commonality and resource similarity. Market commonality is defined as strategic interdependence of firms in unique markets (Chen, 1996), which means the same as Chen and Stucker (1997)'s cross-border competitive engagement. Resource similarity indicates that the firms are alike in their resources, meaning that they pursue economies of scope and competitive advantages in similar manner (Chen, 1996; Gimeno and Woo, 1999).

The two outcomes of multimarket competition are to reap collusive profits and to compete more aggressively (Chen and Stucker, 1997; Ma, 1998; Ito and Rose, 2002). The differences between the contradictory outcomes stem from their differing theoretical foundations (Ito

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and Rose, 2002). Those theories, which are based on industrial organization tend to ignore the effect of uncertainty, and claim that multimarket contact results in collusive behaviour, whereas those theories based on Schumpeter's ideas of dynamics of the market place are trying to model the inevitable uncertainty into the research, and claim that multimarket contact results in more aggressive competitive moves between the players (ibid.).

Chen and Stucker (1997) and Ma (1998) both emphasize that multimarket competition inside national market differs significantly from multimarket competition between global players. The differences are in the availability of information (uncertainty is even greater in the global market place), and in the organizational assumptions stemming from cultural differences of the home countries of the players (Chen and Stucker, 1997). Also the host country markets can be distant to all of the players involved in the competition, ever increasing the uncertainty factor (ibid.).

According to Yu et al. (2009), there are three ways of measuring multimarket contact. Market level measures assess the overall degree of multimarket contact among all the firms serving in one market (Yu et al., 2009). Firm-in-market-level measures calculate the overall degree of multimarket contact between the focal firm in one market and its competitor (ibid.). Dyad-level measures determine the overall degree of multimarket contact between two firms in all the markets, in which both are present (ibid.). This thesis concentrates on the two firms (a dyad) in the global markets, so the appropriate measure is the third dyad-level measure.

Competitive strategies
The most often used definition for competitive actions in competitive dynamics research is that competitive actions are "externally directed, specific, and observable competitive moves initiated by a firm to enhance its relative competitive position" (Ferrier et al., 2002, p. 307; cf. also Ferrier et al., 1999; Ferrier, 2001; Derfus et al., 2008). The competitive dynamics researchers also tend to distinguish between two types of interactions: strategic and tactical (Nair and Selover, 2012). Strategic actions are those that firms use to improve the competitive position of their firm such as investing in new assets, and tactical actions are those that directly respond or initiate a competitive move towards a competitor, such as pricing decisions (ibid.).
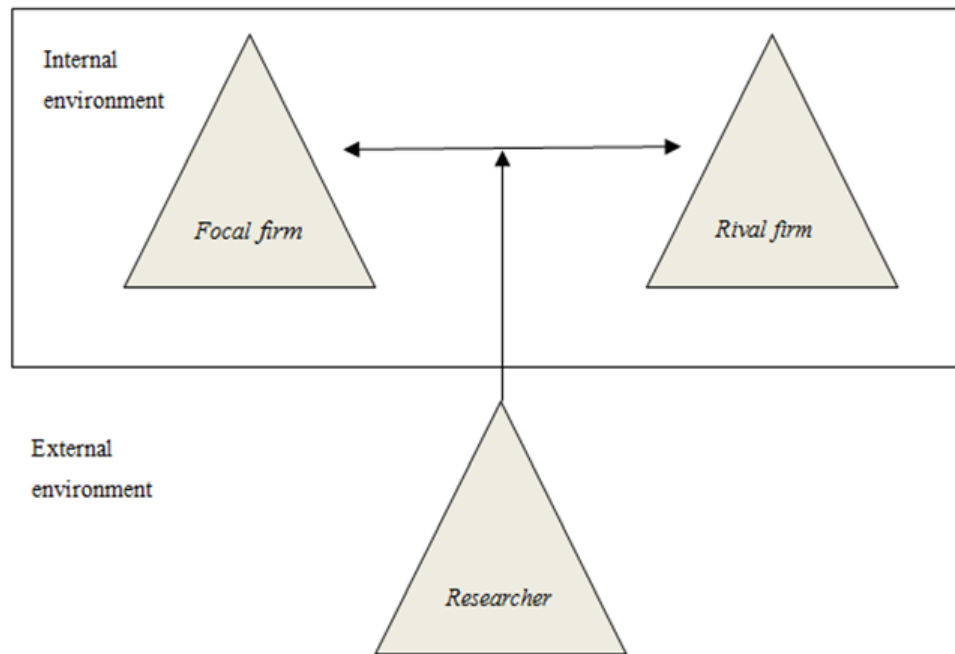
Figure 3: Strategy terminology. The different terms used about strategic actions depend on the point of view. Based on Chen (1996).

I suggest along with the terminology of Chen (1996) that the nuances between the different terms can be related to the point of view of the focal firm (internal), the rival (internal), or the researcher (external) as seen in the Figure 3 above. Focal firm initiates strategy or tactics (internal: focal firm), which is seen as a certain behaviour or interaction from the point of view of an outside observer (external: researcher), and experienced as actions, reactions or moves by the competition (internal: rival) (cf. Chen, 1996). This is based on Chen (1996)'s ideas of seeing the competition as a construct from the focal firm's point of view.

The different strategies are most often quantified by conducting a content analysis of a news archive related to specific industry context (e.g. Derfus et al., 2008; Upson et al., 2012; Ferrier, 2001; Ferrier et al., 2002; Yu et al., 2009; Young et al., 1996). In this thesis I am trying to pinpoint strategies and competitive actions used in the game consoles market by conducting a content analysis of an online news archive concentrated on the gaming industry.

Hypercompetition

The competitive markets have evolved from the simple cases of monopolies, oligopolies and perfect markets examined in classical economics to a more complex competition system, which entails more uncertainty, more dynamics, and more difficulties in finding and sustaining competitive advantages as before (D'Aveni and Gunther, 1995). D'Aveni and Gunther (1995) call the new system a hypercompetitive market. Since the markets where strategic interactions usually take place can be categorized as hypercompetitive, many competitive dynamics researchers utilize the term in their research (e.g. Baum and Korn, 1999; Gimeno and Woo, 1999; Ferrier, 2001).

Hypercompetitive market has a few large players like a traditional oligopoly (D'Aveni and Gunther, 1995). However, instead of relying on the market power ensured by the structure of the industry, the companies actively pursue strategies, which erode the competitive advantages of the others resulting in lower barriers to entry, and more intense competition (ibid.). The competition can occur on local, regional, or global scale (ibid.). Especially the global scale of production accounts for loss of information, and affects the performance of the firms in the market (ibid.).

In the Figure 4 below the industry structure for traditional oligopoly is portrayed on the left side. In oligopolistic or monopolistic markets the players can reap the benefits of their market power as long as the industry structure protects their competitive advantages (Scherer, 1980). As discussed in the section 2.1, the factors supporting industry structure according to industrial organization include barriers to entry, the number of the firms in the industry (market concentration), the relative size of the firms in the industry (market inequality), and the degree of differentiation of the products (Barney, 1986).

In the hypercompetitive market the traditional sources of protection in the industry are failing because there are no sustainable competitive advantages (D'Aveni and Gunther, 1995). The right side in the Figure 4 portrays the factors of industry dynamics, which lead to intensity of rivalry (D'Aveni and Gunther, 1995, cf. also competitive dynamics research, e.g. Baum and Korn, 1999; Gimeno and Woo, 1999; Ferrier, 2001; Chen, 2009).
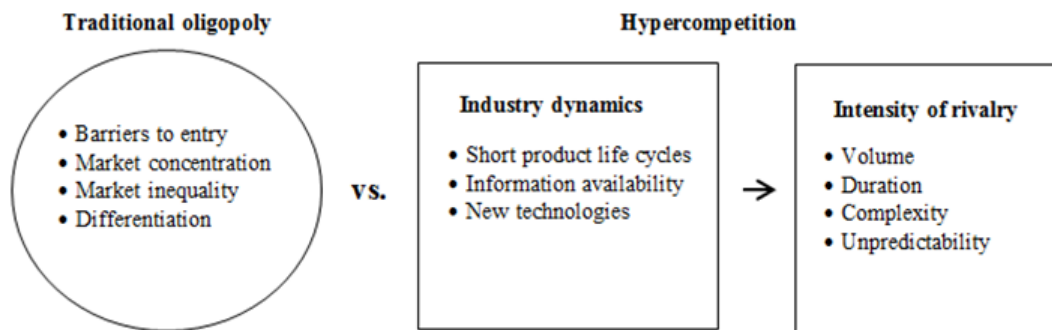
Figure 4: Traditional vs. hypercompetitive industry structure: Hypercompetitive industry structure consists of industry dynamic factors, which lead to increased intensity of rivalry. Adapted from Scherer (1980); D'Aveni and Gunther (1995); Ferrier (2001); Chen and Stucker (1997); Derfus et al. (2008).

Industry dynamics are measured by examining the length of product life cycles, assessing the availability of the information to the players, and counting the amount of new technological innovations in the market (D'Aveni and Gunther, 1995). The length of product life cycles is shorter in the more dynamic environments, forcing companies to be innovative and quick in their moves (ibid.). The information in the dynamic market is uncertain and asymmetric, and there are waves of new technologies. The dynamic conditions affect firms' abilities to make decisions, and lead to intensified competition (ibid.).

Intensity of rivalry or competitive aggressiveness can be assessed by considering the different dimensions of competitive attacks (Ferrier, 2001). According to Ferrier (2001), these are volume, duration, complexity, and unpredictability. Intensity of rivalry is measured by calculating the number of the strategic actions during a specific period, by measuring the durations of the attacks and responses, and by counting the variety of the different strategies used (ibid.).

Examples of hypercompetitive markets include oil, cars, tyres, mobile phones, computer chips, computers, and fizzy beverages (e.g. D'Aveni and Gunther, 1995; Rose and Ito, 2008, 2009; Nair and Selover, 2012; Upson et al., 2012). Service-based industries dominated by

a few players, but engaged in competitive battle include consulting, banking and finance, newspapers, and airline services (e.g. D'Aveni and Gunther, 1995; Gimeno and Woo, 1999; Haveman and Nonnemaker, 2000). The game consoles market examined in this thesis also satisfies the characteristics of hypercompetitive market in the global scale.

Creative destruction

Competitive strategy researchers often refer to Joseph A. Schumpeter's idea of creative destruction from the 1930s (e.g. Barney, 1986; Collis and Montgomery, 1995; Ferrier, 2001). Creative destruction occurs when firms that once held the state-of-the-art innovation in a market are overrun by the next generation of innovation, building on or imitating the first-movers (Collis and Montgomery, 1995).

Nonaka and Johansson (1996) assess the advantages of the intense rivalry (in Sandberg, 2001). In hypercompetitive markets consumers are kept educated about the product, the core features of the product are defined, consumer preferences are updated, price is kept low and quality high, suppliers are kept educated and the technology is diffused, training and after-sales service are continuously improved and new and complementary components can be produced (ibid.).

2.2.2 Theories

In this section I am looking into theories of multimarket competition. The theories discussed in this thesis are oligopolistic reaction (bandwagon effect, follow-the-leader behaviour), first mover and late mover strategies, exchange of threats (multimarket retaliation) and mutual forbearance (rivalry deterrence). The specific theories have been chosen to reflect the most discussed topics in the reviewed literature on multimarket rivalry. At the end I review the ideas of the school of competitive dynamics, including the concept of the Red Queen effect.

Oligopolistic reaction is a pattern of investment behaviour between firms investing in multiple markets (Rose and Ito, 2008). It is related to first mover and late mover strategies of the

firms, where both being the pioneer and being the follower can have implications for financial performance of the firms (Lieberman and Montgomery, 1998).

Exchange of threats is behaviour found between multimarket competitors, where the competing firms place so called foothold attacks in each other's key markets in order to threaten the other player (Upson et al., 2012). The theory of mutual forbearance suggests that firms may also implicitly collude and refrain from competition when they meet in multiple markets (Haveman and Nonnemaker, 2000).

At the end of this section, I look into the advances of the competitive dynamics stream in more detail (e.g. Chen, 1996; Ferrier, 2001; Ferrier et al., 2002; Derfus et al., 2008; Nair and Selover, 2012). The discussed literature is summarized in an analytical table (Table 1) at the end of this section.

Oligopolistic reaction

Knickerbocker (1973) was one of the first to discuss the geographical patterns of foreign direct investment, and used the term bandwagon effect to describe the clustering of the investments in the same industries and locations (in John et al., 1997; Rose and Ito, 2008). The effect, which is also known as the follow-the-leader behaviour is based on the idea that companies in an oligopolistic setting need to react to their competition in order to survive, and therefore tend to follow each other into new markets (Rose and Ito, 2008).

This behaviour, also coined oligopolistic reaction or herding results in multimarket contact (Ito and Rose, 2002; Rose and Ito, 2009). The first moving leader is called as the pioneer (Rose and Ito, 2009). In the case of multiple firms in an oligopolistic market like in the tyre industry, Ito and Rose (2002) and Rose and Ito (2009) find evidence that the order of the investing companies rarely differs from market to market. These specific rivalries tend to follow each other's movements, but ignore or avoid the rest of the firm in the market (Rose and Ito, 2008).

It has been argued that the reason why firms tend to establish themselves in the same markets as the first movers is to reduce uncertainty by becoming more familiar with the competition

(Ito and Rose, 2002). Due to this mutual familiarity, Ito and Rose (2002) suggest that firms are more likely to invest in those areas where their competition is already present.

Rose and Ito (2008) examine Japanese car manufacturers' international strategies, and find evidence of reduced oligopolistic reaction and specific rivalry between certain players. Although the theory of oligopolistic reaction was first used to examine the actions of the firms from the same home country, Ito and Rose (2002) and Rose and Ito (2009) show that also the global tyre industry displays evidence of the herding behaviour. The study is further reviewed in the empirical examples section 2.2.3.

First mover and late mover strategies

First mover advantage is a term coined for the performance effects of the timing of entry into a market (Street et al., 2010). It states that the firm, which takes the leadership position, tends to perform better financially than its late moving counterpart (Lieberman and Montgomery, 1988, 1998; Ito and Rose, 2002; Street et al., 2010). First move can be related to entering the market before the competition by acquiring scarce assets, entering with a new product and positioning and branding itself in the minds of the consumers before the competition, or entering with a new kind of work process or business model (Ito and Rose, 2002; Street et al., 2010).

However, there are also multiple studies, which have found no evidence of the first mover advantages, and even those that have found that instead late movers are those reaping the benefits (cf. Lieberman and Montgomery, 1998). Lieberman and Montgomery (1998) explain that pioneers can often miss market opportunities, as they can initially acquire wrong resources because of the uncertainty in the market place.

Sandberg (2001) recommends that the late movers should carefully observe the first mover's products, find the core features of the products that the consumers prefer, and produce goods and services tailored to succeed by stepping up the market or changing the game by introducing something better, simpler, or differently positioned than the first mover. Conversely Rose and Ito (2009) posit that late mover firms tend not to have the skills to be pioneers, because they are not as experienced as the first moving companies. It is therefore possible that the late

movers have difficulties in stepping up the market like Sandberg (2001) suggests (cf. Rose and Ito, 2009).

Lieberman and Montgomery (1998) note in their literature review that the conflicting outcomes for different first and late mover studies may be the result of conceptual differences. In order to clarify the concept of first mover advantages, Lieberman and Montgomery (1998) suggest combining empirical studies on the first mover advantages with the theories in resource based view (RBV).

Street et al. (2010) present a theoretical framework based on RBV, where first mover advantages are dependent on specific firm resources. According to the authors, because of the riskiness of the first moves, firms should first analyse their resources and capabilities, and assess the environmental dynamics carefully before launching ahead their competition (Street et al., 2010).

Exchange of threats

Graham (1975; 1985) first explained behaviour called exchange of threats, where the rival oligopolistic firms engage in foreign investment in another's home market in order to send a threatening message to the rival, so that they would leave the competitor's home market (in John et al., 1997). Similarly Watson (1982) recommends that global corporations should engage in counter-competitive moves that prevent foreign companies from functioning in their domestic market by penetrating their home markets.

The countermoves can be either product-related or non-product competitive moves relating to the manufacturing techniques or after-sales support (Watson, 1982). However, the tactics only work in such markets where it is possible to capture market share quickly, to offer a differentiated and inimitable product, and to build a distinguishable infrastructure (ibid.). This idea is further defined as cross-subsidization by Hamel and Prahalad (1985).

Hamel and Prahalad (1985) explain cross-subsidization as a way to direct the firm's resources to a subsidiary in a strategic position, that is, in a weak market (loose brick) for the competitor in order to catch the market share where the competitor is too weak to react. The

authors describe a situation where an aggressive competitor attacks a foreign competitor in the home (=main) market for the foreign competitor, and the foreign competitor retaliates by attacking in foreign markets where the aggressive competitor is weak (Hamel and Prahalad, 1985).

Karnani and Wernerfelt (1985) formulate multiple point competition theory called mutual foothold equilibrium, which postulates that firms meeting each other repeatedly in multiple markets should choose to obtain small footholds in each other's key markets rather than engaging in a total war or holding a total peace. This idea extends the ideas of exchange of threats to anticipating the retaliatory moves of the competition, instead skipping the costly war and resulting in a mutually balanced behaviour (ibid.).

Edwards (1955) formulated the idea of spheres of influence, which are defined as asymmetric market positions of the firms in their overlapping markets (in Bernheim and Whinston, 1990; Jayanchandran et al., 1999). In a similar manner to Karnani and Wernerfelt (1985)'s foothold positions, the spheres of influence lead to mutual understanding between the competing firms (Jayanchandran et al., 1999).

Upson et al. (2012) is a recent discussion and theorization of footholds as a strategic tool. The authors posit that footholds are a signal to the competition that the player is ready to make a move (Upson et al., 2012). However, the move can either be aggressive or withdrawing, and therefore footholds function as competitive deterrents that increase the uncertainty in the market place (ibid.).

Utilizing Chen (1996)'s concepts market commonality and resource similarity, Upson et al. (2012) predict that the similarity of resources and markets between the competing firms affect the competitor's willingness to place a foothold attack (Upson et al., 2012). If the resources and markets contested are not similar, competitor is more likely to place a foothold attack because it does not fear retaliation as much (Upson et al., 2012). Similarly, if the firms have a lot of common ground resource- and market-wise, the competitor is likely to maintain its foothold positions for the deterrence reasons than if the resources and markets are not as overlapping (ibid).

Mutual forbearance

Edwards (1955) was one of the first industrial organization researchers to formulate the idea of mutual forbearance, which postulates that when firms meet regularly in multiple markets, the level of competition between them de-escalates (in Yu et al., 2009; Ma, 1998; Baum and Korn, 1999; Jayanchandran et al., 1999). This happens because the firms have reached foothold equilibrium, where each firm holds a threat of retaliation over the other's key market (cf. Karnani and Wernerfelt, 1985).

Although the original theory by Edwards (1955) concerned diversified conglomerate companies, Gimeno and Woo (1999) add that mutual forbearance is on the contrary most likely to happen when the firms have similar resources (cf. Chen, 1996, resource similarity) and both aim for same economies of scope with their market expansion strategies (cf. Chen, 1996, market commonality). Similarly, Jayanchandran et al. (1999) explain that mutual forbearance depends on the level of familiarity, and the deterrence abilities of the firm. Familiarity refers to firms' awareness of the other players' actions, whereas deterrence means the retaliatory powers perceived by the competitor (ibid.).

Ma (1998) criticizes the studies for not considering the antecedents for mutual forbearance theory, and assuming that firms automatically engage in de-escalation of competition if they meet in multiple markets. Haveman and Nonnemaker (2000) agree, and assess that mutual forbearance is likely to occur only when conditions of centralized decision-making and non-complex environments are assumed.

Yu et al. (2009) examine mutual forbearance hypothesis in a global multimarket setting, where they find evidence for local responsiveness factors affecting the rivalry of global competitors. On the basis of their findings, Yu et al. (2009) explain that firms with tightly controlled subsidiaries are able to reap the benefits of the mutual forbearance, whereas those firms with independent subsidiaries are less efficient in controlling rivalry (cf. Haveman and Nonnemaker, 2000). This is also supported by Rose and Ito (2008)'s finding of mutual avoidance between the highly concentrated Japanese car manufacturers.

Derfus et al. (2008) suggest that high industry demand is one of the antecedents to mutual

forbearance. If the goods produced by the industry are in high demand, the overall market share pie increases and consumers want the product or service (Derfus et al., 2008). A growing market results in so called "live and let live"-attitude among the players, where competitive actions are avoided and all the players can grow without costly competitive moves (ibid.). On the other hand, declining demand means increasing competition and even a full on war if some firms are not willing to quit the industry without a fight (D'Aveni and Gunther, 1995).

Ma (1998) proposes that the willingness of the firms to mutually collude depends on multiple antecedents. The author suggests that relative market positions, corporate strategy (global or multidomestic), product diversification strategy, organizational structure (globalization vs. localization), subsidiary control, resource and capability profiles, organizational culture, and trade policies in the market environment (antitrust organizations) are all factors in the firms' decisions to mutually forbear from competing (ibid.).

Both Jayanchandran et al. (1999) and Haveman and Nonnemaker (2000) theorize that if the firms are familiar with each other through meeting often in multiple markets, they may actually compete more aggressively because of the reduced uncertainty. Based on these theories, the authors suggest an inverted U-shape between the firm's willingness to compete aggressively and multimarket contact (Haveman and Nonnemaker, 2000). Baum and Korn (1999) find evidence of the inversely U-shaped relationship between the entry and exit levels and multimarket contact in a California airlines market.

The U-shaped mutual forbearance is depicted in the Figure 5. First when firms have a little multimarket contact, there is rivalry, since there are no strategic footholds to use as a threatening strategy (cf. Haveman and Nonnemaker, 2000). As the amounts of multimarket contact and footholds increase, mutual forbearance starts to affect the behaviour, since the firms want to avoid retaliatory actions (ibid.). Eventually, when the level of multimarket contact increases even further, the firms have become so familiar with each other that they appear more daring in their strategies (ibid.).

Baum and Korn (1999) call for examination of the effects of intentionally built multimarket
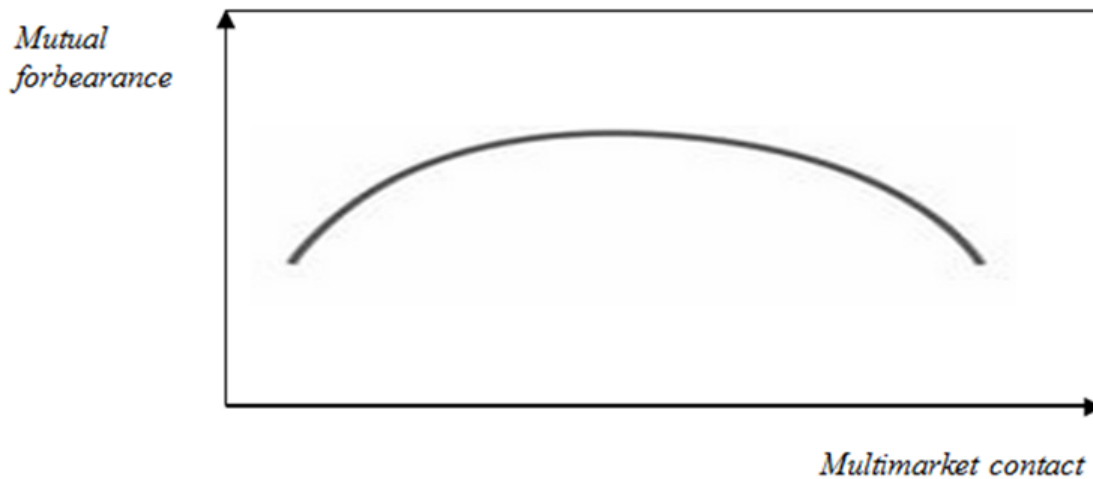
Figure 5: Multimarket contact and mutual forbearance. Haveman and Nonnemaker (2000) suggest that the relationship between multimarket contact and mutual forbearance is inversely U-shaped.

contact pursuing mutual forbearance, and Gimeno (2002) answers by trying to find out if mutual forbearance performance effect is stronger if the motivation behind establishing multimarket contact with competitors is intended versus if it happens off chance. The author finds that in his data of US airlines the performance improvements due to mutual forbearance occur when the level of multimarket contact is high, and that it does not matter whether the contact was formed with strategic intent or by off chance (Gimeno, 2002).

Competitive dynamics

Rooted on Schumpeter's ideas of dynamics of competition (Barney, 1986), research has been done to specifically account for dynamic interactions between firms (cf. Chen, 2009, for a comprehensive narratorial of the development of the competitive dynamics research stream in the University of Maryland). As discussed in the section 2.1, competitive dynamics is a recent research program trying to combine the results from the previous research of strategy and competitive firm behaviour (Chen, 2009).

The research concentrates on individual competitive actions between pairs of rival firms (firm

dyads) (Chen, 1996; Baum and Korn, 1999; Chen, 2009). The researchers emphasize the uniqueness of each competitive relationship (Chen, 1996). As an example, Chen (1996) discusses the concept of competitive asymmetry. It states that even if B is A's major competitor, it is not necessarily that A is B's major competitor (ibid.). This emphasizes the way how each firm is seen as individual, and each relationship examined through the relative positions of the firms (ibid.).

The findings from the competitive dynamics stream suggest that the number of the competitive actions (volume; inertia), the repertoire of the actions (complexity and unpredictability; simplicity and nonconformity), and the timing of the actions (duration) are all related to firm performance (Ferrier, 2001; Chen, 2009). Ferrier (2001) posits that a greater number of more complex actions lead to better financial performance. The studies have also found that the faster the timing of the counteractions, the better the performance of the focal firm (ibid.).

The theoretical foundation behind the competitive dynamics research is called the awareness-motivation-capability framework (Chen, 1996; Chen and Stucker, 1997; Yu and Cannella, 2007). The framework states that a firm must be aware of the actions of the competition, there needs to be a reward that motivates the firm to act against the action, and finally, the firm must have the right resources to be able to respond to the attack (Chen, 1996; Chen and Stucker, 1997; Yu and Cannella, 2007). The roots of the awareness-motivation-capability framework are in resource-based-view of the firm discussed earlier in the section 2.1 of this literature review.

Chen and Stucker (1997) propose conceptually that such characteristics as the level of firms strategy (multidomestic or global), the international experience of the top management team, the level of control in the subsidiaries, the level of knowledge transfer between the subsidiaries and the headquarters, the cultural distance between the subsidiaries and the headquarters, the barriers in the local markets, the diversity of the local markets and the cultural distance between the competitors, all affect the awareness-motivation-capability framework of the competing firms.

Nair and Selover (2012) is a recent example of a study in competitive dynamics stream. The authors study Pepsi and Coca-Cola in order to test for hypotheses relating to dynamic competition theories (ibid.). They examine how the competing firms react to each other, and whether there is evidence of oligopolistic reaction, exchange of threats, or mutual forbearance (ibid.). The study is further reviewed under the next section as an empirical example.

Ferrier et al. (2002) suggest that firms that compete aggressively and engage in rivalry appear to be winning market share and fare better financially than those firms that are not able to engage in aggressive competition. They define competitive aggressiveness as those competitive actions that challenge the competition and try to steal the market share in a hypercompetitive environment, where speed and timing of the actions is crucial for survival (ibid.).

The survival and success of the most aggressive player is echoed in the concept of the Red Queen effect. Derfus et al. (2008) define the Red Queen effect as constant striving to be better than the competition. The idea of the Red Queen effect has been derived from a discussion between the Red Queen and Alice in Lewis Carroll's Through the Looking Glass[2].

The Red Queen effect further describes Schumpeter's idea of creative destruction, where firms that stand still are left behind when those firms that are constantly searching for the next innovation win market share (Derfus et al., 2008; Baumol, 2004). In a Schumpeterian manner (Baumol, 2004) emphasizes the Red Queen nature of innovation, where especially in high-technology industries no firm can leave outside the constant upgrading of their products in fear of becoming obsolete and outdated, and therefore to be run over and destroyed by their competition.

Table 1 summarizes the discussed theories, their short definitions, and the related authors.

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[2]"Alice realizes that although she is running as fast as she can, she is not getting anywhere, relative to her surroundings. The Red Queen responds: 'Here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!' (Carroll, 1960: 345)" (in Derfus et al., 2008).

Theory	Authors	Definition
Oligopolistic reaction	Knickerbocker (1973) Ito and Rose (2002) Rose and Ito (2008) Rose and Ito (2009)	Clustering of investments; herding behaviour of the firms in multiple markets.
First movers and late movers	Lieberman and Montgomery (1988) Lieberman and Montgomery (1998) Sandberg (2001) Street et al. (2010)	First-mover and late-mover theories explain which strategy is better for multiple point competition players: being the pioneer or being the follower.
Exchange of threats	Graham (1975; 1985) Watson (1982) Hamel and Prahalad (1985) Karnani and Wernerfelt (1985) Upson et al. (2012)	Strategic behaviour by competitive firms in multiple markets, where firms acquire strategic resources, which they can use as footholds over the other firm.
Mutual forbearance	Edwards (1955) Ma (1998) Baum and Korn (1999) Jayanchandran et al. (1999) Gimeno and Woo (1999) Gimeno (2002) Haveman and Nonnemaker (2000) Yu et al. (2009)	Collusive or cooperative implicit or explicit strategy of avoidance between firms in multiple markets. There is an inverse U-shaped relationship between multimarket contact and mutual forbearance.
Competitive dynamics	Chen (1996) Chen and Stucker (1997) Ferrier (2001) Ferrier et al. (2002) Yu and Cannella (2007) Chen (2009) Nair and Selover (2012) Baumol (2004) Derfus et al. (2008)	Firm action dynamics in Schumpeter's footsteps set in awareness-motivation-capability framework. Aims to explain why and how firms compete in multiple markets.

Table 1: Theories of multimarket competition

2.2.3 Empirical examples

In this empirical examples section I am introducing some of the most recent and relevant empirical research on the concepts and theories examined in the previous parts. I am discussing the contents of each study, mentioning the method of the data analysis and shortly reviewing the main findings and limitations.

The studies examined here are examples of differently chosen data in the recent empirical works (national – global, industry specific – multiple industries). These specific examples were also chosen as they reflect similar methods than the ones used in the empirical case for this thesis. In most studies the data was generated by structured content analysis, and analysed through an econometric analysis of panel data. Table 2 summarizes the reviewed empirical examples.

Ito and Rose (2002) and Rose and Ito (2009)

Ito and Rose (2002) and Rose and Ito (2009) examine the behaviour of the firms in the global tyre industry. The research objective of the first study is to examine the player behaviour in subsidiary location decisions in the context of the theories of oligopolistic reaction and first mover advantages (Ito and Rose, 2002). The second study considers pairs of firms, and concentrates on the concept of specific rivalry (Rose and Ito, 2009).

The tyre industry can be thought as a global oligopoly, since there were five multinational players in 1992 with a global market concentration of 75 per cent (Ito and Rose, 2002). Ito and Rose (2002) also compare the 1992 results with the observations from 1982 with ten tyre manufacturers, and 1987 with eight tyre manufacturers. Rose and Ito (2009) utilize the same data. The data analysis is conducted through a binomial logistic regression analysis in both studies (Ito and Rose, 2002; Rose and Ito, 2009).

The main findings in the 2002 study are that investment patterns are related to the number and identities of competitors, host country characteristics, and foreign experience (Ito and Rose, 2002). The authors find evidence of oligopolistic reaction in the global tyre manufacturing oligopoly (ibid.). In the 2009 study the authors find that the strategic behaviours of

the firms differ depending on both the presence of individual rival firms (especially the pioneer), and the amount of the past interactions between firms (Rose and Ito, 2009). Since the studies are limited to only one industry with specific characteristics, it is difficult to draw any generalizable conclusions.

Yu and Cannella (2007) and Yu et al. (2009)

Yu and Cannella (2007) and Yu et al. (2009) consider the global car manufacturing industry in their studies. Yu and Cannella (2007) are interested in the strategizing opportunities of the firms in the case of international markets, where the effect of such factors than subsidiary ownership, local regulations, local competition, and cultural distance may affect the behaviour of the firms. Yu et al. (2009) consider the same data concentrating on the effects of the international business factors to the mutual forbearance hypothesis.

The studies consider data from 13 firms in the car manufacturing industry between the years 1995 and 2001 (Yu and Cannella, 2007; Yu et al., 2009). The examined firms cover 76–88 % of the total production, so car manufacturing can be thought as a global oligopoly (ibid.). The both studies use the same structured content analysis with 65 keywords on an industry publication with 6,648 articles, which included 1,778 subsidiary actions in 27 countries (ibid.). Yu and Cannella (2007) use the event history approach in the data analysis, and Yu et al. (2009) use the generalized least squares method.

Yu and Cannella (2007) find that distance between the countries slows the strategic actions speed, government policy can also affect the speed of strategies used negatively, and market-related actions such as the strategic importance of the attacked market and the amount of multimarket contact between the firms result in speedier actions. Yu et al. (2009) discover that greater subsidiary ownership strengthens the deterrence influence of multimarket contact on competitive aggressiveness, whereas cultural distance, local regulatory restrictions, and the presence of local competitors decrease it.

Similarly than Ito and Rose (2002) and Rose and Ito (2009) above, Yu and Cannella (2007) and Yu et al. (2009) are also limited to one industry, so the obtained results cannot be generalized further. Yu et al. (2009) are, however, quite confident that similar results could be

obtained also in any other domestic or global setting, where difficulties with subsidiary control are manifesting. Yu et al. (2009) criticize the structured data analysis method for its shortcomings: the method is highly dependent on the data chosen by the analysed publication, and there may be omissions in the data.

Ferrier et al. (2002)

Ferrier et al. (2002) is a multi-industry study on Fortune 500 firms. The research problem of the study is to find whether those firms that are experiencing financial distress compete more aggressively than those, which are doing well in the market (ibid.). The authors also study the organizational and environmental antecedents to competitive aggressiveness (ibid.).

Since there have been conflicting results on what sort of firms tend to compete aggressively, Ferrier et al. (2002) try to find a contingency theory and pinpoint the factors that lead to aggressive competitive behaviour. Some theories claim that losing firms are risk takers, whereas winning firms are risk aversive (ibid.). The other theories posit the opposite, where losing firms rely on their old behaviour and try to avoid taking deviating risks, whereas winning firms take proactive stance in order to maintain their market-leading positions (ibid.).

The data consists of Fortune 500 firms which were ranked first or second in their industries in terms of the U.S. market share between 1987 and 93 (Ferrier et al., 2002). The final data set consisted of total 4,617 product-market actions in 39 different industries collected through a structured content analysis (ibid.). The authors use the SAS regression technique PROC MIXED regression in their regression analysis (ibid.).

Ferrier et al. (2002) explain that those firms which do not have heterogeneous management teams are losing when the management is backward-looking and risk-averse, and winning when the management proactively engages in competition. The authors also find that those firms that function in industries with high entry barriers and high concentration ratios are more likely to compete aggressively in financial distress, which explains the differences in previous studies (ibid.).

The study is very general, and the authors suggest finer grained research as they posit that the

specific industry characteristics play such a big role in determining which way the companies tend to behave (Ferrier et al., 2002). The study also only considers large, mainly US-based firms, and the authors suggest that examining smaller firms could be beneficial (ibid.).

Derfus et al. (2008)

The domestic-set multi-industry study by Derfus et al. (2008) examines the Red Queen effect by asking whether the effect exist, and considering possible moderating factors such as concentration, industry demand and market position (whether the firm is a leader or a follower).

The data consists of 11 industries in the United States, and it was collected with the structured content analysis resulting in 56 firms between 1993 and 1998 (Derfus et al., 2008). The final data set includes 4,474 actions (ibid.). The authors used random-effects regression model and negative binomial regressions to analyse their data (ibid.)

Derfus et al. (2008) find that the speed and duration of competitive attacks seems to be increasing in the US market, which supports the Red Queen effect theory. The authors also find evidence of the moderating factors affecting the speed of the actions (Derfus et al., 2008). The market position is an exception to their expectations, where they find that the leaders are more negatively influenced by rival actions than the followers, which supports the late mover theories (ibid.).

The study is only limited to the US environment and considers only big firms, and is therefore too generalized to draw any conclusions to any specific industry contexts (Derfus et al., 2008).

Nair and Selover (2012)

Nair and Selover (2012) is a recent study on competitive dynamics, examining the battle between Coca-Cola and Pepsi in order to find out how firms are interacting, if is there evidence of the mutual forbearance, and who is following whom (first mover, late mover strategies).

Study	Data	Methods used; dependent variable	Strategies considered
Ito and Rose (2002) Rose and Ito (2009)	Tyre industry Global	Logistic binary model; Subsidiary location	Oligopolistic reaction First/Late movers FDI
Yu and Cannella (2007) Yu et al. (2009)	Car industry Global	Structured content analysis Event history approach Regression analysis; Competitive actions	Multimarket contact Competitive aggressiveness Subsidiary level
Ferrier et al. (2002)	Multiple industries Global	Structured content analysis Regression analysis; Competitive actions	Competitive aggressiveness Speed Performance
Derfus et al. (2008)	Multiple industries Domestic	Structured content analysis Regression analysis; Competitive actions	Red Queen effect Competitive aggressiveness Speed Performance
Nair and Selover (2012)	Coke vs. Pepsi Domestic	Pricing model; Product prices	Competitive aggressiveness Mutual forbearance First/Late movers

Table 2: Empirical studies on multimarket competition

The authors use the weekly pricing information of 12-packs between 2000 and 2005 in two US markets as the data (Nair and Selover, 2012). The econometric analysis used includes cointegration analysis, the Goldfeld–Quandt test, and the Granger causality test (ibid.).

The authors find that Coke's and Pepsi's strategies clearly display interdependent relationships, but there is neither evidence of mutual forbearance, nor a clear division to a pioneer and a follower (Nair and Selover, 2012). Since the data is limited only to two markets, which both are domestic, the data limitations may affect the results, and cannot be generalized even to the level of the companies (ibid.).

2.3 Summary of the literature review and theoretical framework

Figure 6 summarizes the basic assumptions in the literature considering the relationships between multimarket contact, strategic actions, and performance between two firms competing in multiple markets. Figure 6 forms the theoretical framework and the theoretical contribution of this study.

Chen (1996) answers to the call to examine rivalry and strategy as a relative construct between a pair of firms. In this thesis I too take this relative position and examine a pair of firms' relative rivalry rather than the whole market setting. The theoretical framework starts with a pair of firms, and considers their internal resources and external market factors as a basis for their resource similarity and market commonality (Chen, 1996).

The internal factors are those internal resources and capabilities of the firms such as size, economies of scale, market position, top management team heterogeneity, corporate strategy, the level of subsidiary control and cultural considerations (e.g. Chen and Stucker, 1997; Upson et al., 2012). The external factors are those related to the external market such as concentration, industry demand and growth, the length of product life cycles, availability of information and the amount of uncertainty, and the pace of the technological innovation (e.g. Derfus et al., 2008; D'Aveni and Gunther, 1995).

If resource similarity and market commonality are high enough, firms are engaged in multimarket competition through the awareness-motivation-capability framework of competitive dynamics (e.g. Chen, 1996; Ferrier, 2001; Yu and Cannella, 2007). Multimarket competition manifests as attacks and counterattacks (e.g. Ferrier, 2001). In global business, it may also be seen in the clustering investment patterns of the firms as oligopolistic reaction, and first mover and late mover strategies of the firms (e.g. Rose and Ito, 2009; Lieberman and Montgomery, 1998).

Exchange of threats is strategic behaviour by competitive firms, where firms acquire strategic resources, which they can use as leverage over the other firm (Hamel and Prahalad, 1985). The theory of mutual forbearance describes collusive or cooperative implicit or explicit strategy between firms (Haveman and Nonnemaker, 2000). There are both evidence that support
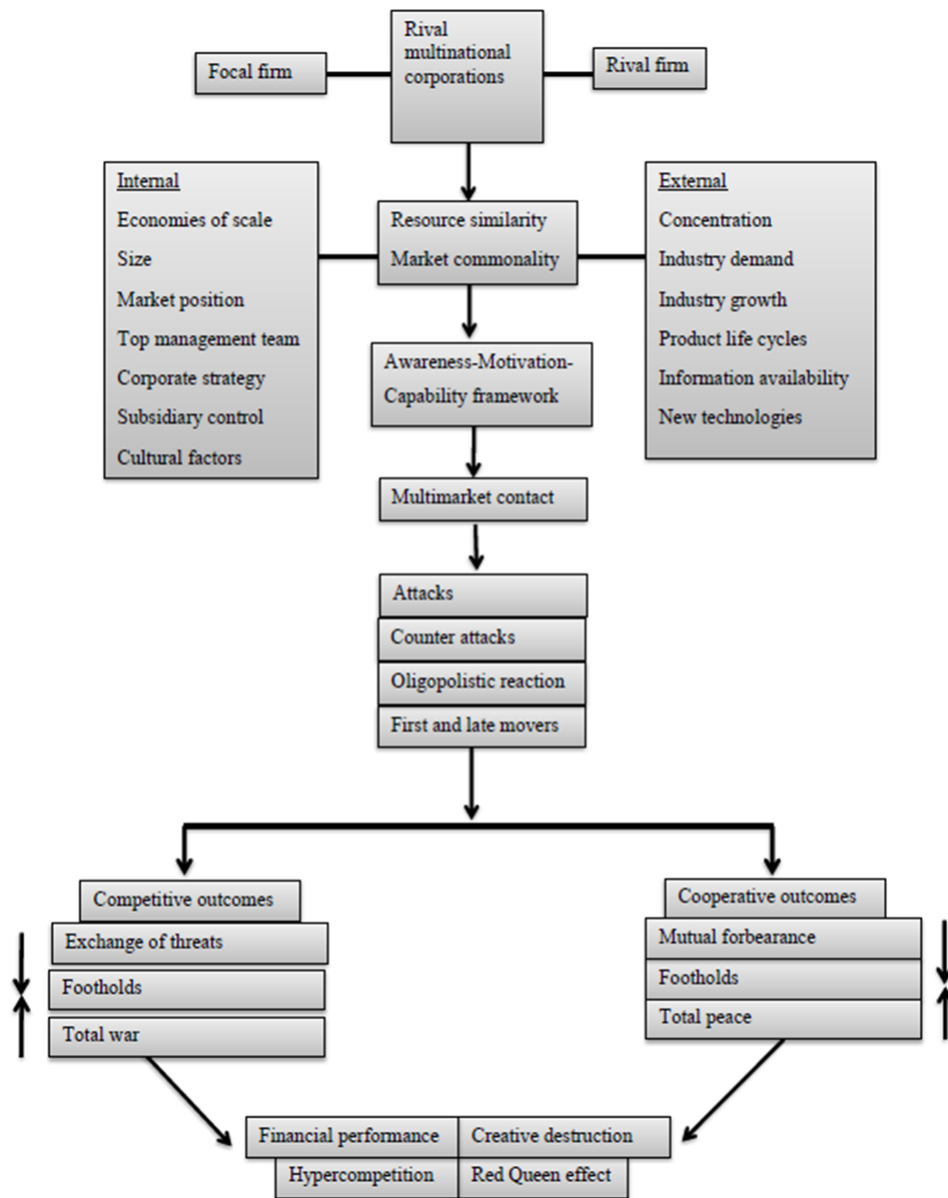
Figure 6: Theoretical framework presents the relationships between antecedents and the different outcomes of multimarket competition between a pair of competing multinationals. Based on the literature reviewed in the previous sections (e.g. Karnani and Wernerfelt, 1985; Rose and Ito, 2009; Lieberman and Montgomery, 1998; Hamel and Prahalad, 1985; Haveman and Nonnemaker, 2000; Chen, 1996; Ferrier, 2001; Derfus et al., 2008; Yu et al., 2009)

mutual forbearance, and evidence against it, which has made some researchers to conclude that there exists an inverse relationship between mutual forbearance and the amount of multimarket contact (e.g. Haveman and Nonnemaker, 2000; Baum and Korn, 1999).

The most probable result is that the firms neither engage in total war nor they collude by having total peace, rather they end up placing small foothold in each other's markets in order to be able to respond in case the other firm manoeuvres something new in the key markets (cf. Karnani and Wernerfelt, 1985; Upson et al., 2012).

Multimarket competition can have effects on financial performance, and in the case of uncertain market settings and short product lifecycles it can also result in hypercompetition (cf. D'Aveni and Gunther, 1995). Hypercompetitive markets drive the technological progress forward, and affect the whole world's economics through the creative destruction and the Red Queen effect (cf. Baumol, 2004).

In the section 1.3 of this thesis I formulated the research problem as

> How does the competition between Microsoft and Sony compare to the previous research on other types of businesses and market settings, and how could the data be presented so that the reliability of the statistical inferences would be improved.

In this chapter I have introduced the previous research on other types of businesses and market settings, and reviewed the methods of data analysis for several empirical examples. By conducting this literature review I have achieved the objective set for the chapter two to review the literature on multimarket competition and to present a synthesized theoretical framework of competitive interactions for global firms. I utilize the framework in the chapter six, when I discuss the results of the game consoles case. Next I move on to the case study.

3 MICROSOFT VERSUS SONY

Entertainment is more amazing with Xbox.[3]
Never stop playing.[4]

In this chapter I discuss the game consoles case in detail. I first further justify why I am including only Microsoft's Xbox 360 (Xbox) and Sony's PlayStation 3 (PS3) in the discussion. I then include relevant information on the players and their game consoles divisions (cf. Table 3 for a summary of the section 3.2). The chapter is concluded by setting hypotheses for the empirical testing.

3.1 Case limitations

The hypercompetitive gaming market is not limited only to game consoles. In addition to the three game consoles produced by Microsoft, Sony and Nintendo, the gaming market includes other gaming platforms, which are often seen as substitutes to game consoles, as most of the players prefer to concentrate on a single platform (e.g. console gamers vs. PC gamers). Consequently, it would be also possible to look into the gaming market as a whole, as it is quite artificial to try to separate the players in the concentrated gaming market. For example, Microsoft produces games and the Windows platform for PC gamers, while Sony competes with Nintendo in handheld consoles.

Other gaming devices besides game consoles include mobile multifunction phones and tablets (Apple iPhone and iPad, Android phones and tablets), handheld consoles (Nintendo 3DS, Sony PS Vita) and personal computers (PCs), including social games, and multiplayer war and role playing games played online such as the World of Warcraft (in order to review the current supply, see for example Electronic Arts, 2013a,b; Nintendo, 2013b; Sony PlayStation, 2013e; Blizzard Entertainment, 2013).

Furthermore, the game consoles oligopoly is undergoing changes due to recent advances

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[3]Current US Xbox 360 slogan (Microsoft Xbox, 2013e).
[4]Current US PlayStation 3 slogan (Sony PlayStation, 2013b).

in technology. Despite the game console market's consolidation, which has shrunken the console manufacturing to the oligopoly of three companies for the duration of the last seven years, there are firms willing to take on the challenge of trying to penetrate the barriers to entry to the game consoles market (cf. Fitzsimmons, 2012).

Ouya is a recent game console venture developed by Boxer8 and planned to launch in April 2013 (Fitzsimmons, 2012). Another new venture into the game console market is Google's cloud service OnLive platform, which lets the players to access the gaming data for console games online, and play the games without a physical console with just a controller, a TV, and an Internet access (Robinson, 2011).

In the beginning of the thesis I explained the limitation of the empirical examination to include data considering only Sony's PS3 and Microsoft's Xbox. There I described the differences in product markets between the two case console manufacturers, and Nintendo, which produces the Wii console. Although Nintendo is usually also included in the discussion on the oligopolistic market for game consoles manufacturing, based on the differences in their consumer segments and the fact that Nintendo is already moving on to the eight generation with its eight generation console Wii U, I am omitting the data considering Nintendo's Wii.

I am including the data from 2007 to 2012, comprising the seventh generation of the game consoles market. Although both consoles were in retail already in 2006, 2006 is not included in the discussion due to data availability reasons. I do not limit the data geographically. However, it should be noted that the home (and key) markets of the firms are the United States for Microsoft and Japan for Sony.

The industry analyst VGChartz (2013b) estimates that United States, United Kingdom, Germany, France and Japan form 70 % of the global retail games market. Subsequently, although the market is global, most of the sales are still generated in the developed countries. However, the developing BRIC (Brazil, Russia, India and China) markets are growing, and present an important market opportunity for both firms now and in the future (cf. O'Neill, 2001; Wilson et al., 2011).

Figure 7: Xbox 360 and PlayStation 3 models (Microsoft Xbox, 2013c; Sony PlayStation, 2013f).

3.2   The players

The seventh generation game consoles

Microsoft's entertainment division, Interactive Entertainment Business division (in 2011 Annual report Xbox belongs to Entertainment and Devices Division) is responsible for the production of Microsoft's second version of the game console Xbox 360 (Microsoft, 2011a,b, cf. Figure 7 on the left). The division also includes the production of the online service Xbox LIVE, and the motion technology device Kinect for the Xbox 360 (Microsoft, 2011a). Xbox has sold approximately 68.1 million units in its lifetime (by Q2/2012), which begun a year before the launch of PS3 in October 2005 (VGChartz, 2013a). Although widely rumoured to be in development and ready for launch by the end of 2013, Microsoft is yet to announce a new generation Xbox (Rivington, 2013).

Sony Computer Entertainment, Inc. (SCEI) is a business division of the Japanese multinational Sony Corporation (SCEI, 2013a). It is responsible for developing, producing, marketing, and selling the PlayStation 3 (ibid.; cf. Figure 7 on the right). By Q2/2012, PS3 has sold approximately 66.2 million units worldwide (VGChartz, 2013a). PS3 is Sony's third iteration of a game console, making Sony the longest standing player in the game console market (Rivington, 2008). The original PlayStation was released in 1994 followed by the

Feature	Microsoft Xbox	Sony PS3
Best price in 2012	Cheapest model at $199	Most expensive model at $299
Console launch	First in 11/2005	Second in 11/2006
Exclusive best-selling franchises	Gears of War, Fable, Halo etc.	Little Big Planet, Killzone, SingStar etc.
Media content	Xbox LIVE	PSN; Quicker to adopt the media entertainment concept
Online service	Xbox LIVE community (larger)	PSN community
Paid subscriptions	Xbox Gold	PSN Plus service includes better games and other content
Motion controlling device	Kinect launched second in 11/2010	PlayStation Move launched first in 09/2010
Market leader	US market in 2012 Global sales in 2012	Japanese market in 2012
Bundles based on exclusive titles	e.g. Gears of War 3, Star Wars	e.g. Uncharted 3, God of War
Technological leadership	Integrating Windows 8 and Windows Phone as part of the console experience as well: SmartGlass	3D compatibility; Doubles as a Blue-ray player; Best model has bigger storage
Other advantage	Collaboration with Nike+, Kinect training: opportunities also for non-traditional gamers	Slim and sleek model design is attractive to gamers

Table 3: Xbox vs. PS3. Table summarizes the discussion of the firms' products and services. See Goss (2010); Chacksfield (2010); Smith (2011a,b); Totilo (2012); VGChartz (2013a); Evans (2013); Microsoft Xbox (2013c); Sony PlayStation (2013f); cf. also Table 4.

Specification	Xbox	PS3
Hard drive	250 GB	500 GB
Ports	5 2.0 USB ports; 1 Kinect port	2 USB 2.0 ports
Weight	2.9 kg	2.1 kg
Dimensions	270 mm x 75 mm x 264 mm	290 mm x 60 mm x 230 mm
Optical drive	CD, DVD	CD, DVD, BD

Table 4: Technical comparison. Table summarizes some key technical specifications for the current Xbox and PS3 models. See Microsoft Xbox (2013b); Sony PlayStation (2013a).

PS2 in 2000, and the PS3 in 2006 (ibid.). Sony has also announced in 2013 that there will be a PS4, although the exact launch time is yet unknown (Fitzimmons, 2013).

Although Microsoft was able to launch their new generation console well ahead of the competition, the early mover strategy backfired to some extent when the reports of the infamous *red ring of death* problem started to come in (Hartley, 2008a). Some reports estimated that almost 25 % of the Microsoft consoles malfunctioned during the first two years after the purchase (Lytle, 2009). Although the problem, caused by overheating was fixed in the subsequent models, the reputation of the console suffered.

When the smaller, Blu-ray and high-definition boasting PS3 finally launched in the end of 2006, Xbox was only saved because Microsoft was able to offer the Xbox models for almost $200 cheaper than Sony, which was struggling with high production costs of making PS3 (cf. Table 5; Goldstein, 2006). As the seventh generation console production has developed further, the quality and price differences between the hardware of the two consoles have been minimized almost completely, and it is hard to say which one of the two would be better in terms of hardware, as it can be seen in the Table 4.

Game availability is another important feature in the game consoles market. In the beginning of the battle, there were better games offered for Xbox, while Sony was finding it hard to provide quality games to sell with the powerful console (Rivington, 2007d). While Sony's own studios were struggling to offer any good exclusive titles, the third party game developers were initially not very keen on providing games for the new PlayStation either (Rivington,

2007c).

Over time, the game availability has increased for both consoles, and currently game availability is rarely a decisive feature for the buyer. While most of the third party titles are offered for both consoles, Microsoft appears to be holding more tightly on to the exclusive game strategy with their exclusive game series Fable, Gears of War and, Halo (Chacksfield, 2010).

Concurrently with the launches of the two consoles, there was a media format war between Toshiba's HD DVD and Sony's Blu-ray (Williams, 2008). While the war was won by the Blu-ray format in 2008, Microsoft refused to integrate Blu-ray in the Xbox production, instead deciding to concentrate on digital content (Hartley, 2008b). To date, the Xbox models still do not include a Blu-ray player, cf. Table 4.

The most important technological advances in the game consoles market during the seventh generation have been motion controlling technology led by Nintendo's Wii (Nintendo, 2013a), 3D technology led by Sony (Goss, 2010), and increasing online content and other services at Xbox LIVE and PlayStation Network (Microsoft Xbox, 2013d; Sony PlayStation, 2013d).

Microsoft's answer to motion controlling technology is the Kinect for Xbox 360, launched in November 2010 (Microsoft Xbox, 2013a; Smith, 2011a). Kinect is a peripheral device, which can read movement and recognize sounds (Microsoft Xbox, 2013a). It has gained more attention and sold more copies than the corresponding PlayStation Move and PlayStation Eye by Sony (Sony PlayStation, 2013c; Smith, 2011a; Jackson, 2010).

Sony has included 3D technology to its console models from early on, whereas Microsoft has been slower to adopt 3D (Goss, 2010; Chacksfield, 2011a; Whitehorn, 2012). The 3D technology is not yet fully accessible to normal household consumers due to the high prices of the technology, and clumsiness of 3D goggles has had the customers suspicious about the products (Carter, 2011; Solomon, 2012). The main uses of the technology remain in the movie theatres rather than being the part of the entertainment systems at home (Solomon, 2012). However, the sales of the 3D systems have been increasing over the last few years,

indicating that 3D could become more important in the future (Carter, 2011), although there are also those who think that 3D is an infeasible feature (Solomon, 2012, 2013).

On the digital content and services side Sony has been slightly faster to adopt the *on demand* concept, which means offering such entertainment services as Netflix, BBC iPlayer and Hulu Plus, where the customer can download content such as TV programs and movies based on a subscription fee for services (or their bundles) (Sony PlayStation, 2013d). On the contrary, Microsoft has been more successful in promoting its Xbox LIVE service for the gamers (Totilo, 2012).

Microsoft has been catching up with PlayStation's supply of on demand content as well, now offering a selection of the most popular content services for Xbox (Microsoft Xbox, 2013d). Nevertheless, looking at the content subject to charge, Totilo (2012) ranks Sony's PSN Plus service over the Xbox LIVE Gold service, as it includes more games. Since neither company publishes the numbers for paying subscriptions, it is hard to decide which system fares better considering the offered content.

The future of the game consoles

As both Sony and Microsoft have almost equal standing in the global market at the moment, the opportunities and threats the companies are facing are mostly the same for both. Growing BRIC markets mentioned in the beginning of the chapter (O'Neill, 2001; Wilson et al., 2011) present a larger future market for the consoles. Ever growing concerns over social responsibilities of the firms are likely going to continue to exert more and more pressure on the production conditions of the console parts (Rivington, 2007b), energy usage of the consoles (Rivington, 2007a), and overall ethical behaviour of the firms.

The advances in technology present opportunities for both console makers. Whereas Microsoft has been investing in the motion controlling technology, Sony has concentrated early on the 3D capabilities of the PlayStation console (Goss, 2010; Smith, 2011a). Blu-ray discs are becoming more affordable and more common, meaning that Microsoft will likely need to add a Blu-ray drive sometime in the future (cf. Hartley, 2008b). Granted, there is a possibility that Blu-ray could become completely obsolete if online media content and clouds become

more prevalent (e.g. Chacksfield, 2011b).

Other technological advances include cloud gaming and multiple platforms (Robinson, 2011; Chacksfield, 2011b). Whereas cloud services for consoles are still taking baby steps, Microsoft has moved on with the SmartGlass project, promising a hybrid gaming between tablets and the Xbox console (Evans, 2013). Content providing is one of the current competitive war zones between the firms, and it is likely to continue to be so in the future (Sony PlayStation, 2013d; Microsoft Xbox, 2013d). The threats of the future also include competition from the old enemies such as PC gaming and mobile gaming, and from the new rivals cloud gaming (OnLive Platform) and new console ventures (Ouya) (Robinson, 2011; Fitzsimmons, 2012).

The Wii U is a first mover in the eight generation of the consoles, and being a more advanced than the previous version of the Nintendo console, it might pose a threat to the current generation of the other two consoles (Nintendo, 2013a). After all, the two consoles are now moving closer to Wii's consumer segment of casual gamers with their motion controlling devices (cf. Microsoft Xbox, 2013a; Sony PlayStation, 2013c). For now, it seems that Sony is the first one to launch the next generation console, and start the battle for the dominance of the eight generation gameplay and entertainment (Rivington, 2013; Fitzimmons, 2013).

3.3 Hypotheses

The first research question of this thesis asks how the companies compete against each other. In order to answer the question, I am setting hypotheses for statistical inference based on the previous research reviewed in the literature review, and the case specifics presented in the sections 3.1 and 3.2 above.

The second research question asks whether the method of Chernoff faces can help to clarify competitive dynamics modeling. Although Chernoff faces cannot be used as a statistical testing tool, the results of the statistical inference for the hypotheses can be compared to the generated faces. The used statistical methods and Chernoff faces are discussed in more detail

in the next chapter.

I am following Nair and Selover (2012) in setting the hypotheses, as the object of interest in their study is a single pair of competitive firms (dyad) following the competitive dynamics discourse discussed in the literature review (e.g. Chen, 1996). Similarly, the theoretical framework of this study has been built to reflect the dyadic nature of competition between two firms (cf. Figure 6).

In the same way than Coca-Cola and Pepsi, which are the companies under the examination in Nair and Selover (2012)'s study, Microsoft and Sony have customarily been seen as a competitive pair in the game consoles market. In order to study whether the companies see each other as symmetric competitors (cf. Chen, 1996), Nair and Selover (2012) examine whether the data includes significant interlinked behaviour.

Interlinked behaviour is the basic assumption behind the competitive dynamics awareness-motivation-ability framework as it was discussed in the literature review (cf. Chen, 1996; Ferrier, 2001; Yu and Cannella, 2007). Following Nair and Selover (2012)'s hypothesis one, the first hypothesis of this study is formulated as:

Hypothesis 1. Competitive moves between Microsoft and Sony display an interlinked relationship. The strategic moves of the companies follow each other.

H_0: There are no signs of interlinked behaviour.
H_1: Competitive moves display an interlinked behaviour.

Nair and Selover (2012) also examine the previous research's results of mutual forbearance behaviour in the beverage market. As discussed in the literature review, the mutual forbearance theory posits that when the companies become familiar with the other firm, the aggressiveness of the competition reduces (Yu et al., 2009; Ma, 1998; Baum and Korn, 1999; Jayanchandran et al., 1999). Some researchers have also found evidence of a U-shaped relationship between multimarket contact and mutual forbearance (Baum and Korn, 1999; Haveman and Nonnemaker, 2000, cf. Figure 5).

In this study the observation period is shorter than the time that the companies have spent

competing together in other markets (including the market for the previous generation of game consoles). Therefore I cannot test the U-shaped relationship between multimarket contact and the number of attacks like in Haveman and Nonnemaker (2000) or Baum and Korn (1999). However, I am still curious to find out whether the competition attenuates when the console market matures and the companies learn more about each other's behaviour for this generation as the mutual forbearance theory suggest.

Hypothesis 2. Competitive moves between the companies decrease in number over time as the companies get more familiar with each other's moves.

H_0: The amount of competitive moves remains the same.
H_1: The amount of competitive moves decreases.

The final hypotheses of Nair and Selover (2012) concentrate on the dominant firm position, *id est* which company is initiating the attacks, and who is following whom. The authors use the brand value comparison executed by Interbrand to compare Coke's and Pepsi's brand values in order to determine which company is the brand leader. Consequently they determine that the leading firm Coke is the most dominant, as it also is the market and the price leader over the observed time period (Nair and Selover, 2012).

In the game consoles market, the first-mover Microsoft leads the global market slightly, while also leading the sales in the US (VGChartz, 2013a). Microsoft has also been the historic price leader, having been able to offer Xbox cheaper than the PS3 in the beginning of the battle (cf. Table 5). Consequently, I am positing that Microsoft is the dominant firm in the relationship.

Since both case companies produce other things along with consoles, the company brand ranking by Interbrand cannot be used in the context of this study. Another brand ranking company Brandirectory ranks Microsoft Xbox as 206th and Sony PlayStation as 289th in Global 500 brands (Brandirectory, 2013a,b). Although the reliability of the brand value surveys can be questioned, the Brandirectory survey appears to offer support for Microsoft's brand leadership, further supporting the suggestion that Microsoft is the dominating firm in the relationship.

The competitive dynamics research has also suggested that sometimes the non-dominant firm can be the more aggressive one initiating the attacks (Nair and Selover, 2012, cf. also Ferrier et al., 2002). In the case of Coke and Pepsi, Nair and Selover (2012) get mixed results depending on the type of the strategic action. In the same manner, in order to find out who is dominating the strategic behaviour in the game consoles case, I am testing both cases:

Hypothesis 3a. The dominant Microsoft is initiating the attacks.

H_0: Microsoft is not initiating the attacks.
H_1: Microsoft is initiating the attacks.

Hypothesis 3b. The non-dominant Sony is initiating the attacks.

H_0: Sony is not initiating the attacks.
H_1: Sony is initiating the attacks.

This chapter has examined the game consoles market and introduced the players, which was the objective set in the chapter one. Additionally, I have formed the hypotheses for statistical testing. Test results are presented in the chapters five and six. The next chapter introduces the statistical tools used in the analysis.
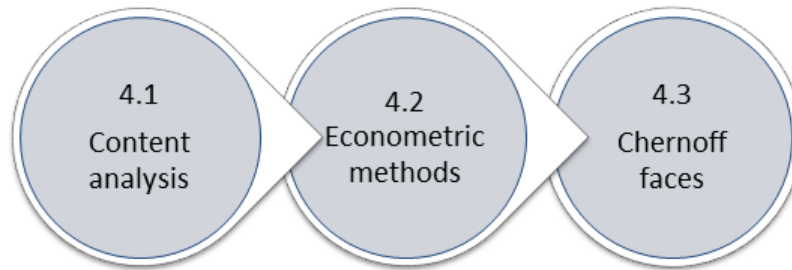
Figure 8: Research methods outline

4 RESEARCH METHODS

The empirical data described in this chapter are used to answer the research questions. The first question of how the companies compete with each other is answered by analysing the gathered data with the methods of statistical data analysis (including Chernoff faces) presented in this chapter.

The second research question evaluates the method of Chernoff faces in competitive dynamics modelling. While the final conclusions on the usability of the method are left to the chapter six of this thesis, the third section of this chapter introduces the graphical statistical method of Chernoff faces, and describes the Chernoff face variables used in this study.

Figure 8 shows the outline for the chapter. In the first section, I describe the data collection method of quantitative content analysis, and discuss the process for this study. In the second section I introduce the tools used in the regular econometric data analysis. The third section reviews the more unconventional statistical method of Chernoff faces, suggested in this thesis as a supporting tool for the data analysis.

The data set for this study is quantitative panel data. The summary of the variables other than the ones generated by the content analysis is presented in the Table 5 below. The data is for $n = 2$ entities (firms: Microsoft, Sony), and for $T = 24 - 2 = 22$ time periods (quarters 2007 Q1-2012 Q2). Therefore there are a total of $n * T = 44$ observations in the panel data set for each variable in this study.

Obs. number	Company	Quarter	Unit sales	Dyadic market share	Low price ($)[5]	High price ($)[5]
1	Microsoft	2007Q1	1388481	0.46	334.00	535.00
2	Sony	2007Q1	1606157	0.54	557.00	669.00
. . .	. . .	. . .	. . .	. . .	. . .	. . .
7	Microsoft	2007Q4	3936367	0.49	300.00	483.00
8	Sony	2007Q4	4166406	0.51	445.00	557.00
. . .	. . .	. . .	. . .	. . .	. . .	. . .
37	Microsoft	2011Q3	1922174	0.42	205.00	308.00
38	Sony	2011Q3	2603361	0.58	256.00	308.00
. . .	. . .	. . .	. . .	. . .	. . .	. . .
43	Microsoft	2012Q2	1358053	0.44	199.00	299.00
44	Sony	2012Q2	1708165	0.56	249.00	299.00

Table 5: Selected observations on key figures by company and quarter

Because the companies do not publish comparable sales data (cf. Microsoft, 2013b; SCEI, 2013b), I am utilizing a second-hand sales database collected by the industry analyst VGChartz (VGChartz, 2013a,b). The data provider publishes monthly unit sales data from the most important markets, and yearly data from the global market (VGChartz, 2013b). In this study, I have summed the unit sales data quarterly. The market share observations are calculated as a percentage of the unit sales of the firm i from the total sales of the two competitors.

In order to keep the discussion coherent, I am using the US data to represent the price changes and model changes for the companies. The data on price and model changes have been collected from the companies, where available (Microsoft, 2013a; Xbox Press Center, 2012; Sony, 2013), and double checked against the more comprehensive Wikipedia lists (Wikipedia, 2013a,b).

With the purpose of making the prices comparable over time, they are adjusted for inflation, and presented in 2012 dollars using the US figures for the Consumer Price Index (CPI) (Bureau for Labor Statistics, 2013). Only two price-model variables are offered for each company for each quarter: the price for the cheapest, most basic model offered during the time

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[5]Prices adjusted for inflation and presented in 2012 dollars.

period, and the price for the most expensive model offered during the time period. In reality, the companies have offered several models with different specifications of their consoles, as it can be seen from the Wikipedia lists (Wikipedia, 2013a,b). As discussed in the previous chapter, this is due to the fast pace of technological change in the game consoles market, forcing the companies to reinvent their products regularly.

As the United States is one of the key markets for both companies, the competitive dynamics awareness-motivation-ability framework posits that the companies are likely competing aggressively with each other (e.g. Chen, 1996; Chen and Stucker, 1997; Yu and Cannella, 2007). Consequently, I choose Microsoft as the focal firm, and Sony as the rival firm, as the United States is the home country for Microsoft. The data is analysed with the statistical freeware program R (www.r-project.org) and the statistical program SPSS.

4.1 Quantitative content analysis

The method of quantitative content analysis was developed in the 1960s based on the newspaper analyses from the 1920s (Sjøvaag and Stavelin, 2012). In addition to journalism research, the method is used in such fields as sociology, psychology and business (Neuendorf, 2002). Sjøvaag and Stavelin (2012) concentrate specifically on quantitative analysis of online newspaper content, which is also the data source for this study.

Jauch et al. (1980) suggest that content analysis can be utilized in organization research, including researching strategies. The competitive dynamics researchers have taken Jauch et al. (1980)'s approach and adopted quantitative content analysis as the main method of development and testing hypotheses in studying competitive actions of firms (e.g. Young et al., 1996; Ferrier et al., 1999; Ferrier, 2001).

Quantitative content analysis can be conducted either manually or by computer assisted methods (Neuendorf, 2002; Sjøvaag and Stavelin, 2012). The sample data in this thesis is gathered and coded manually. Sjøvaag and Stavelin (2012) advice to start by assessing whether the research questions and hypotheses can be answered by the chosen method. In this thesis the

purpose is to quantify the reactions of two competing firms, and find competitive patterns from them with statistical methods. Therefore quantitative content analysis appears to be the right method for this thesis.

The second stage is to use inductive or deductive coding to create a codebook of keywords (Sjøvaag and Stavelin, 2012). The authors suggest that previous studies and codebooks should be used as far as possible, as they have been validated through use (ibid.). Table 6 presents previously done studies on competitive actions, and examines their coding categories and keywords. Most of the studies do not provide a list of the used keywords, however, the ones that do (Ferrier et al., 2002; Upson et al., 2012) are included in the list as examples.

Introducing new products or making changes into the existing products due to the advances in technology is a competitive action category mentioned in all of the studies. Some studies have also gone further and separated categories for new technologies (Yu et al., 2009). Service actions such as after-sales services can also be thought to be part of the product action category, however, some of the studies consider this as a separate category (Ferrier, 2001; Ferrier et al., 2002; Yu and Cannella, 2007; Yu et al., 2009).

Yu and Cannella (2007) categorize product actions into two different action types: minor and major product action. Product redesign, modification, use of new technology, and annual model introduction are considered as minor actions, whereas major actions correspond to substantial investments, new product introductions, and technology breakthroughs (ibid.).

Changes in pricing and marketing actions are also categories considered in all of the studies. Cost and quality based strategies such as pricing, marketing, and product design are traditional sources of competitive advantage (e.g. Hamel and Prahalad, 1989), and hence it is not surprising to see the categories in all of the studies. Other categories considered by the previous researchers include capacity, geography, signalling and organizational changes.

Yu and Cannella (2007) define capacity actions as changes in company's capacity or output. Derfus et al. (2008) explain that increasing capacity is one of the possible ways to deter entry in markets. Geographic actions refer to entry and exit of the firms from each other's markets

Coding category	Keywords	Studies
product introductions, product actions	introduce, launch, unveil, roll out	Young et al. (1996); Ferrier et al. (2002); Ferrier (2001); Derfus et al. (2008); Yu et al. (2009); Upson et al. (2012)
major product action	not available	Yu and Cannella (2007)
minor product action	not available	Yu and Cannella (2007)
technology innovations	not available	Yu et al. (2009)
service actions, distribution and after-sales service	service, warrantee, guarantee, financing	Ferrier (2001); Yu and Cannella (2007); Ferrier et al. (2002); Yu et al. (2009)
pricing	price, rate, discount, rebate	Ferrier (2001); Upson et al. (2012); Ferrier (2001); Derfus et al. (2008); Ferrier (2001); Yu and Cannella (2007)
promotional, advertising, marketing	ads, spot, promote, distribute, campaign	Ferrier et al. (2002); Upson et al. (2012); Yu et al. (2009); Derfus et al. (2008); Yu and Cannella (2007); Yu et al. (2009); Young et al. (1996)
signalling, overt signalling actions	vows, promises, says, seeks, aims	Ferrier (2001); Upson et al. (2012); Ferrier et al. (2002)
geographic moves	not available	Derfus et al. (2008)
capacity, capacity related actions	raises, boosts, increases	Ferrier (2001); Derfus et al. (2008); Ferrier et al. (2002); Yu et al. (2009); Yu and Cannella (2007)
changes in organizational structure and management systems	not available	Yu et al. (2009)

Table 6: Coding categories and keywords in previous studies

(ibid.). Signalling means sending threatening messages to the rival of the intended action of the focal firm (Upson et al., 2012). Organizational changes refer to the actions aiming to restructure the firm in order for it to become more efficient in competing against the rivals (Yu et al., 2009).

The sample in this thesis is collected and coded manually from Techradar news archive containing console news published between January 2007 and June 2012. Techradar is the UK market leader in online entertainment and video games news and reviews, and it is a part of the Britain based Future Plc. media group (Future plc., 2012; Techradar, 2013).

The site was chosen as it offers access to the game consoles news archive throughout the sample period unlike most of the online console news services. Additionally, Future Plc. has official partnerships with both case companies Future plc. (2012). The reliability of the web service can be tested against the publications in other comparable services (e.g. www.engadget.com), and the annual reports of the case firms (Microsoft, 2013a; Sony, 2013).

Table 7 lists the coding categories and keywords developed for this thesis. Coding categories and keywords are based on the previous studies, and adapted to match the style of the data source Techradar. Table 7 also provides example headlines in each category.

The third stage of content analysis after codebook formulation is to define the sample (Sjøvaag and Stavelin, 2012). The process for this study included first searching for the news articles on console news in the Techradar news archive, organizing them by date, and collecting every news article, which mentioned Xbox 360, Microsoft, PlayStation 3, or Sony. I then read all the articles, retaining those, which clearly belonged to one or more of the categories defined in the Table 7. I then used numerical coding to code the articles accordingly to the categories console manufacturer i: 1=Microsoft, 2=Sony, year i: 1=2007, . . . , 6=2012, and category i: 1=product, . . . , 6=signalling.

The final stages of content analysis according to Sjøvaag and Stavelin (2012) include checking for mistakes, and revising the codebook and the categories. During the coding process, I redefined the categories by adding relevant keywords. As some of the articles discuss both case companies and several different actions, I reread the articles and separated the different

Coding category	Keywords	Example
product action	introduce, launch, unveil, reveal, add, offer, change, announce, switch, update, release, debut, design, hardware, revision, version	On Friday the 120 GB Xbox 360 Elite will be launched on British shores.
service action	service, warranty, fix, content, access, application, support, download, firmware, software, security	Microsoft to fix all broken Xbox 360 consoles.
pricing action	price, rate, discount, rebate, cost	Kinect costs same as Xbox 360 console.
marketing action	ads, promote, distribute, campaign, claim, boost, bundle, pitch	Sky Player on Xbox launches today, with a bundle that includes a media remote, a month of Sky Sports and a three-month Gold membership subscription available for £29.99.
capacity action	raises, boosts, increases, acquires, production, patent, developers	Microsoft has moved to acquire the Xbox8.com domain name.
signalling action	vows, promises, says, seeks, aims, mention, trumpet, talks, states, works on, strategy, threat, leaves, concentrates on, announces, claims, reacts, hints, expects, job advertising, boast	Microsoft was also proud to trumpet the fact that it's been able to maintain its lead over Sony and Nintendo in terms of total money spent by gamers on hardware and software.

Table 7: Coding categories and keywords in this study

sales action	outsells, sells, sales, battle, victory, lose, ship, profit, loss, fail, compete	The Xbox 360's sales victory comes after Microsoft sold a staggering 270,000 of the consoles in January 2012.
games action	exclusive, game, publishes, special edition, limited edition	Today sees the release of the much mooted Halo 3 game for the Xbox 360.

Table 8: Adding extra action categories based on the data review

actions for each company. Thus one article can be a source for several actions, or for both companies.

Additionally, I created categories called Sales (i=7) and Games (i=8) presented in the Table 8. The sales action category tracks the posts related to the battle of the sales figures reported regularly on Techradar. The action is marked to the company, which is leading the sales according to the news report. The games category includes the news on the game deals and publications for each company.

Jauch et al. (1980) state that for the sake of validity it is important to have multiple raters, whose interrater reliability is assessed with a correct measure. Similarly, Chen (1996, 2009) emphasizes the use of industry informants in validation of the data collection when data is collected by the content analysis.

Validity is not an excessive issue for this thesis, since the purpose of the empirical part of this thesis is to function as an example of an analysis of competitive actions rather than a comprehensive analysis of a complete database. Nevertheless, I provide exact information on the research design, and the validity of the results can be checked by trained coders in a different setting if needed.

In total, there were $n = 311$ competitive actions in the data. The summary of the data generated with the content analysis can be seen in the Table 9. Each of the used categories is large enough for statistical analysis, although the service and the signalling categories are marginally larger than the other six categories for both companies.

Action	Microsoft	Sony	Total actions
C1:Product	21	16	37
C2:Service	34	31	65
C3:Pricing battle	16	16	32
C4:Marketing	18	11	29
C5:Capacity	7	12	19
C6:Signalling	39	33	72
C7:Sales battle	19	11	30
C8:Games	16	11	27
Total actions	170	141	311

Table 9: Action category breakdown by companies

Figure 9 describes the breakdown of the actions for both companies. In the figures it can be seen that signalling and service actions are the two most often used actions for both firms. Microsoft has been flagged the winner in the articles for more times than Sony, which corroborates the finding in the chapter 3 that Microsoft is the sales leader. Product, marketing, and games action bars are also higher for Microsoft than Sony, while Sony has a higher capacity bar. The pricing bars are equally high for both companies. The content data appears to suggest that Microsoft is the more aggressive player in the relationship.

Figure 10 shows combined action counts across the observed time periods. The most actions observed are in the beginning of the time series, when Sony has just made the entrance to the market. Visible peaks in the activity data can be seen in the quarters Q1 2007, Q2 2007, Q4 2008, Q2 2010, and Q2 2012.

4.2   Econometric methods

In this section I am reviewing the conventional statistical tools used in the data analysis. I utilize econometric measures used in previous research in order to statistically test the hypotheses presented in the previous chapter, and in order to find a comparison point for the Chernoff faces, which are presented in the next section.
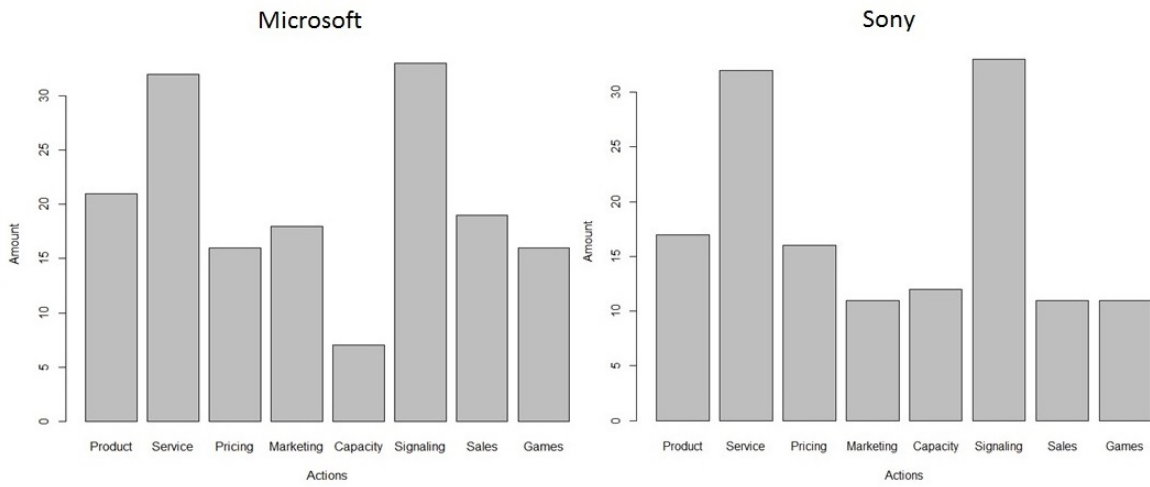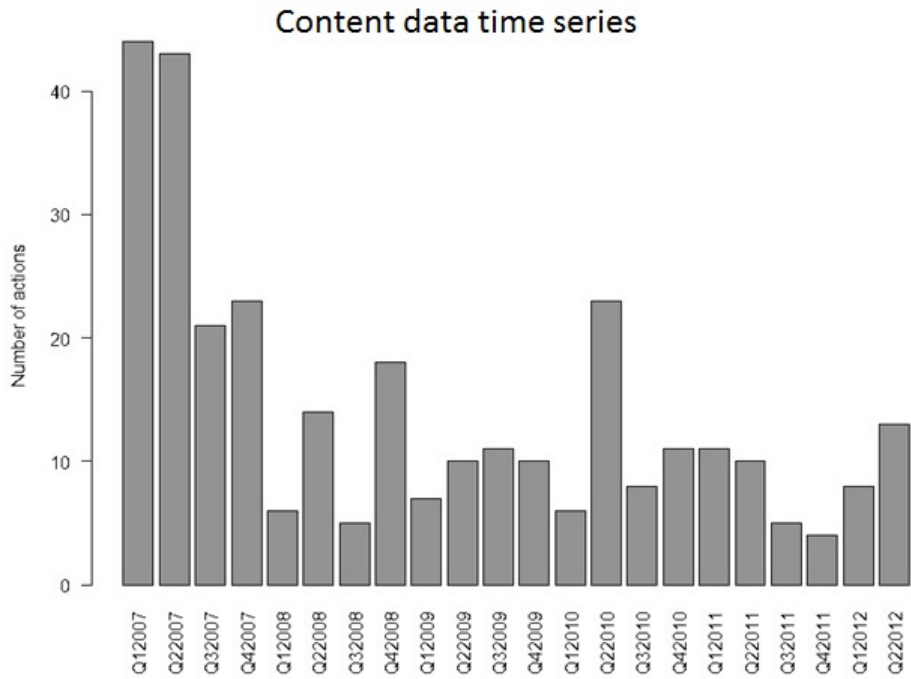
Figure 9: Action breakdowns

Figure 10: Content data time series breakdown

Time series name	Minimum	Maximum	Mean	Std. Dev.
High price Microsoft ($)	299.00	535.00	365.18	81.69
Low price Microsoft ($)	199.00	334.00	238.18	48.97
High price Sony ($)	299.00	669.00	447.59	132.61
Low price Sony ($)	249.00	557.00	364.64	107.97
Unit sales Microsoft	1023343	7521471	2699635	1892976
Unit sales Sony	962452	6936351	2900906	1695482
Log sales Microsoft	13.84	15.83	14.63	0.57
Log sales Sony	13.78	15.75	14.74	0.53
Total actions Microsoft	1	25	7.36	6.57
Total actions Sony	1	17	6.36	4.80
Log actions Microsoft	0.00	3.22	1.64	0.89
Log actions Sony	0.00	2.83	1.54	0.87

Table 10: Descriptive statistics of the variables used

The data analysis utilizes the data described in the beginning of this chapter, including the primary data generated by the content analysis presented in the section 4.1. In order to get meaningful results with the number of observations in the data set, the action categories are grouped as one variable called *total actions* for each company. Table 10 includes the minimum, maximum, mean and standard deviation values for the time series used in the statistical testing.

The time series pairs used in the statistical testing are total actions, sales, high price, and low price for each company. Log sales have lower variances than the sales variables, so the sales are transformed to log sales. Total actions have quite high variances as well, so the series are transformed to log actions.

As I have constructed similar hypotheses than Nair and Selover (2012), I am also using similar methods for obtaining the test results. The tests used are cointegration test, Goldfeld-Quandt test, and Granger causality test. I review each method and their assumptions shortly below; the results are reported in the next chapter.

Cointegration test

The cointegration test is used to examine whether there is a long term interdependent relationship between two firms (Nair and Selover, 2012). Cointegration measures whether two non-stationary time series are cointegrated, or if the behaviour of one time series can be predicted by looking at the behaviour of the other time series (Chen, 2011).

Cointegration test is done by first checking that the time series are non-stationary integrated of order one series, or $I(1)$-type series where the trend can be removed by differentiating the series once (Chen, 2011). On the contrary, the stationary $I(0)$-type series do not present visible trend (ibid.). The linear relationship between the two series is then estimated by graphing the series in order to see if they share a stochastic trend and by conducting the ordinary least squares (OLS) regression (Chen, 2011; Stock and Watson, 2012).

The cointegration residual terms should be stationary, which can be checked with a unit root test (Chen, 2011; Stock and Watson, 2012). Stock and Watson (2012) warn that the test is often not reliable, as the OLS estimator tends to have a non-normal distribution, which leads to misleading inferences based on its t-statistic. Therefore the authors urge to use common sense, economic theory, and graphs in order to confirm the results (ibid.).

The steps utilized in this thesis are:

1. Checking if the two corresponding time series are stationary by graphing the series and checking if there is a significant trend component. Confirming the trend by calculating autocorrelations for each series.

2. Using R to compute the OLS regression and the unit roots to test for cointegration, in case the previous step proved that the time series were non-stationary.

3. Reporting the test results for each time series pair.

Goldfeld-Quandt test

Goldfeld-Quandt test is used to examine whether the number of actions decreases or increases significantly over two different time periods (Nair and Selover, 2012). The variant that Nair

and Selover (2012) use is constructed as the ratio of residual sum of squares $\frac{ERR2}{ERR1}$, where the two residuals are calculated from two regressions on the first third and the last third of the observations of two time series. The test assumes a normal distribution of the error terms and no serial correlation (Nair and Selover, 2012).

The steps utilized in this thesis are

1. Checking the error terms distributions and serial correlation.

2. Conducting the test by using the variant used in Nair and Selover (2012)'s study.

3. Reporting the test results for each time series pair.

Granger causality test

Granger causality test is used to examine relationships between two time series (Nair and Selover, 2012). Granger causality test's null hypothesis is that the regressor time series does not contain any predictive content of the regressand series, or that the coefficients on all lags of the regressor series are zero (Stock and Watson, 2012). Stock and Watson (2012) note that from the semantics point of view the test is a measure of predictability rather than causality, which means that if X Granger-causes Y, then X can be used to predict Y's behaviour but any causal interpretations should not be drawn on the basis of the test only.

The test assumes the basic time series regression model assumptions (Wooldridge, 2009; Stock and Watson, 2012). The residual terms must have conditional mean zero for both regressors and the lags included, the series must be stationary or the non-stationary series must be transformed, large outliers are rare, and there is no perfect multicollinearity (ibid.).

The steps utilized in this thesis are:

1. Discussing the applicability of Granger causality test to the variables of this study.

2. Running the test for all the possible cases.

3. Reporting the test results for each time series pair.

Figure 11: Examples of Chernoff faces

4.3   Chernoff faces as a method of analysis

This section discusses Chernoff faces, and the reasoning behind their use in this Master's thesis. I first describe the epistemological and ontological background of the faces, and then examine examples of studies where Chernoff faces have been utilized previously.

At the end of this section I evaluate the usability of the faces in the context of competitive actions based on the experiences of the previous research, and describe the design of the faces for this study. The description of the method in this section lays down the basis for the discussion in the chapter six, where I answer the second research question of how Chernoff faces could be used to help to model competitive dynamics.

Background of Chernoff faces

Chernoff faces is a statistical method of depicting multivariate data in the form of cartoon faces (Chernoff, 1973). There is a maximum number of 18 variables, which each describe facial characteristics, such as the size and shape of the head, angle of the eyebrows, curvature of the mouth, size of the eyes, or direction of the eyes (Nel et al., 1994). Chernoff faces are especially useful in presenting a visual image of changes in time series (Chernoff, 1973). Figure 11 depicts three examples of Chernoff faces generated by the statistical program R's TeachingDemos package's faces2 function (cf. Snow, nd).

According to Chernoff (1973, p.363) pictures have four different functions:

  1. They can help to understand the data more quickly.

2. They can function as mnemonics.

3. They can facilitate communication.

4. They can help with calculation.

Chernoff (1973) argues that the faces are useful in the first two ways. When the human mind is processing the data from human interaction in real life, it draws a caricature of a face according to different facial expressions in order to be able to concentrate on the most important messages (ibid.). The faces try to mimic this same process: Figure 11 depicts simple caricatures of faces, which utilize different facial features to express differences in data (ibid.).

Chernoff (1973) ponders if subjective interpretation plays a part in assessing facial diagrams. Similarly, Huff et al. (1981) are worried about the cases where one can add emotional differences to the faces, even if the data does not include any emotional inferences. In contrast, Apaiwongse (1995) evaluates that one of the benefits of the Chernoff faces is exactly in the way Chernoff faces can be used to depict those data sets, which include emotional nuances such as whether a company is doing better or worse than at previous period. The author claims that Chernoff faces are a quick way of depicting this type of data, whereas other methods may not emphasize the emotional differences at all (Apaiwongse, 1995).

The use of Chernoff faces in research

Chernoff faces have previously been used in business research by Nel et al. (1994) to study service quality from customer point of view, and Huff et al. (1981), who present the failure data of firms by utilizing Chernoff faces. Golden and Sirdesai (1992) demonstrate how Chernoff faces can be used to measure brand development in consumer study. Apaiwongse (1995) uses the faces to measure uncertainty and the success of business environmental politics.

Huff et al. (1981) is one of the first applications of the faces on business data. They suggest that Chernoff faces could be used in historical data analysis in demonstrating time series of product strategies, brand development, sales figures, competitive strategies, and changes in

the business environment. Similarly, Golden and Sirdesai (1992) claim that Chernoff faces are an especially good method for behaviour and strategy researchers, whose data is usually complex and the variables complicated.

According to Golden and Sirdesai (1992) comparisons between several different data sets are easy with the faces, and the advantage of the Chernoff faces is that the overall picture is easier to interpret from a visual image than from a table. Continuing with the interpretation argument, Nel et al. (1994) try the method of Chernoff faces because they want to present their multivariate service quality data in an easily understandable format. According to them the top management and researchers are able to understand complicated models, but the middle management and customer service personnel can benefit from an easier way to interpret the data (Nel et al., 1994).

Chernoff faces in this study

The most important advantages from the use of the faces according to the previous research are the simplicity of the faces in explaining complex multivariate data to a large audience (Nel et al., 1994), and the use of the faces in comparing complicated time series data in order to see the overall picture and the possible emotional nuances (Golden and Sirdesai, 1992; Apaiwongse, 1995).

The most likely audiences for competitive moves analysis are the competition researchers and the managers of the competitive firms. Though the researchers who are familiar with statistical methods of time series analysis are unlikely to gain too much insight from the use of Chernoff faces, could the top management who need to be able to efficiently and quickly to interpret data results benefit from the data presented in the facial format. Additionally, looking the data from the overall vantage point might help to improve the statistical insights gained from competitive research data.

The face variables chosen for this study include the content variables described in the section 4.1 (product, service, pricing, marketing, capacity, signalling, sales, games), the dyadic market share measure measuring the piece of the market divided between the two firms, log sales of the companies, and the prices for high and low end models. The same data is analysed

with the statistical tools introduced in the section 4.2; as discussed in this section, Chernoff faces form a visual representation of the competitive dynamics between the firms.

Chernoff (1973) considers which variable the audience of the facial diagram will concentrate on, and advices to try different combinations of the variables in order to see whether the places of the variables matter. Nel et al. (1994) agree with Chernoff and Rizv (1975) that the most important variables should subjectively be selected to correspond to the most important facial features so that the data will not disappear in the formation of the faces. Apaiwongse (1995) refers to De Soete and De Corte (1985)'s study, where the authors found the most important features in the faces are the curvature of the mouth, the length of the face, the size of the eyes, and the length of the eyebrows.

The Chernoff faces variables chosen for this study are presented in the Table 11 below. The function faces2 in the R package has a predesigned order of the facial features from 1 to 18: 1=Width of center, ..., 18=Width of Eyebrows (Snow, nd). The variable zero in the table represents the quarterly time variable, which is used as labels for each face. As suggested by Chernoff (1973) and Nel et al. (1994), several feature and variable combinations were tested in order to generate the final facial set, which presents the information of the variables as deemed subjectively best by the researcher.

As it can be seen from the Table 11, some of the variables are attached to more than one feature in order to emphasize the importance of the variable and allow for natural movement of facial features. For example, to represent a growing dyadic market share, the first three features, which all are related to the shape and size of the face, are attached to the market share variable. Therefore the face appears relatively bigger in comparison for the company, which has a larger market share.

Table 11: Description of the Chernoff face variables

Facial feature	Variable number	Variable	Explanation
Labels	0	Time	Face series labels: Quarterly

Continued

Width of center	1	Market share	Bigger head means bigger market share
Top vs. Bottom width (height of split)	2	Market share	Bigger head means bigger market share
Height of Face	3	Market share	Bigger head means bigger market share
Width of top half	4	High price	Smaller means a price reduction
Width of bottom half	5	Low price	Smaller means a price reduction
Length of Nose	6	C5:Capacity	Longer nose means more capacity actions
Height of Mouth	7	C7:Sales	Lower means more sales actions
Curvature of Mouth	8	Log sales	More curved means bigger sales
Width of Mouth	9	Log sales	Wider means bigger sales
Height of Eyes	10	C1:Product	Higher means more product actions
Distance between Eyes	11	C8:Games	More distant means more games actions
Angle of Eyes/Eye-brows	12	C6:Signalling	Looking angrier means more signalling actions
Circle/Ellipse of Eyes	13	C6:Signalling	More squinted eyes mean more signalling actions
Size of Eyes	14	C4:Marketing	Bigger means more marketing actions

Continued

Position Left/Right of Eyeballs/Eyebrows	15	C3:Pricing	Looking left means more pricing actions
Height of Eyebrows	16	C2:Service	Higher eyebrows mean more service actions
Angle of Eyebrows	17	C6:Signalling	Looking angrier means more signalling actions
Width of Eyebrows	18	C2:Service	Wider eyebrows mean more service actions

Face series for quarterly data were generated for each company based on the chosen variables. The process resulted in 22 faces for both firms. The results are discussed in the next chapter, and the complete facial sets for each company can be found from the appendices. The use of the faces in competitive action research is further evaluated in the chapter six.

The objective for this chapter set in the beginning of this thesis was to research the interactions between the players by conducting a structured content analysis, and to introduce the methods used in the statistical data analysis. Next chapter reports the results of the data analysis.

5 EMPIRICAL FINDINGS

This chapter presents the results of the data analysis. The first section reports the results of the econometric analysis, and the second section discusses the results of the Chernoff faces analysis. The results presented in this chapter are synthesized with the case and the literature in the following chapter.

5.1 Results of the statistical analysis

The process for each test follows the steps described in the previous chapter. Complete graphs are only presented for selected examples in order to keep the report concise and clear.

5.1.1 Cointegration test results

The first step of the cointegration test is to check if the time series present a significant trend (nonstationary series) or if they are stationary (no trend, random) (Wooldridge, 2009). This can be done by graphing the time series (ibid.). Figure 12 presents the graphs for Microsoft and Sony's logged total actions across the time periods.

It can be seen that while the observations peak during the early 2007 periods for both companies, Microsoft data does not appear to have a trend, whereas the Sony data presents a slight downward sloping trend. Autocorrelations can be used to confirm the visual results (Wooldridge, 2009). The autocorrelation graphs for the total actions series for each company are presented in the Figure 13.

The autocorrelations graph confirms that Microsoft's total actions autocorrelation coefficients are not significant at 5 % confidence limit except for the lags 19 and 20. Additionally, there does not seem to be a pattern in the residuals. The Sony total action series has some significant autocorrelation coefficients with the lags 1, 19 and 20, and the residuals seem to form a downward sloping pattern. The results imply that while Microsoft total actions are a stationary series, Sony's series present some nonstationary properties.
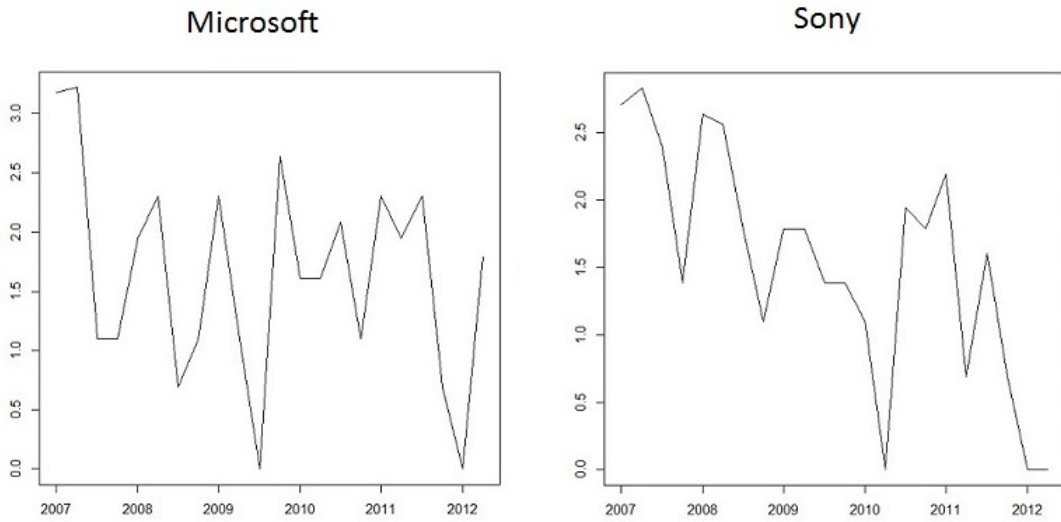
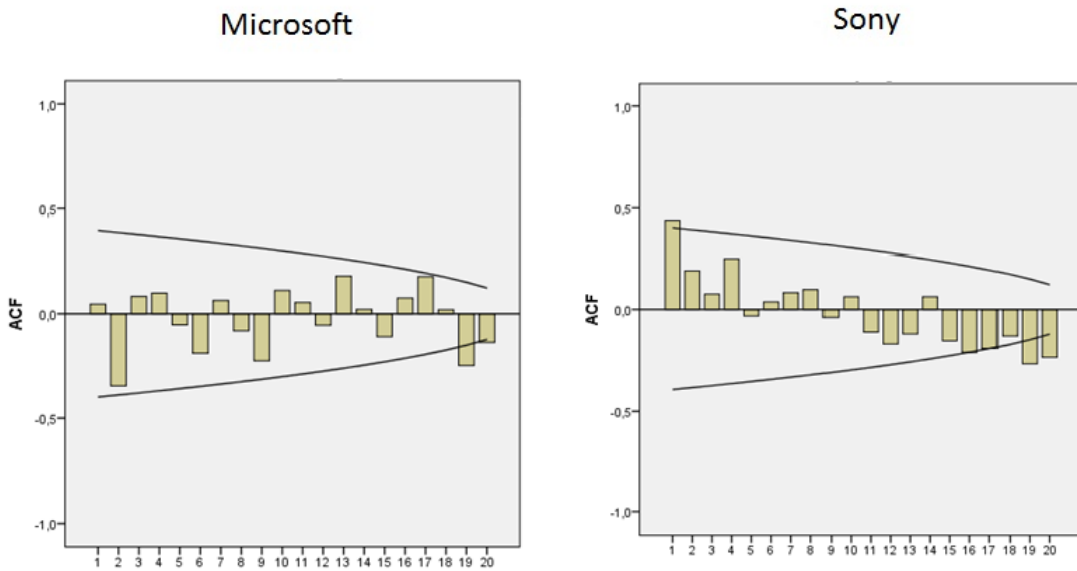Figure 12: Time series comparison for logged total actions series

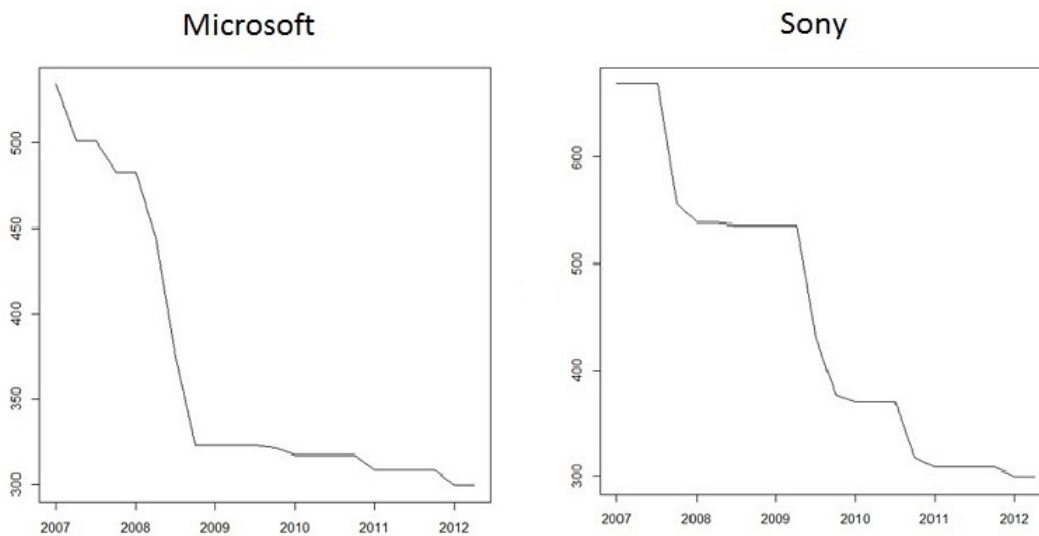Figure 13: Autocorrelations for total actions

Figure 14: Time series comparison for high price series

Figures 14 and 15 present the same process for the high price series for each company. In the high price case the both time series are clearly the type $I(1)$ non-stationary series confirmed by highly significant autocorrelation coefficients and patterned residuals visible in the Figure 15.

Log sales present only a slight upward sloping trend when graphed, and there are some significant autocorrelation coefficients in both series. However, the residuals do not form a pattern in either series, implying stationary series. Low price series present similar tendencies than the high price series described above.

Table 12 presents the summary of the autocorrelation and stationary results. Autocorrelation is confirmed by running the Durbin-Watson test for autocorrelation (Hanke and Wichern, 2005). Table 13 includes the cointegration test results. If the cointegration test cannot be run, R^2 is included as an estimate of the relationship between the two series.

The cointegration test is not run for log action and log sales, because the series are not the right type, as seen in the Table 12. The OLS results suggest that log sales follow each other

73
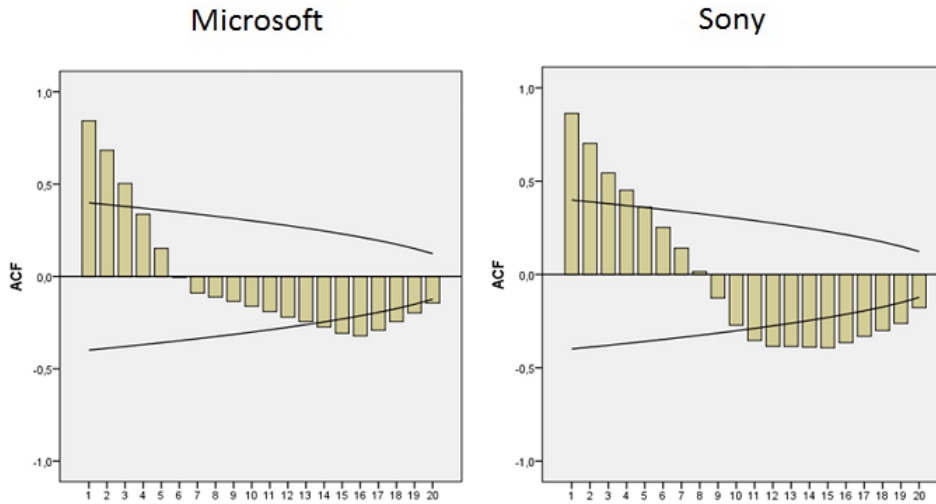
Figure 15: Autocorrelations for high price series

Series	Durbin-Watson test	Autocorrelation	Stationary
Log total actions	1.5318 > 1.17	Accept null, no auto-correlation at 1 %	Microsoft total actions series are stationary
Log sales	1.5200 > 1.17	Accept null, no auto-correlation at 1 %	Both stationary
Low price	0.6275 < 1.00	Reject null, auto-correlation at 1 %	Both nonstationary
High price	0.3599 < 1.00	Reject null, auto-correlation at 1 %	Both nonstationary

Table 12: Autocorrelation and stationary results

Series	Unit root test	Cointegration	OLS R^2 if stationary
Log actions	n/a	No test; stationary	0.2430
Log sales	n/a	No test; stationary	0.8315
Low price	$-2.5125 < -1.95$	Reject null, cointegrated at 5 %	n/a
High price	$-1.8069 < -1.60$	Reject null, cointegrated at 10 %	n/a

Table 13: Cointegration results

quite closely, so Microsoft log sales series can be predicted by using the Sony log sales series quite well, as the Sony observations cover over 80 % of the Microsoft observations. Log actions series' R^2 is lower around 25 %, so the model's predictive power is not as good as the log sales.

Both price series are cointegrated according to the test, which means that there is statistical evidence that the series follow each other. This indicates that at least the pricing strategies of the companies are interlinked. Consequently, in the case of the pricing strategies the null hypothesis H_0: *There are no signs of interlinked behaviour* is rejected in the favour of the alternative hypothesis H_1: *Competitive moves display an interlinked behaviour*.

5.1.2 Goldfeld-Quandt test results

The first step in the Goldfeld-Quandt test is to check the error term distributions and serial correlation. In the Figure 16 it can be seen that the errors are distributed around the normal line in the case of log actions series. Log sales behave in a similar manner. In the pricing cases the errors do not follow the normal line and there are many clear outliers as shown in the case of the high price series.

Serial correlation was checked in the previous test, autocorrelation was found in the cases of the pricing variables. Therefore the Goldfeld-Quandt test is not applicable to the pricing variables. The test results are summarized in the Table 14.

The test is not significant for the logged actions and logged sales series. This means that there is no evidence in the data that the either series interactions are decreasing in volatility. The test could not be run with the pricing series due to serial correlation and non-normal errors. Therefore the null hypothesis H_0: *The amount of competitive moves remains the same* cannot be rejected on the basis of the data analysis.
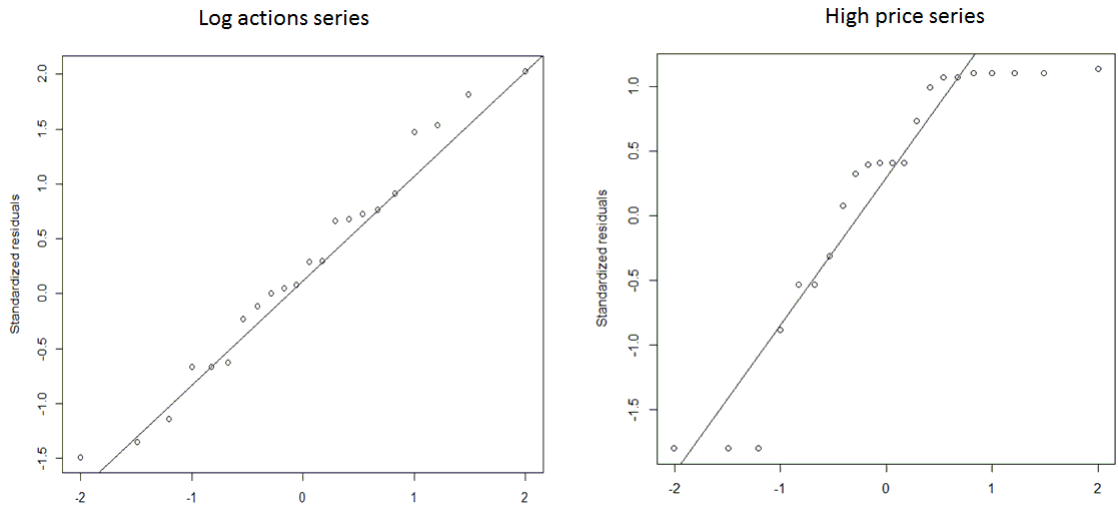
Figure 16: Regression error normality

Series	Normal errors	Goldfeld-Quandt test	Volatility
Total actions	Yes	0.1635799 < 1.96, Accept null, errors are homoscedastic at 10 %	No evidence of decreased volatility
Log sales	Yes	0.8045471 < 1.96, Accept null, errors are homoscedastic at 10 %	No evidence of decreased volatility
Low price	No	No test because errors are not normal and serial correlation exists.	n/a
High price	No	No test because errors are not normal and serial correlation exists.	n/a

Table 14: Goldfeld-Quandt test results

Figure 17: Transformed price series: First differentiation of the low price series

5.1.3 Granger causality test results

The first step for the Granger causality test determined in the previous chapter was to consider the applicability of the test to the variables in this study. The assumptions are the basic OLS assumptions for multiple variables regression. The OLS assumptions ca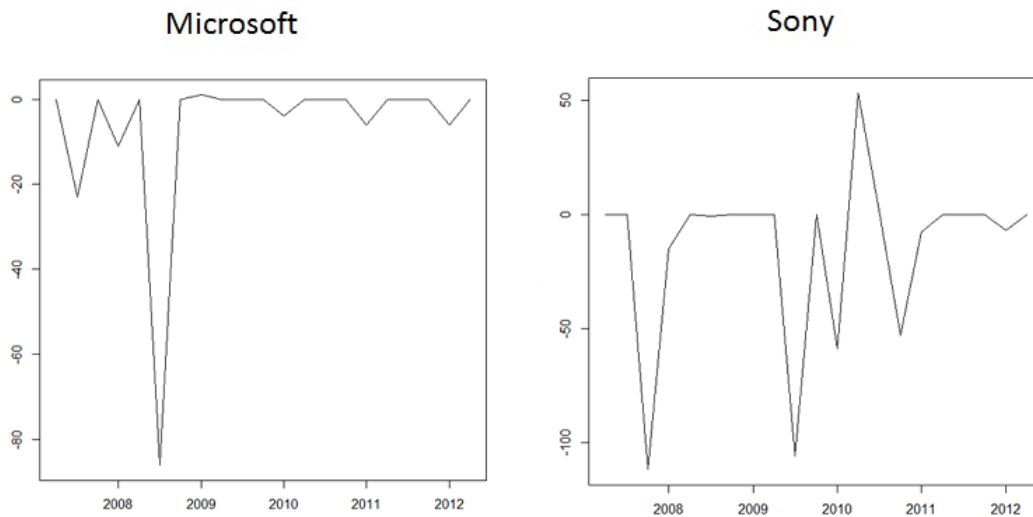n be seen to apply to the total actions and log sales series, but the nonstationary pricing series must be transformed to stationary series. Figures 17 and 18 present the transformed series for low price models.

Table 15 summarizes the results of the Granger causality test. The results are not significant except for the high price series, where Sony Granger-causes Microsoft is significant at 10 % level. Based on the Granger causality results the null hypothesis H_0: *Microsoft is not initiating the attacks* cannot be rejected. There is some statistical support for the alternative hypothesis H_1: *Sony is initiating the attacks*. However, three out of four strategic variables fail to reject the null hypothesis H_0: *Sony is not initiating the attacks*.

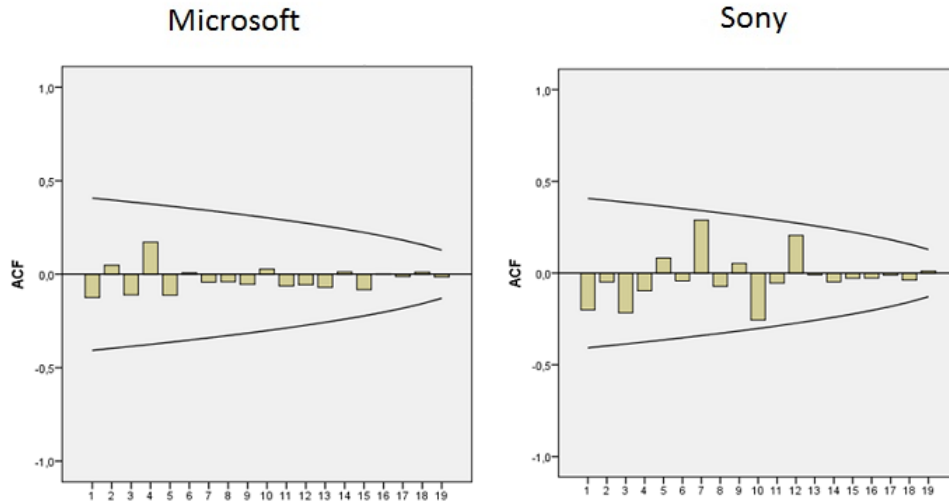Figure 18: Autocorrelations for differentiated low price series

Granger causality	Total actions	Log sales	Low price (diff)	High price (diff)
Microsoft Granger-causes Sony	0.0102 < 1.43	0.0537 < 1.43	0.0439 < 1.43	0.1512 < 1.43
Sony Granger-causes Microsoft	0.4718 < 1.43	0.0293 < 1.43	0.0000 < 1.43	1.4780 > 1.43

Table 15: Granger causality test results

Figure 19: Microsoft vs. Sony 2007

5.2   Chernoff faces results

In order to report the results from the Chernoff faces, I am discussing each year separately. For each year, figures from 19 to 24 represent the Microsoft faces (top row in the figures) compared with the Sony faces (bottom row in the figures). The results are reported in tables from 16 to 21 where each action category is compared between the faces and the more aggressive face is reported as the **winner**. If the faces do not differ significantly on the basis of subjective review, the result is reported as **even**.

The results are summarized for each quarter and year, marking the most aggressive player for the quarter/year (the company with most action category wins), and the market share winner for each quarter/year (the biggest head). If the companies have been equally aggressive (or docile), the summarizing results is reported as **even**. If the companies have won the quarterly market share battle at equal times, the yearly result is reported as **even**.

Pricing strategies are discussed in addition to the table results. Pricing strategy can be determined by comparing the top and bottom halves of the faces. If the top half is larger, the company is pricing its top model higher in relation to the low model. If the bottom half is larger, the opposite is true. If the halves are balanced, the pricing is equally balanced between the models.

Battle	Q1	Q2	Q3	Q4	Winner
Signalling	Sony	Microsoft	Sony	Even	Sony
Service	Microsoft	Microsoft	Sony	Even	Microsoft
Pricing	Even	Sony	Even	Even	Sony
Capacity	Microsoft	Microsoft	Sony	Sony	Even
Games	Sony	Microsoft	Microsoft	Microsoft	Microsoft
Sales	Microsoft	Sony	Even	Microsoft	Microsoft
Product	Microsoft	Sony	Sony	Sony	Sony
Marketing	Microsoft	Sony	Microsoft	Sony	Even
Most aggressive	Microsoft	Even	Sony	Sony	Sony
Market share winner	Even	Microsoft	Microsoft	Even	Microsoft

Table 16: Microsoft vs. Sony 2007

In the first quarter of 2007 the prices for both low and high end models are high for both companies. There is an indication of the different pricing strategies in the second and third quarters, where Microsoft is pricing the top model lower and low model higher, and Sony is doing the opposite. In the fourth quarter the both companies are again pricing the models evenly.

Microsoft is the market share winner in 2007 by winning in two quarters. Sony is the most aggressive, having shown most signalling, pricing and product actions in most quarters.

In 2008 it can be seen from the shapes of the heads that the companies are following opposite pricing strategies: In the first two quarters Microsoft is pricing its top model high and the low end product lower, whereas Sony is pricing the top model low and the low end product higher. In the last two quarters the pricing strategies switch places.

Both companies win the market share battle in two quarters, so there is no winner in terms of market share in 2008. Sony continues to be the more aggressive company, winning the action battle in signalling, services, pricing, capacity, and sales categories. In fact, Microsoft is only winner in the marketing category.

In 2009 first quarter the pricing strategies continue to be opposite, Microsoft is pricing the top model low and low model higher, whereas Sony is doing the opposite. Microsoft is pricing
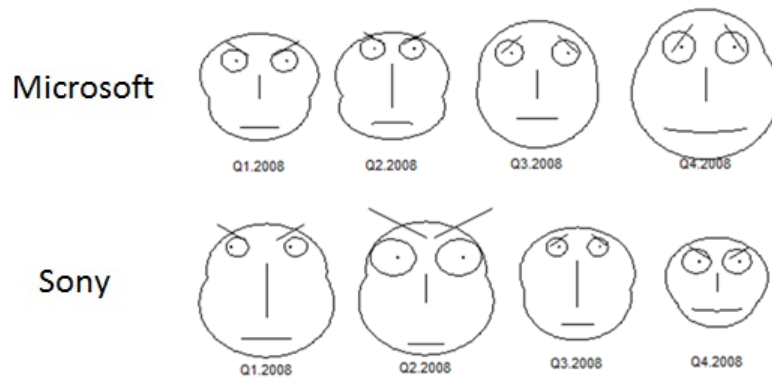
Figure 20: Microsoft vs. Sony 2008

Battle	Q1	Q2	Q3	Q4	Winner
Signalling	Even	Sony	Even	Sony	Sony
Service	Sony	Sony	Even	Microsoft	Sony
Pricing	Sony	Even	Even	Even	Sony
Capacity	Sony	Microsoft	Sony	Even	Sony
Games	Sony	Sony	Microsoft	Microsoft	Even
Sales	Microsoft	Sony	Sony	Even	Sony
Product	Even	Microsoft	Sony	Even	Even
Marketing	Microsoft	Sony	Microsoft	Even	Microsoft
More aggressive	Sony	Sony	Sony	Microsoft	Sony
Market share winner	Sony	Sony	Microsoft	Microsoft	Even

Table 17: Microsoft vs. Sony 2008

Figure 21: Microsoft vs. Sony 2009

Battle	Q1	Q2	Q3	Q4	Winner
Signalling	Even	Microsoft	Even	Microsoft	Microsoft
Service	Microsoft	Sony	Even	Even	Even
Pricing	Even	Even	Even	Microsoft	Microsoft
Capacity	Microsoft	Even	Sony	Sony	Sony
Games	Microsoft	Microsoft	Sony	Even	Microsoft
Sales	Microsoft	Even	Even	Even	Microsoft
Product	Even	Even	Even	Microsoft	Microsoft
Marketing	Microsoft	Sony	Microsoft	Even	Microsoft
More aggressive	Microsoft	Even	Sony	Microsoft	Microsoft
Market share winner	Microsoft	Even	Sony	Sony	Sony

Table 18: Microsoft vs. Sony 2009

Figure 22: Microsoft vs. Sony 2010

the two products quite evenly in the last three quarters, whereas Sony is moving on to low top model and higher low model pricing in the last two quarters.

In 2009 Sony takes the lead in the market share battle, selling more consoles in two quarters. Microsoft is the more aggressive company in 2009, winning the action battle in signalling, pricing, games, sales, product, and marketing categories. Sony wins only in the capacity category.

The pricing strategies seem to be quite even and similar for both companies during this period. There is no market share winner in 2010. Microsoft is the more aggressive player, winning the action battle in the service and the marketing categories. Sony wins the product category, whereas the rest of the categories are tied between the companies. Neither company is aggressive in the pricing and sales categories.

In 2011 the pricing strategies are quite even for both companies and similar than during the previous period. In 2011 Sony is the market share winner taking the market lead in two quarters. Microsoft is again the more aggressive player, winning the signalling, service, capacity, product, and marketing categories. Sony wins only in the games category. The pricing and the sales categories do not have any activity.

In the two first quarters of 2012 both companies continue pricing the products evenly. The market share win goes again to Sony, whereas Microsoft continues to be more aggressive,

Battle	Q1	Q2	Q3	Q4	Winner
Signalling	Microsoft	Even	Even	Sony	Even
Service	Even	Microsoft	Even	Even	Microsoft
Pricing	Even	Even	Even	Even	Even
Capacity	Even	Even	Sony	Microsoft	Even
Games	Even	Microsoft	Even	Sony	Even
Sales	Even	Even	Even	Even	Even
Product	Even	Even	Sony	Even	Sony
Marketing	Sony	Microsoft	Even	Microsoft	Microsoft
More aggressive	Even	Microsoft	Sony	Even	Microsoft
Market share winner	Sony	Sony	Microsoft	Microsoft	Even

Table 19: Microsoft vs. Sony 2010

Figure 23: Microsoft vs. Sony 2011

Battle	Q1	Q2	Q3	Q4	Winner
Signalling	Microsoft	Even	Microsoft	Sony	Microsoft
Service	Microsoft	Even	Microsoft	Microsoft	Microsoft
Pricing	Even	Even	Even	Even	Even
Capacity	Microsoft	Even	Microsoft	Microsoft	Microsoft
Games	Sony	Even	Even	Even	Sony
Sales	Even	Even	Even	Even	Even
Product	Microsoft	Even	Microsoft	Even	Microsoft
Marketing	Microsoft	Sony	Even	Microsoft	Microsoft
More aggressive	Microsoft	Sony	Microsoft	Microsoft	Microsoft
Market share winner	Sony	Even	Sony	Microsoft	Sony

Table 20: Microsoft vs. Sony 2011
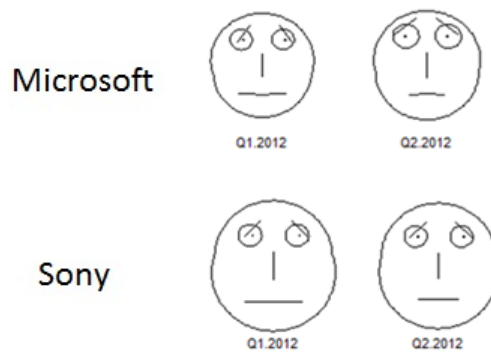
Figure 24: Microsoft vs. Sony 2012

Battle	Q1	Q2	Winner
Signalling	Even	Even	Even
Service	Even	Even	Even
Pricing	Even	Even	Even
Capacity	Even	Even	Even
Games	Even	Even	Even
Sales	Even	Even	Even
Product	Even	Microsoft	Microsoft
Marketing	Even	Microsoft	Microsoft
More aggressive	Even	Microsoft	Microsoft
Market share winner	Sony	Sony	Sony

Table 21: Microsoft vs. Sony 2012

winning the product and the marketing categories. The rest of the action categories are even between the companies, neither has been aggressive in them.

Overall, Microsoft is deemed the more aggressive company on the basis of the yearly face analysis (years 2009-2012 vs. Sony's lead in 2007 and 2008). Still, Microsoft seems to be the overall loser in terms of the market share; Sony is leading in over half of the quarters. On a yearly basis Sony is the market share leader in three years (2009, 2011, and 2012), whereas Microsoft wins in only one year (2007). Two of the years are a tie between the companies. Interestingly, the volatility of actions seems to attenuate or at least equalize over years, resulting in more **even** results in the tables for later years.

The goal for this chapter set in the beginning was to run a statistical data-analysis including Chernoff faces, and report the results. The implications of the results of the data analyses presented in this chapter are discussed further in the following chapter, which also provides the answers to the research questions, and summarizes the empirical study conducted in this thesis.

6   DISCUSSION AND ANALYSIS

The first research question guiding this thesis set in the section 1.3 was to find how the game consoles manufacturers compete against each other. The second research question was methodological in nature, concentrating on the statistical method of Chernoff faces, and its usage in dynamic modelling of strategic actions.

I begin this chapter with the first question, gathering the statistical support for the hypotheses set in the section 3.3 from the results of the data analysis in the chapter five, while reviewing the case data in the chapter three and utilizing the theoretical framework built in the chapter two. The second part of this chapter concentrates on the questions around the methodology for dynamic competition modelling, assessing the usability of the Chernoff faces based on the experiences gained from this study.

6.1   How do the game console companies compete with each other

In this section I aim to answer the first research question. The section has been divided into three parts on the basis of the theoretical framework built in the chapter two. The game consoles example is set in the theoretical framework, and analysed through the theories discussed in the literature review.

The first part reviews Microsoft and Sony as a rival dyad, the second part discusses the market commonality and resource similarity of the firms, and the third part refers to the results of the data analysis in order to analyse the nature and volatility of the actions in the game consoles example compared to the theories of multimarket competition, and previous empirical research.

The firms of interest in this study have been Microsoft's and Sony's game console operations. Both companies are multinationals producing other products as well, and both are well recognised throughout the world as leading manufacturers of technological products. The firms are from the US and Japan, which have been the centres for technological advances in the world
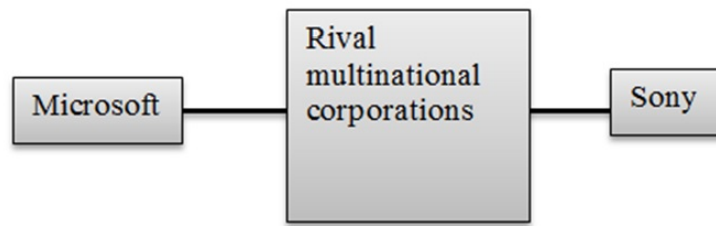
Figure 25: Establishing rivalry

after the World War II. In the chapter three Microsoft was selected as the focal firm based on its global sales leadership in the seventh generation game console production. Consequently Sony is the rival firm trying to upset the competitive balance (cf. Figure 25).

Game consoles are produced from the parts made mainly in the Asian region. The most important parts of the process are the R&D and product development phases as the products are both complex and highly technical. The products are distributed through regional centres, which deliver the merchandise to wholesalers, which then supply the retailers where the consoles are bought by the end customers. The regional centres are also responsible for the marketing of the products.

As discussed in the chapter three, the products are used for gaming, but also increasingly for watching movies and other entertainment content, especially on-demand content such as movie rentals, TV series, and on-demand game chapters. The gaming side is concentrated especially on single player, high quality, and movie-like game experiences, which take the gamer across multi-hour game scenery and dialogue, or two player co-op gaming, where the games can be played through with a friend. The new motion controlling games add another dimension to the gaming experience, but mostly motion control adds to the entertainment section, while also attracting new types of consumers to buy the consoles.

Generally Microsoft and Sony seem to fill the requirements for a global rival dyad, since they are producing similar products on a similar scale, and are going after the same consumer segment (cf. Jayanchandran et al., 1999). The firms can therefore be placed in the theoretical framework as shown in the Figure 25.
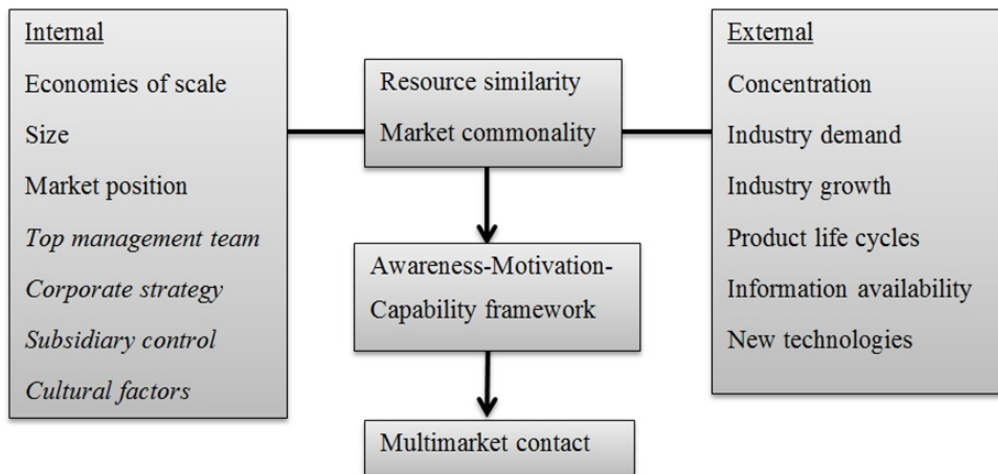
Figure 26: Assessing resource similarity and market commonality

In the theoretical framework the first step towards interlinked competition are the overlapping levels of market commonality and resource similarity between the firms. In this study I have chosen to concentrate more on the external market commonality factors discussing different industry characteristics and describing the game console market environment.

Internal resource similarity factors apart from size, economies of scale and market position factors have not been mentioned in the context of this study. Examining the left-out factors marked in cursive in the Figure 26 could possibly offer an avenue for a further study concentrating on the resource similarity factors affecting awareness-motivation-capability framework in the game consoles market.

The firms meet up in the global market regularly since their consoles are sold as competing products to customers. One is rarely talked in the press without mentioning the other. The fiercest battleground for the seventh generation console productions has been Europe, since the both companies remain strong in their respective home territories, and the Western European countries represent the next largest markets after the home countries of the firms in the global scale (VGChartz, 2013b).

The market is a high-concentration global oligopoly because the product development costs

of the consoles are too high for smaller players. The technology needed for the consoles is also protected by patents, which work as additional barriers to entry. In addition to producing the actual console, the console maker needs also to be prepared to produce high quality content and games, and it needs to be able to persuade the third party content and game producers to work with the console specifics.

Especially the last activity demands market power, since the third party developers are not willing to cover costs for multiple small platforms. A new console venture needs to ensure that there are enough good quality games either produced by the third party developers or by the game studios run by the console company. As discussed in the chapter three, Sony was losing the battle when it was not able to get as many good quality games published for the console as the competitor Microsoft in the beginning of the seventh generation production (Goldstein, 2006; Rivington, 2007d,c).

The current console production has been on for seven years counting from the launch of the Xbox 360 in November 2005. Although there have been expectations for the firms to move on to a new generation, only Sony has recently announced a new iteration of the PlayStation console to be launched in the end of 2013 (Fitzimmons, 2013; Rivington, 2013). Continuing the life spans of the seventh generation consoles makes sense, as the sales of the current consoles are still strong due to renewal process that each console goes through quite regularly. In fact, Microsoft has made the last record sales of the Xbox as recently as Q4 2011. This suggests that the seventh generation game console market is not yet declining in its life cycle and the companies are unlikely to completely move on to a new iteration of the consoles yet.

The newest notable improvements to the consoles include motion controlling technology and 3D compatibility, which are certainly helping the current generation to lengthen their life cycles (Goss, 2010; Smith, 2011a). Additionally, virtual entertainment content is increasing in importance. It is likely though that the next generation will be pushed through in a few years time. The future success of the game console manufacturers will also depend on the success of alternative products such as mobile gaming, cloud gaming and content, return of the PC gaming, and Nintendo Wii U's success, as discussed in the chapter three.
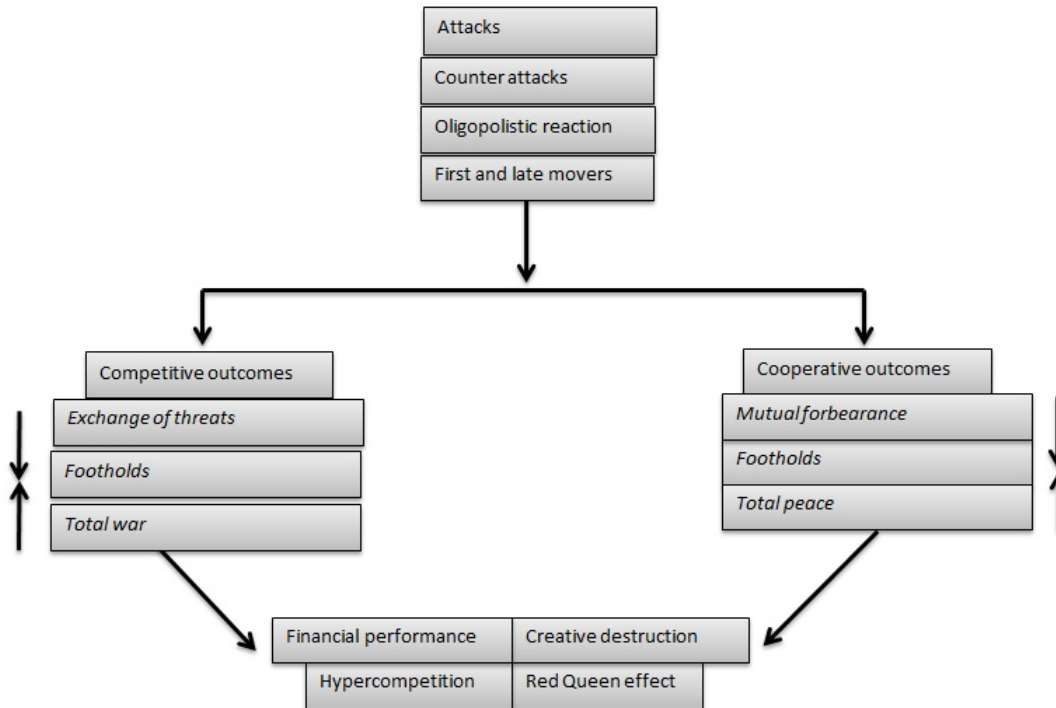
Figure 27: Reviewing the actions and the outcomes

Overall, the examined factors of resource similarity and market commonality imply that the companies function within the awareness-motivation-capability framework suggested by the competitive dynamics researchers (e.g. Chen, 1996; Ferrier, 2001). Being the opposite forces in the relationship makes sure that the companies are aware of each other and motivated to compete. As both companies are multinationals on a global scale, they are also capable of attacking each other all over the world.

The purpose of this thesis has been to find out how the two companies compete. Figure 27 shows the actions and outcomes part of the theoretical framework. The results of the empirical study implicate that the case companies are competing aggressively. The most used actions in the content analysis were the signalling actions, meaning that the statements boosting the own products and belittling the competitive products were widely used by both companies. The second most often used actions had to do with the content and services

side of the production. This is not surprising as the direction of the consoles has been from pure gaming devices towards whole entertainment package for the duration of the seventh generation.

The most apparent strategies used in the market are pricing and product strategies. The firms also concentrate greatly on the service and content side. Games produced and third party game deals are important, but diminishing in importance since multiple third party games are now available for both consoles. Microsoft is still relying more on the game actions, whereas Sony has clearly tried to move on from the game-based competition, concentrating on product development strategies.

The study found some support for the hypothesis one from the cointegration test results presented in the section 5.1. The price series were found cointegrated, which means that they seemed to follow each other. The other two time series were stationary, so the test was not possible. The results of the Chernoff faces in the section 5.2 implied that the firms are reacting to each other by using opposite pricing strategies and being mutually aggressive throughout the action categories. Overall, the data seems to support the hypothesis one.

> **Hypothesis 1 is supported.** Competitive moves between Microsoft and Sony display an interlinked relationship. The strategic moves of the companies are dynamic and aimed at each other.

The Goldfeld-Quandt test was not possible for the pricing series due to serial correlation and error non-normality. The test did not show evidence for heteroschedastic errors for either total actions or sales series. However, this could be due to the data availability, as some series might not have enough observations to show how the errors are distributed. The Chernoff faces implied that there in fact is attenuation of the actions over time, as the faces and the prices both become more and more even between the companies.

> **Hypothesis 2 is partially supported.** Competitive moves between the companies decrease in number over time as the companies get more familiar with each other.

The Granger causality test was done for both Microsoft being the initiating firm, and Sony

being the initiator of the attacks. The results were not significant for Microsoft Granger-causing any of the attacks. It is possible that the data availability is again issue with this test. The Granger causality test was significant at 10 % level for Sony Granger-causing differentiated high price series, which indicates partial support towards hypothesis 3b. In terms of the pricing strategies used, it is interesting to note that the Chernoff faces appear to indicate that the firms are almost always utilizing opposite pricing strategies for their top and low end models. Looking at the other Chernoff faces results, it does seem that Microsoft is the one initiating more attacks indicating support towards the hypothesis 3a.

Hypothesis 3a is partially supported. Microsoft is initiating the attacks.

Hypothesis 3b is partially supported. Sony is initiating the attacks.

Overall, it seems that there is evidence that Microsoft and Sony are rivals but that the amount of actions has decreased from the launch of the products. Thus there is evidence for both competitive and cooperative outcomes from the multimarket contact between the companies. As this thesis did not concentrate on specific attacks but rather reviewed and summarized the total global attacks, it is not possible to say on the basis of this study if the companies utilize foothold strategies in specific situations. Looking at such micro motives of the companies could be another possible opportunity for an extension of this study.

Although the market is protected by high entry barriers, signs of hypercompetition have started to show also in the game consoles market. Such products than Nintendo's Wii and mobile devices such as Apple's iPad are attacking niches overlooked by the two main consoles, and are slowly pushing to the market space of the two giants. The pace of the technological development has clearly increased since the likes of Wii and iPad hit the market, forcing the two console makers to reinvent their products and invest more and more in the entertainment capacity and quality of the devices.

6.2 How can Chernoff faces help to study dynamic competition

Dynamic competition researchers tend to use econometric tools for the analysis of their data, but there is no single procedure which would result in reliable analysis, since the data is usually panel data with high variances and non-normal distributions. As described in the chapter five, this study too, suffered from such problems.

The competitive dynamics researchers are trying to find better ways to formulate normative strategy suggestions given the dynamic nature of competitive strategy which can be hard to model (Ma, 1998; Chen and Stucker, 1997). I am suggesting in this thesis that Chernoff faces is a helpful graphical tool in addition to the econometric analysis normally used.

Advantages

Normally, statistical results can only be graphed single variable at the time, or sometimes groups of variables can be shown using two different scales. Chernoff faces summarize all the observations for single time period in a single picture. Although tables are a clear way of showing information, Chernoff faces and tabulated results help to visualize the results of the data analysis in a more concrete way. In this study, the faces helped to see that the action count appears to be decreasing, and that Microsoft is an aggressive player. Neither of those results could be determined with the conventional data analysis.

I posit that because the field of strategic competition is fairly dramatic, it would be expedient if the results of the competitive actions studies could be presented in a more visually appealing manner to account for the dramatics of the changes in the positions of the firms. Furthermore, visualizing the results could also help the managers of the firms, who could see the results of their decision-making in a concrete way, making the further decision-making more efficient.

Additionally, regression analysis as the method for analysing data with high variances and non-normal error distribution is problematic, and the reliability of the inferences based on models generated by regular or even adjusted regression methods can be questioned. The faces work for a small amount of data, and can help to see the data from another angle.

Disadvantages

The code for Chernoff faces is not the easy to master in R. There exists a better function than the faces2 function used in this thesis, but it does not have 18 features and the faces are not as visually appealing. The statistical program Survo coded at the University of Helsinki has a Chernoff faces function, but Survo is not widely used.

In the faces2 function there are difficulties especially with the curvature of the mouth, which does not result in logical smiles for the faces. There are other small coding difficulties with the graphs — nose length scales with the rest of the face and does not reflect the changes in the data in the right proportion. Although these are more cosmetic faults, if the faces are used as a visual aid, they would work better if all of the features were logical and easy to use.

The faces are not used very often in the academic literature, and since cartoon faces are a different way of showing data, the more traditionally thinking researchers might prefer not to use them. On a similar line of argument, as Chernoff faces are a subjective tool, their usability in objective academics can be questioned. Therefore they should not be used as the only tool, but as a supporting analytical tool besides more rigorous measures. Then, if the inferences based on the faces are presentable, the faces can at minimum be used to show highlights of the data for wider audiences.

The objective for this chapter set in the beginning was to model the competition between Microsoft and Sony, and assess the usability of the Chernoff faces in the analysis of competitive interactions. I have now answered these research questions, and thus also provided an analysis for the research problem, which was formulated as

> How does the competition between Microsoft and Sony compare to the previous research on other types of businesses and market settings, and how could the data be presented so that the reliability of the statistical inferences would be improved?

7 CONCLUSIONS

This chapter concludes the Master's thesis by summarising the main findings and reviewing the theoretical contribution in the first section. Additionally, I present some managerial implications in the section 7.2 and suggestions for further research in the section 7.3.

7.1 Main findings and theoretical contribution

The theoretical framework presented in the section 2.3 of this thesis summarized the literature considering multimarket competition and competitive strategies available to global firms. The most important findings from the literature were that the firms needed to be justified as a pair of competing firms, a rival dyad (Chen, 2009). In order to confirm rivalry between two firms in the same market, the resource similarity and market commonality components needed to match, so that the firms were aware of each other, motivated to compete with each other, and had the resources to battle.

If the internal and external factors matched, the resulting multimarket competition could lead to two different outcomes: competitive or cooperative. Competitive outcomes could lead to total war, whereas the cooperative outcomes could lead to total peace, but most often the firms were acting strategically in such manner that they placed small foothold attacks in order to keep the competitive balance in place (Karnani and Wernerfelt, 1985; Upson et al., 2012).

The literature suggested that strategic competition between a global rival dyad is likely to lead into improved products, ongoing development, and eventually in creative destruction as forecasted by Schumpeter, the father of competitive dynamics (Ferrier, 2001; Chen, 2009).

Although the firms, which are part of the competitive dyad are likely to win out from the rivalrous relationship at the end, they need to be careful to protect the market where they are playing from hypercompetitive outcomes (D'Aveni and Gunther, 1995). Even the smallest overlook of a niche can be fatal in terms of the market space, if an outsider born global is able

to infiltrate the barriers to entry (ibid.). In the times of increasing information asymmetries it is harder and harder for any rival dyad to remain in power (ibid.).

The findings from the empirical case of the game console giants Microsoft and Sony suggest that the companies are fighting with each other. Although this study was inconclusive on the exact relationship (whose actions are driving the other), it was clear that there is a competitive relationship between the two firms. The study found that Microsoft is the more aggressive player, but regardless, Sony seems to be the one winning at the moment, having almost caught up in terms of sales with Microsoft's overall sales. Additionally, Sony appears to be the first mover in the eight generation gameplay (Fitzimmons, 2013).

The game consoles market is in a revolutionary point, where the forces of hypercompetition are trying the boundaries of the entry barriers built by the console makers during the last twenty years (D'Aveni and Gunther, 1995). The Red Queen effect has already picked up the pace of the technological advances, giving the market new technologically advanced features such as Microsoft's motion controller Kinect and Sony's PlayStation Move, the Microsoft SmartGlass project, and Sony's 3D ventures (Derfus et al., 2008; Smith, 2011a; Goss, 2010; Evans, 2013). It remains to be seen whether the console makers can keep up with the pace or if they are overrun by other technologies such as the cloud gaming or the online multiplayer experiences on PC (Robinson, 2011).

This thesis has used the statistical method of Chernoff faces in order to try out an alternative method for statistical analysis normally used in the competitive dynamics studies. Competitive dynamics interactions are hard to model because they are presented in the panel data format, which usually results in problems with serial correlation and otherwise inconsistent and non-normal data or errors, which again results in unreliable regression models (Yu and Cannella, 2007). Although there exist a variety of methods to counter these problems, methods such as Chernoff faces, which visualize the data in k-dimensional space can be found useful, as they help to understand the data better.

However, this study also found that the faces are difficult to use in the statistical programs (or have not been popular enough to be coded properly), and in order to produce good faces there

would need to be a better code than the one used in this study. Additionally, since the faces have a subjective side, it is important that they are not used as the single tool for analysis, as subjective inferences may result in heterogenous outcomes. Though all graphical representations are subject to manipulation by their creator, given the multidimensional nature of Chernoff faces, the combinatory possibilities are more pronounced than with the traditional visual tools.

7.2   Managerial implications

This thesis has contributed towards expanding knowledge on the matter of strategic behaviour of firms in a globally oligopolistic setting. The managers of these types of firms could learn new strategic management practices from the examples discussed in this thesis and in the referred literature.

By being aware of the regularly presenting patterns of behaviour, the managers of these firms could better monitor and guide their organization towards more complicated strategies against the other players in the market, and therefore gain more market share. It is also possible that costly escalations of rivalry could be avoided to some extent if all the managers were aware of the possible action sequences and scenarios.

Overall, it is important for the managers to note that the world is in constant movement and that by examining the specific context of each firm with its rival can be beneficial. Awareness of the escalation of technological development and focus on the right competitor at the right time can make a difference in the success of a firm even on the global scale. In the game consoles example the pace of the actions between Microsoft and Sony has started to attenuate but the volume of the technological advances seems to have increased. These could be signs for both mutual familiarity between two rivals, which have been meeting in multiple markets for a while, or signs for outside forces penetrating the market entry barriers.

Chernoff faces could be used as the tool along with other statistical methods to both counteract the data problems and to see the whole picture at once. Content analysis is of course

a backward looking method for collecting data, and not much can be determined of strategic competition from a review of short time periods. Competitive dynamics is, as the name suggests, a study of dynamic movement seen in long term, rather than the static results from the short term analysis.

As we know from readings of management cultures, especially the US based management culture tends to concentrate on the short term. However, the findings from this study suggest that the long term concerns should also be monitored and addressed. Especially the firms that function in markets where the product life cycles are short and the product needs to be reinvented regularly could benefit from the review of the dynamic strategic direction of the market.

Although this first sounds almost counter-intuitive; looking at the history, while the market changes so quickly, this thesis has found that patterns of the competition are possible to decipher and to some extent, even predict, from the flow of information between the firms. Dyadic strategy building is based on the old proverb about knowing your enemy, and could result in improvements in the firm's global position.

7.3   Suggestions for further research

The empirical study in this thesis has been limited to the competitive dyad between the Xbox and the PS3. As both firms' decisions are certainly affected by the actions of the other gaming devices, it would also be interesting to look into other relationships in the market. In effect it was Nintendo Wii, which brought interactivity to the game consoles market, and pressured both Sony and Microsoft to launch their interactive controllers PlayStation Move and Xbox 360 Kinect.

Examining the left-out factors marked in cursive in the figure 26 could possibly offer an avenue for a further study concentrating further on those resource similarity factors that affect the awareness-motivation-capability framework in the game consoles market. Top management team, management culture, global cultural differences, corporate strategy and subsidiary

movements are all likely to bring in new challenges and details into competitive strategy building with a specific rival.

Looking at the micro motives of the companies in specific situations could be another possible opportunity for an extension of this study. Examining the places where the companies have moved on to place a foothold attack in one area or retreated from a fight in another could provide interesting new information about the behaviour of the companies. However, at least in the case of the game consoles, gathering such data could prove to be challenging, as the micro movements of two global giants are not documented in any single data source.

Another interesting angle to the strategy research is that of game theory (Camerer, 1991). For example, competitive dynamics researchers tend to often refer to Bernheim and Whinston (1990)'s model of multimarket contact and collusive behaviour, which utilizes Bertrand price competition, and which could offer a relevant basis for a more mathematical approach in the subject.

Finally, this thesis has found that Chernoff faces, although a refreshingly non-standard method for graphing the data, do not help to solve the problems of the competitive dynamics modelling completely. Thus the further studies should strive to improve and standardize the statistical methods used to model the competitive interactions.

In a world that seems to be progressing towards a more globally unified place to do business in, the businesses take new forms, and the strategies of competition intensify and become more complex. Because it is critical to understand these strategies and to come up with new ones in order to capture more market share, or even to stay in the business in the long term, it is also crucial to study the phenomena related to competitive dynamics further.

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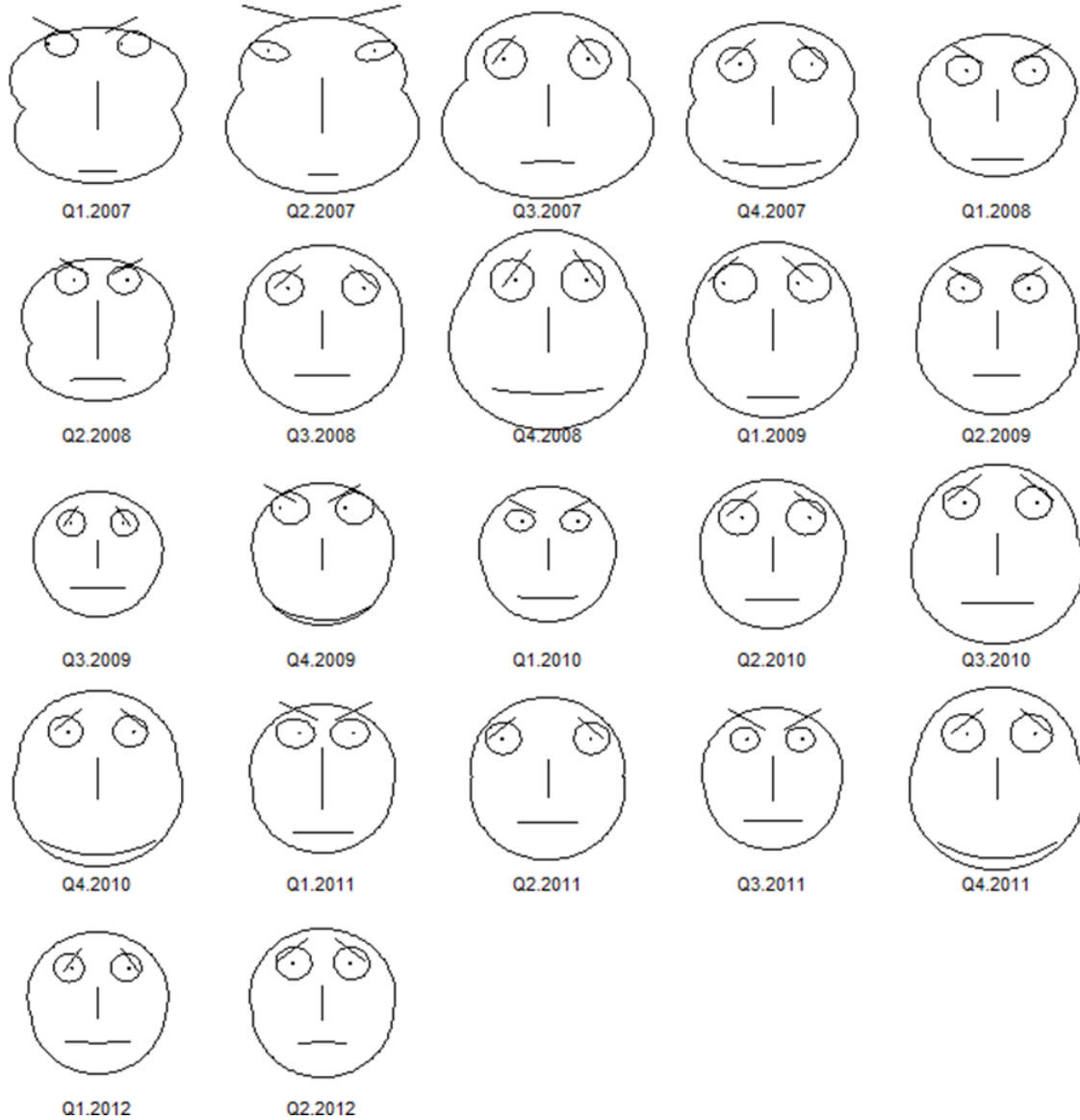
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Appendices

Appendix A. Microsoft Chernoff faces

Q1.2007	Q2.2007	Q3.2007	Q4.2007	Q1.2008
Q2.2008	Q3.2008	Q4.2008	Q1.2009	Q2.2009
Q3.2009	Q4.2009	Q1.2010	Q2.2010	Q3.2010
Q4.2010	Q1.2011	Q2.2011	Q3.2011	Q4.2011
Q1.2012	Q2.2012			

Appendix B. Sony Chernoff faces

Q1.2007   Q2.2007   Q3.2007   Q4.2007   Q1.2008

Q2.2008   Q3.2008   Q4.2008   Q1.2009   Q2.2009

Q3.2009   Q4.2009   Q1.2010   Q2.2010   Q3.2010

Q4.2010   Q1.2011   Q2.2011   Q3.2011   Q4.2011

Q1.2012   Q2.2012

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