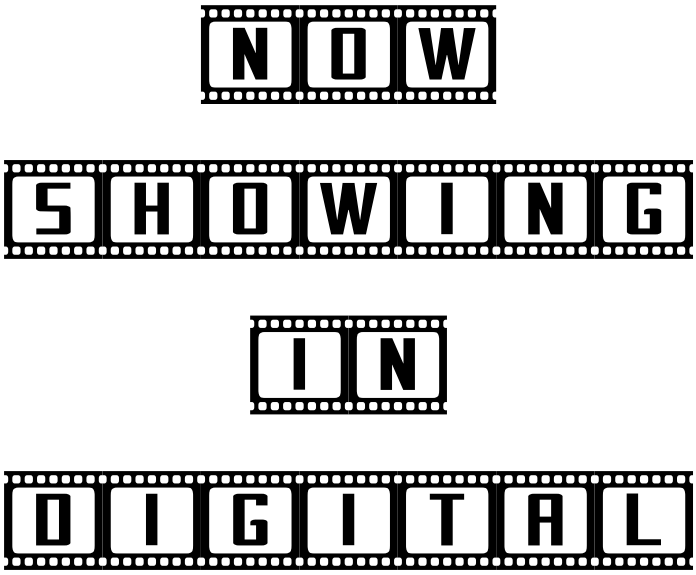

Implications of digital cinema for the theatrical life cycle of motion pictures, volatility of programming and the market concentration of the motion picture industry in the United States

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Abstract

This thesis explores the implications of digital movie exhibition in the United States movies produced and distributed by major studios and independent studios. Over the last 15 years almost all cinemas in the United States have been digitized. Instead of projecting on 35mm projectors, movies are now screened in a digital media format. The thesis develops key characteristics of digitized exhibition which are put in context with previous innovations in the theatrical exhibition market. The dataset for the empirical analysis utilizes weekly box office reports of the United States for a period of 15 years and additional data about the theatrical market of the United States. The emphasis of the empirical analysis lies in investigating the supply dynamics of the exhibition industry. The supply dynamics are defined through the product life cycle and the volatility in the programming of cinemas. Furthermore, effects on the market concentration according to gross revenues in the box office are analyzed.
Empirical results indicate that the digital transition in the exhibition industry has had a positive effect on the supply dynamics for motion pictures produced by major studios. Independent movies are not profiting from digitized exhibition yet which is also reflected in an increasing market concentration of the motion picture sector in the United States.

Keywords: digital cinema, motion picture industry, theatrical exhibition, innovation

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1. Introduction

"The effects of digitization on the film sector are massive, and we are only just beginning to understand the extent to which changes have taken place and will take place in the years to come"

(Stepan, 2013, p.399)

For more than 100 years, the 35 mm film had been the standard format for projecting movies in the cinema (Belton, 1990). Over the last years, projectors in cinemas have been more and more digitized. Instead of projecting movies on an analog film stripe, most movies are projected in different digital media formats. While this has possible economic effects for the industry, such as the volatility of the market and the lifetime of movies in the cinema, the effects for the audience's experience are limited during a single projection (Belton, 2002). Therefore, John Belton (2002) even calls the transition to digitized cinemas "a false revolution" (p. 99). People who work in the industry, like Peter Buckingham, the former head of the UK film council, do not see a revolution in the audience perception of a single movie but more in the flexibility of cinemas in their programming. (Stuart Hanson, 2007, p.376)

Digitization in the film sector in general, is not a single disruptive innovation, it is a series of innovations that have an impact on how movies are produced, distributed and exhibited. Digitization in the exhibition industry can therefore not be completely detached from process of digitization in other sectors of the industry. Digital cameras lowered the entry barriers to the creation of movies, as analog cameras are an expensive investment. Even some critically acknowledged movies are created with smart phone cameras nowadays.[1] In euphoric terms we could speak about a democratization of film making (Trowbridge, 2013). Whereas 35 mm prints are cost and time intensive in production, digital copies are easily created and either shipped on

[1] i.e. Tangerine (2014) by Sean Baker was shot on an Apple iPhone and premiered at the Sundance Film Festival.

hard drives or via satellite. This is a radical change for the supply chain in the exhibition industry, and creates a new flexibility for distributors and exhibitors. The cost saving from the abandonment of 35 mm prints could specifically be important for movies with smaller budget produced and distributed by independent studios (Crofts, 2011) which will be specifically investigated in this research.

One of the consequences of flexibility in the exhibition industry is a more efficient way of matching supply to demand. Information exchange on internet platforms, by critics, and word-of-mouth after a movie is initially released can influence the theatrical performance of movies in extreme ways. Therefore, demand for a specific motion picture may often be estimated incorrectly before a movie is released in theaters.

According to De Vany (2004), there are two possible ways to adapt supply to demand after a movie is released in cinemas: through the number of theaters a movie is shown in and through the period a movie is exhibited in the cinema which is defined as the run life or lifetime of a motion picture in exhibition. In the following, it will be investigated, if digitization of the exhibition industry led to a higher volatility in the number of theaters a movie is screened and if the lifetime of movies in theaters has been influenced through the process of digitalization. Additionally, effects of digitization on movies produced by major studios and independent studios will be distinguished. Different studios may have different strategies how to deal with the flexibilization of the market. This could influence the level of competitiveness of the market in general and may have implications on the market concentration in terms of box-office revenues. Therefore, the influence of digitization on the market concentration is analyzed in this research. A quantitative approach is taken, due to the availability of rich data on weekly box office reports.

The thesis is organized in different chapters, chapter 2 will inhabit a short summary of the history of the motion picture market, concentrating on innovations that have been already introduced and their effect on the market. It will also introduce the broader technical concepts behind the data analysis and conclude with empirical results of previous studies on the digitalization in the motion picture exhibition market. Chapter 3 covers the methodology adopted to carry out the analysis of the research. In chapter 4, the data set of the research is introduced

and it concludes with the technical specifications of the analysis. Chapter 5 presents the main findings of the analysis and discusses them while linking it to empirical findings in previous research. Concluding remarks on the analysis, limitations of the research and possible implications for future research will be covered in chapter 6.

2. Literature Review

This section presents an overview about the characteristics and development in the motion picture industry with the focus on the market for cinematographic performances. Further it will discuss theoretical and empirical findings about the motion picture exhibition market.

2.1 The motion picture industry

The origins of the motion picture industry took place at the end of the 19th century with the invention of the Kinetograph and the Kinetoscope by Thomas Edison and W.K. Laurie Dickson (Kuhn, 1999). Since the origin of the industry the supply chain of motion pictures is defined through three key stages: production, distribution and exhibition (Eliashberg et al., 2006), which offers a variety of possible economic analyses, especially through the increasing availability of data.

A reference point in most academic literature about the motion picture industry is the studio era, also titled as the Hollywood studio system. The studio era took place from the 1920s to 1948 and its end is seen as a turning point in the history of the industry. There was a high market concentration during this period as just a few companies were dominating the market, all of them highly vertically integrated in production, distribution and exhibition (Schatz, 1999). Through the ownership of cinemas, the distribution and exhibition of all movies was secured. This oligopoly led to antitrust investigations by the United States Department of Justice. The major antitrust case, the so-called Paramount case was decided in 1948 against the major studios and as a result they had to divest their cinemas (De Vany, 2004). Additionally, block booking was banned by the court. Block booking was used by the studios to sell several movies at once to independent

theaters. The theaters were forced to buy a bundle of movies unseen, in order to get the blockbuster movies of the studios (Fox, 1992). Before the Paramount case was decided, the industry has been described as a "fordist" industry, characterized through mass production. The vertical disintegration led to a more specified concentrated output instead of unspecified mass output. In the literature this is partly described through the shock of the paramount case, but also through the appearance of TV as a substitute for cinemas (Aksoy and Robins, 1992). Ricard Gil (2010) investigates the consequences of the Paramount case empirically, and concludes that neither the vertical disintegration nor the rate of TV saturation between 1940 and 1959 had any significant effect on the decrease of the number of movies produced. His results indicate that the change in the contractual form between distributors and exhibitors, and especially the banning of block booking affected the number of movies produced negatively. Modern exhibition contracts will be discussed below.

Recently, the motion picture industry was disrupted through a series of digital innovations. On the audience side, this led to a significant increase in home entertainment possibilities, especially through video-on demand. Empirical data on video-on demand is still restricted, therefore this research will be concentrated on the market of theatrical performances.

2.2 The market for theatrical performances

One standard way to measure the success of a movie, is through the performance at the cinema. Box office reports are published weekly in newspapers and on numerous websites and usually include the theatrical performance of movies from Friday to Thursday, as most movies are released on Fridays. The box office reports used in this research are based on the United States domestic market, which includes the United States and Canada.

Before a movie is released in theaters, the distributor has to take different decisions. First of all, the specific release date has to be set. Like in other entertainment industries, there is seasonality with peaks in the summer and winter season, where the big blockbusters are released in cinemas (Vogel, 2010). These movies are the driving element in the market. Box-office revenues are not normally distributed at all, De Vany (2004) describes the motion picture market as a

„business of the extraordinary“ (p.2). Although there are many different movies every year in the theaters, only a few generate the majority of the total revenues in the market. Examples are movies like „Titanic“ (1997), „Avatar“ (2009) and very recently „Deadpool“ (2016). This is also reflected in weekly top 50 box office reports, where the distribution of weekly revenues in the box office is highly convex (De Vany, 2004).

After the decision for the right timing, the distributor has to choose a release pattern for the movie. In general, there are two different release patterns for motion pictures. The first release pattern is a “wide release“, indicating that the movie starts in many cinemas all over the country, in urban and rural areas at the same time. A “platform release“ or “limited release“ implies that the movie starts in just a few selected cinemas, mostly in different big cities. If the demand is high and the movie gets positive reviews or other influencing positive factors, additional theaters will be added (Sawhney and Eliashberg, 1996). One of the most outstanding examples for a platform release is “Paranormal Activity“ (2007), with a production budget of $15,000 it generated a total domestic gross of more than 100 million USD. The movie opened in only 12 theaters and it was played in 2,712 theaters in the United States domestic market just a few weeks later („Paranormal Activity, 2016).

Box office reports include information on the release date of the movie, the weeks the movie has been in cinema and the weekly number of theaters that are playing the specific film. This information is important regarding the release pattern of a movie and gives information on the lifetime of a motion picture. When a movie drops out the top 50 it will quite likely be taken out of the theaters soon, due to the convex distribution of revenues and the constant supply of new movies every week.

After the distribution studio has decided for timing and release pattern, exhibitors will be contacted to set up contracts between the distributor and the theater. Different scholars have described modern exhibition contracts, i.e. De Vany and Walls (1996), Borcherding and Filson (2001) and Filson et al. (2005). In general, a modern exhibition contract is described through a bidding process, where theaters bid for a defined amount of copies of a movie. The amount of copies is defined by the distributor according to the estimated demand of a movie. In many cases

a contract contains a clause concerning how many weeks the movie must be shown at a particular theater. Additionally, contracts often inhabit a “hold-over clause”, which provides the movie at least another week of run if the movie’s box office revenue is above a contracted amount and further clauses can be added from an exhibitor to get an exclusive screening of the movie in a specified area. The contracts also specify how much the distributors earns from the weekly grosses of the movie. As already mentioned, long-term contracts between distributors and exhibitors and block booking are banned since the Paramount case (Filson et al. 2005). De Vany (2004) remarks that a theatrical run of a motion picture “would rarely, if ever, wholly be determined by the minimum run specified in the first-run contract and is dependent on box office revenues” (p.21). He argues that other factors, as the release date, the release pattern and the movies that are currently on the market for theatrical exhibition could influence the lifetime of a motion picture.

A distributor will hardly ever match the right amount of demand in the first week, and supply has to be adjusted in the following weeks. This is described in the box office reports through the weekly difference of the numbers of theaters the movie is shown. If the demand for a movie is underestimated, other theater owners can bid on the movie to get a copy of it in their house (De Vany, 2004). This depends also on the availability of movie prints. Historically, movies have been shown in theaters on 35mm prints. In early years of the cinema also 8mm and especially 16mm have been used by smaller, independent studios. The production of a 35mm print, is time and cost intensive compared to digital alternatives. Costs for 35mm prints are estimated with around $1,500, which may not be much for a multi million-dollar production, but more so for independent movies (Hanson, 2007).

2.3 Innovations and digital cinema

2.3.1 Sound and Color

Distribution has been more and more formalized over the last century from the beginning of international exchanges of motion pictures at the beginning of the 20th century to the „Runs-

Zones-Clearance system“ (Lobato, 2012, p. 11) in the studio era. The run-zones clearance system established a formal hierarchy of film exhibition. The economic interests of the studios determined which cinemas will show the movie first (Hanssen, 2010). Production and exhibition are driven by innovations, especially through the arrival of sound, the adaption of color and more recently digital production and exhibition.

The innovation of synchronized sound and color provided a disruptive element to the market of motion pictures. Innovations have been an important factor of product differentiation in the industry, as different studios and cinemas used different systems for production and exhibition (Allen, 1999).

Although each innovation and its implication for the market is different, an analysis of previous innovations and their significance for the market will lead to a broader understanding of the implications of recent innovations.

Innovations in the motion pictures are widely discussed in academic literature, especially the introduction of sound and color. Whereas Peter Wollen (1980) claims that innovations in cinema are driven by ingenuity and creativity of individuals, Crafton (1999) and Allen (1999) argue otherwise. They see innovations in a broader socio-economic context, shaped by the reception of the audience but also through the economic interests of the producers.

“The talkies”, which refers to synchronized sound on film, has been invented many years before it was actually implemented by studios and cinemas. The studios’ economic interest was limited, due to the high transition costs of this new technology. It was the decision of one studio, Warner Brothers, which faced growing difficulties in competition, to implement the innovation which forced the other companies to realize it as well. (Allen, 1999)

The process of implementing innovations in production and exhibition was conducted simultaneously for a long period due to the vertical integration of production, distribution and exhibition. (De Vany, 2004) The turning point of this development was the decision of the Paramount case.

2.3.2 Digital Cinema

The vertical disintegration, after the Paramount case was decided, can be seen as one reason why digitization has been slowly adapted by cinemas in the United States. The first movie that was screened digitally in some theaters was “Star Wars: The Phantom Menace“ (1999) by George Lucas. George Lucas is also a prominent advocate of digital cinema and stated in the Premiere magazine in 1999: „In the twentieth century, cinema was celluloid; the cinema of the twenty-first century will be digital“ (p.58).

In the following years, the transition from analog to digital projectors did not emerge quickly. A report by Screen Digest (2007), stated that in 2006, seven years after the introduction of digital projectors in cinemas, just around 0.9 % of the total screens in the United States had been digitized.

While distributors are instantly profiting from digital distribution, exhibitors do not. As Belton (2002) argues, most of the audience will not see any difference in a digital screened movie or an analog print with the exception of 3D movies. Therefore, the audience will not be willing to pay more for this new product - again with the exception of 3D movies - and cinemas are not likely to install digital projectors which are a costly investment. A mixture of 35mm prints and digital copies on the other side is not in the economic interest of the distributors (Crofts, 2011). Therefore, Sony Pictures, as the first studio, agreed in 2005 to subsidize cinemas in their transition process to digital projectors (“New Sony Pictures agreement”, 2005). Other studios followed this decision which led to an agreement on the so-called “Virtual Print Fee”, which is a subsidy paid by the distributors to movie theaters in order to finance the digital transition. A proportion of the savings through digital distribution is paid by the distributors and the theaters commit themselves to use this subsidy for financing digital projectors. The subsidy is going to be discontinued when the projectors are fully paid off (Belton, 2012).

Another important step in the rollout process of digital cinema was the agreement on an industry standard for digital copies. In 2002, the Digital Cinema Initiatives (DCI) was founded by the major studios and the first DCI standard was published in 2005. This standard concerns the technical specifications of the digital movie files, but also includes security provisions, as piracy

is an important economic topic for the industry (Crofts, 2011).

After the Virtual Print Fee was introduced and the first version of the DCI announced, the transition to digital screens progressed quicker than before. As of December 2010 around 37% of the total screens in the United States had been digitized (MPAA, 2012) and today around 98% of the total screens in the United States are using digital projectors. (MPAA, 2015).

2.4 Market structure and concentration

During the studio era, the motion picture market was dominated by only a few companies. In the literature the term "Big Eight" (i.e. Gomery, 2004) is used as a reference for the market dominating companies which where: Columbia, 20th Century Fox, MGM, Paramount, RKO, United Artists, Universal, Warner Brothers. During the 1930s and early 1940s, these eight companies had a market share of 95 percent (Schatz, 1999).

Six of the above named studios are still dominating the cinema market today and had a market share of 80% of the total domestic gross revenues in the United States domestic market in 2015 (Studio Market Share 2015, 2016).

These six studios, Warner Brothers, 20th Century Fox, Paramount, Universal, Walt Disney and Columbia will be further referred to as "major studios" in this research, whereas "independent" will refer to the other studios. This notion simplifies the description of the industry but has been regularly used in literature (i.e. Levy, 1999). There is some literature (i.e. Clayton, 2015) about so-called mini-majors, including especially the studios Lionsgate and Weinstein Companies, which gained a growing market share over the last years. However, the definition of mini-majors in the literature diverges and the category is therefore not used in this research.

There are different ways of measuring market concentration, one of the most used is the Herfindahl-Hirschman Index (HHI) if sufficiently good data on market shares is available. The HHI is computed through the aggregated squared market shares of every competitor in a market. The maximum of the HHI is 10,000, where only one company is in the market (Rhoades, 1993). According to the United States Department of Justice, a market with an HHI index between 1,500

and 2,500 can be regarded as “moderately concentrated” and an HHI over 2,500 is an indicator for a “highly concentrated” market. (Herfindahl-Hirschman Index, 2015)

Eli M. Noam (2009) used the HHI for an analysis of the movie distribution industry and his results show a growing market concentration in the film industry between 1988 and 2005. In 1988, the HHI of the movie industry according to Noam had been 1,146 and in 2005 the HHI had been 1,419 which is slightly below the 1,500 mark of the United States Department of Justice.

The characteristics of digital distribution and exhibition may have influenced the market concentration therefore this research will include an analysis of the development of the market concentration over the last 15 years.

2.5 Empirical research on the movie exhibition industry

One of the most cited researches in the field of motion pictures economics is Arthur De Vany. He wrote several papers concerning the exhibition market for example “The market for motion pictures: rank, revenue and survival” (1997) which was co-published with David Walls. The authors describe competition in the movie exhibition market as an “evolving rank tournament of survival” (p. 784). For their empirical analysis they used weekly top 50 box office data for the United States domestic market. The mean lifetime of a movie in their data set is 5.71 weeks and the mean rank in the first week is 25.51. Their main empirical findings include that the number of theaters the movie is played in the first week and the revenues have significant positive effect on the lifetime of a motion picture in the top 50.

A paper De Vany co-published with Cassey Lee Hong Kim (2003) deals with concentration measures in the motion picture industry. The authors observe that annual market concentration measures ignore the volatility of the motion picture market.

Volatility in the concentration and in revenues is due to the seasonality in the industry. Seasonality in the exhibition industry has been empirically investigated by different scholars. Liran Einav (2007) concludes that there is not only seasonality with peaks in the summer and winter season where the big blockbusters are released, but also peaks on specific public holidays,

as for example the Independence Day of the United States in the beginning of July, President's Day in mid-February or Thanksgiving. There is no clear empirical evidence if the summer or the winter season is more beneficial to the exhibition industry. Movies are often shifted from one to another season before releasing in order to avoid competition with other possible strong movies in the same genre (Litman,1983). Digital distribution and exhibition may even lead to more shifts as distributors and exhibitors can quickly react to timing strategies of the competitors.

Literature on digitization of the movie industry is mostly related to the production side of the industry. Literature on digitized distribution and exhibition often deals with the new competitors of cinema, especially video-on demand or movie piracy. There is still a lack of data on the video-on demand market and most available data is provided by private companies for a high price.

Literature that was available for this research on the digitization of distribution and theaters is divided into different perspectives on the impact of the transition. Early papers, which were published when only a small portion of the total screens had been digitized where mainly concerned with the innovation per se and not so much with the economic impacts on the industry. Belton (2002) argues, that the digitization of cinemas will not have any major impact on the audience. Culcin and Randle (2003) propose that there will not be any fast process in digitization if there is not an industry standard concerning digital cinema. They further argue, that the transition costs have to be partly financed through the studios. The industry standard was later set through the DCI and the Virtual Print Fee has been implemented to finance the transition process.

Literature published after the first wave of digitization is more concerned about the operational efficiency of digital exhibition. A quantitative study by the Netherlands Film Research Foundation (2014) found an increase of movie screenings per screen and a more diverse movie supply through digitization. In the Netherlands, all cinemas are digitized since 2012. This may be mainly due to a different way of financing the digital transition of cinemas. In European countries there is a mixed strategy, small arthouse cinemas are funded by governments if they implement digital projectors but they have to play a specific amount of European financed movies. Other cinemas are also financed through the Virtual Print Fee (Hanson, 2007).

Hanson (2007) suggests that especially independent and arthouse cinemas could benefit from reduced costs of digital media formats in comparison to analog prints. However, he argues that clear predictions cannot be made as the process of digitization is mostly driven by the interests of the major studios.

Karina Aveyard (2009) argues similarly and adds that digitization could even lead to a higher market concentration as the big studios may profit most out of it. There is a growing concentration on commercial multiplex theaters who tend to program big blockbuster movies instead of small independent movies in the exhibition market. She concludes that „despite the novelty of enhanced technology, the cultural diversity of the cinema experience is under threat“ (p.200).

3. Research Design and methodology

A quantitative approach is applied in this research to test implications of digitalization on the motion picture exhibition industry. This can be justified by the good data availability and quality and the desire to obtain results, which are ideally generalizable. Key characteristics of digital exhibition are well developed and although empirical evidence of the implications of digitization is still limited as it is an on-going process, there are statistical methods which allow a quantitative analysis.

Key characteristics of digital exhibition have been already discussed in early literature (i.e. Belton, 2002) and have been developed since then (Hanson, 2007 and Aveyard, 2009). These scholars are indicating a relationship between digitization of theaters and their respective programming. From a quantitative perspective, this relationship can be analyzed through the count of theaters, in which movies are programmed during their theatrical appearance and through the lifetime of different movie in the cinemas.

The proceeding literature was especially concentrated on the implications of digitization for independent studios and this research is focusing on possible differences of the implications of digitization for major studios and independent studios.

Flexible planning, faster supply of copies and the price advantage of digital copies are defined as the key characteristics of digital exhibition. A flexible planning and growing supply through the decreased prices of movie copies could lead to a shorter lifetime of movies in the theaters (H1) as distributors and exhibitors can react more quickly in their programming. The fast supply of prints and the lower price of digital prints could lead to a higher volatility of cinemas movies are shown (H2), as supply can be matched to demand in a more efficient way.

The empirical conclusions of scholars (i.e. Hanson, 2007) indicate an implication on the market concentration due to the digitization of theaters: independent studios could profit from the characteristics of digital exhibition which could lead to a less concentrated market. Therefore, a concentration measure will be used to test the implications of digitization on the market of motion picture exhibition (H3).

4. Data and Methods

4.1 Dataset

The data used in this research was collected manually and includes data on the United States domestic box office and data on the theatrical market of the United States.

4.1.1 Box office

Box office data was retrieved from Box Office Mojo, which has been used in several studies (i.e. Duan et al., 2008) and is known as "the leading online box-office reporting service". It is owned and operated by IMDb, the international movie database (About IMDb, 2016).

Weekly observations of the top 50 box office charts, from the first week of 2000 to the last week of 2015 have been collected. In total, the dataset consists of 41639 single observations on 4827 different movies. For a few weeks, Box Office Mojo was not able to report the full top 50 dataset. 4131 movies were traced from their first appearance in the box office top 50 until they dropped out of the top 50. Gross revenues in the theatrical exhibition market are reported as weekly, monthly or total gross. Therefore the notion of gross instead of gross revenue will be further used in this research for the sake of consistency.

The total gross of the different movies was conducted through the summarized weekly grosses of the respective movie.

Table 1 presents a summary of the key variables that have been collected through the data of Box Office Mojo. The table includes movies that have been traced from their first appearance in the top 50 until they dropped out. Money values have been adjusted to inflation by the consumer price index for the US retrieved from the OECD (2010=100).

The variable average theater count indicates the aggregated mean of the number of theaters, in which the different motion pictures have been projected.

Weeks in top 50 will be used as a proxy for the lifetime of a motion picture in the theaters as it was not possible to trace movies after they finally dropped out of the top 50. De Vany and

Walls (1997) used the same method for their lifetime analysis of motion pictures.

A significant number of budgets especially on independent movies was not reported in the data provided by Box Office Mojo. Therefore, movie budgets have been excluded from further data analysis because a significant bias is expected.

Table 1 - Descriptive statistics United States domestic box office

		Total Gross (in US$)	Gross in first week (in US$)	Budget (in Mio. US$)	Weeks in top 50	Average Theater Count	Rank in first Week
N	Valid	4131	4131	2050	4131	4131	4131
	Missing	0	0	2081	0	0	0
Mean		41,430,828	14,525,295	48.74	9.68	715.90	18.58
Median		13,747,960	2,940,170	33.00	8.00	713.55	13.00
Std. Deviation		69,833,803	26,441,476	46.53	15.67	618.41	16.53
Minimum		8,725	8,725	0.07	1	1	1
Maximum		814,908,470	296,211,625	300.00	659.00	2,760.67	50
Skewness		3.38	3.89	1.73	25.17	.32	.53
Kurtosis		16.33	22.29	3.19	922.69	-1.20	-1.22

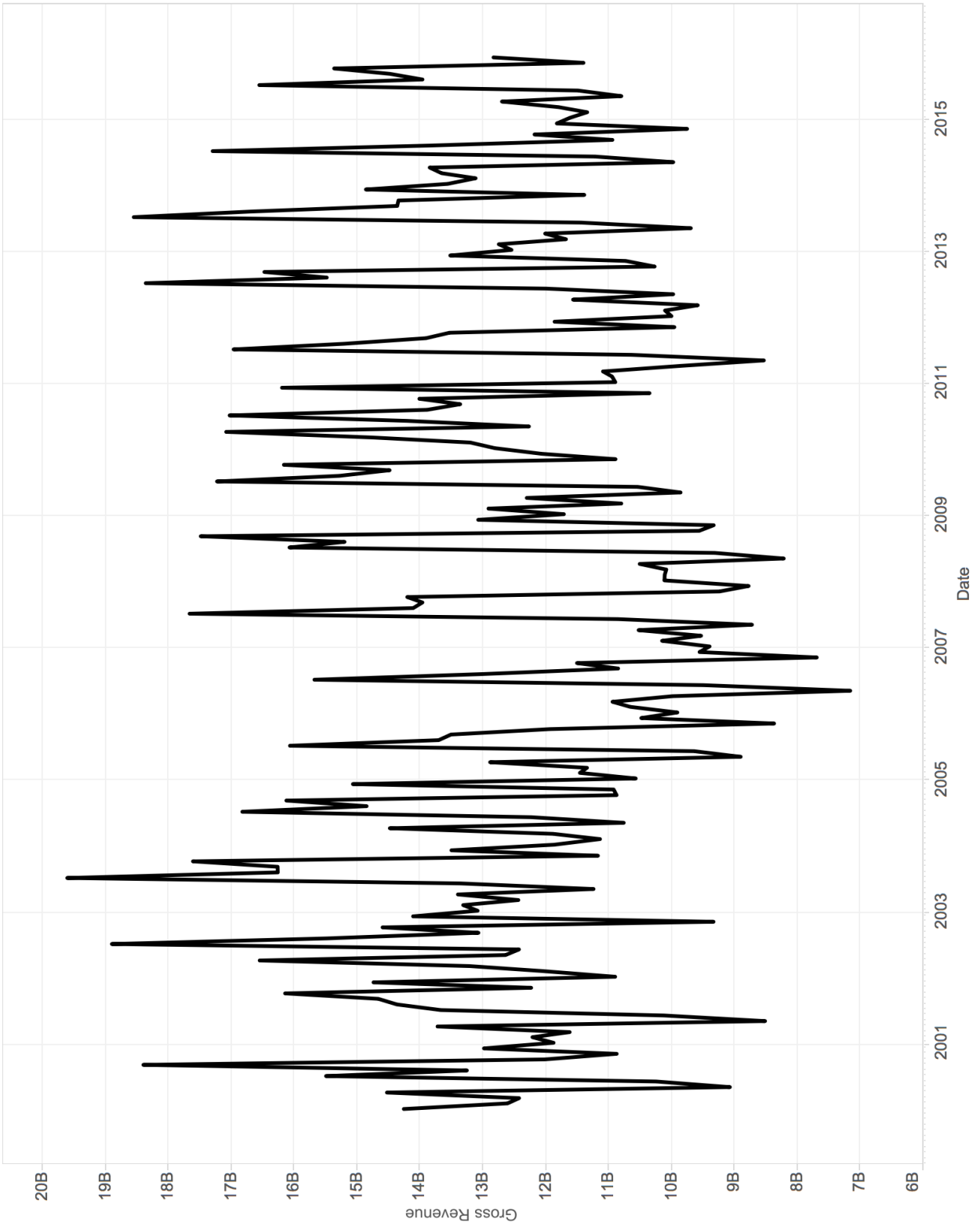

Figure 1 – Monthly gross box office United States domestic in billion US$

Figure 1 presents the development of the aggregated monthly grosses of all movies in billion US$. The grosses have been adjusted to inflation by the consumer price index of the USA retrieved from the OECD (2010=100). As already discussed, the seasonality of the industry is clearly visible but there is no specific trend over the period of data collection.

To observe seasonality in the dataset, weekly grosses were aggregated on a monthly basis.

The seasonal decomposition method (Census I) was used to adjust the monthly grosses by a seasonal component. This is a standard procedure to analyze seasonality in time-series data and has been used in notable research before (see i.e. Zhang and Qi, 2005).

Figure 2 shows the seasonal factor. Monthly grosses are divided through the seasonal factor in order to get the seasonally adjusted grosses. A seasonal factor above 1 indicates that during this period disproportionately high grosses were achieved in the industry. 1.0 indicates an average gross according to the observed data and a seasonal factor under 1 indicates below average grosses in that period. The observed seasonality in the dataset peaks especially in summer but also in the beginning of the winter season which has been discussed already in previous research (i.e. Einav, 2007). This result underlines the importance of controlling for seasonal effects in any further analysis of the market.

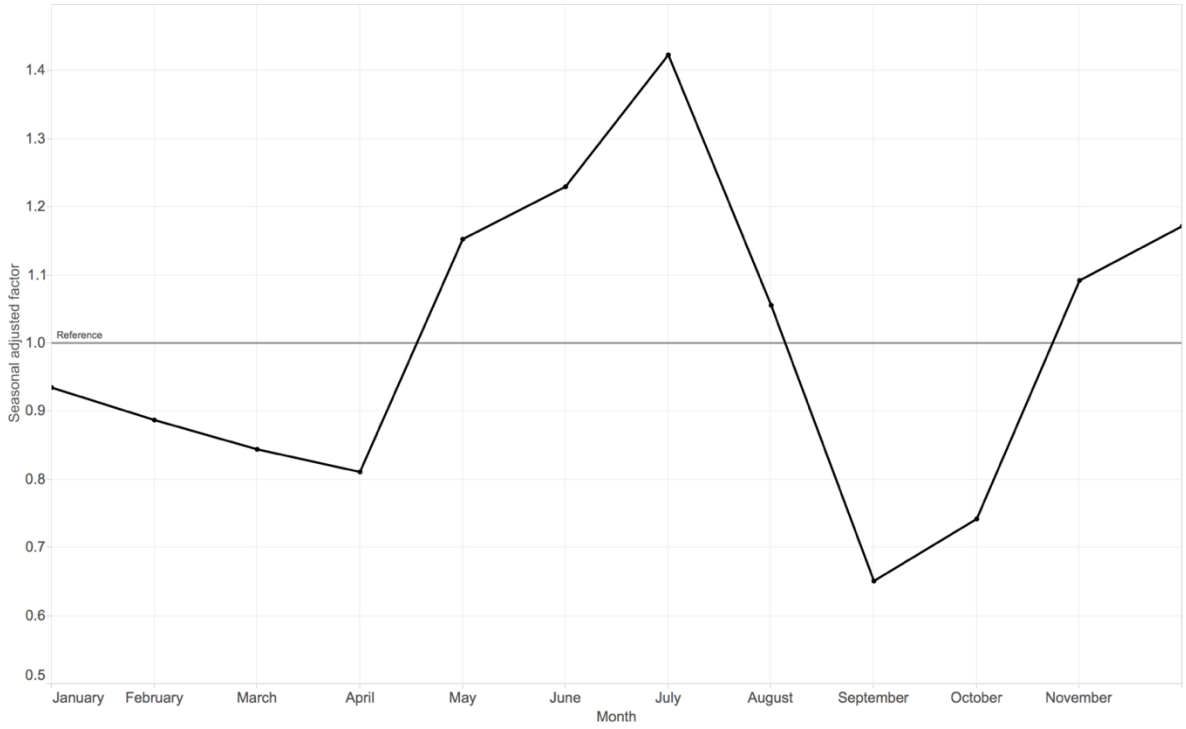

Figure 2 – Seasonal adjusted factor

4.1.2 The theatrical market of the United States

The total numbers of theaters and screens in the United States was obtained through the National Association of Theatre Owners (NATO, 2016). The number of digital and analog screens from 2000-2007 was conducted through a report by Screen Digest (2007), a subsidiary of IHS, the Information Handling Services, which is focused on analyzing global media markets. Data on digitized screens and theaters from 2007-2014 was conducted through annual reports by the Motion Picture Association of America (MPAA, 2007, 2012, 2015).

For the available data it was not possible to construct a measure on digitized theaters. In order to evaluate the process of digitalization in theaters, the ratio of digitized screens to total screens in the United States is used as a proxy of digitalization. It is a continuous measure conducted through the monthly number of digitized screens divided through the total screens.

Table 2 presents the annual number of total cinema sites, total screens, analog screens, digital screens and the respective measure of digitalization in the United States.

Table 2 - Theatrical market in the United States

Year	Total cinemas	Analog screens	Digital screens	Total Screens	Measure Digitization
2000	6992	36366	13	36379	0.036%
2001	6253	35487	19	35506	0.054%
2002	6144	35612	76	35688	0.213%
2003	6100	35573	77	35650	0.216%
2004	6031	36350	85	36435	0.233%
2005	6114	37364	324	37688	0.860%
2006	5939	36412	2003	38415	5.214%
2007	5928	34162	4632	38794	11.940%
2008	5786	33319	5515	38834	14.201%
2009	5942	31815	7418	39233	18.908%
2010	5773	24812	14735	39547	37.259%
2011	5697	13959	25621	39580	64.732%
2012	5683	6533	33129	39662	83.528%
2013	5719	2981	36802	39783	92.507%
2014	5856	1747	38411	40158	95.650%
2015	5833	1109	42552	43661	97.460%

Whereas the number of total screens is growing in the United States, the number of theaters is declining. This may be due to a concentration on so-called multiplex cinemas, that hold multiple screens in one theater. There was not sufficient data about the actual composition of different types of movies in the United States.

Figure 3 shows the transformation from analog screens to digital screens graphically.

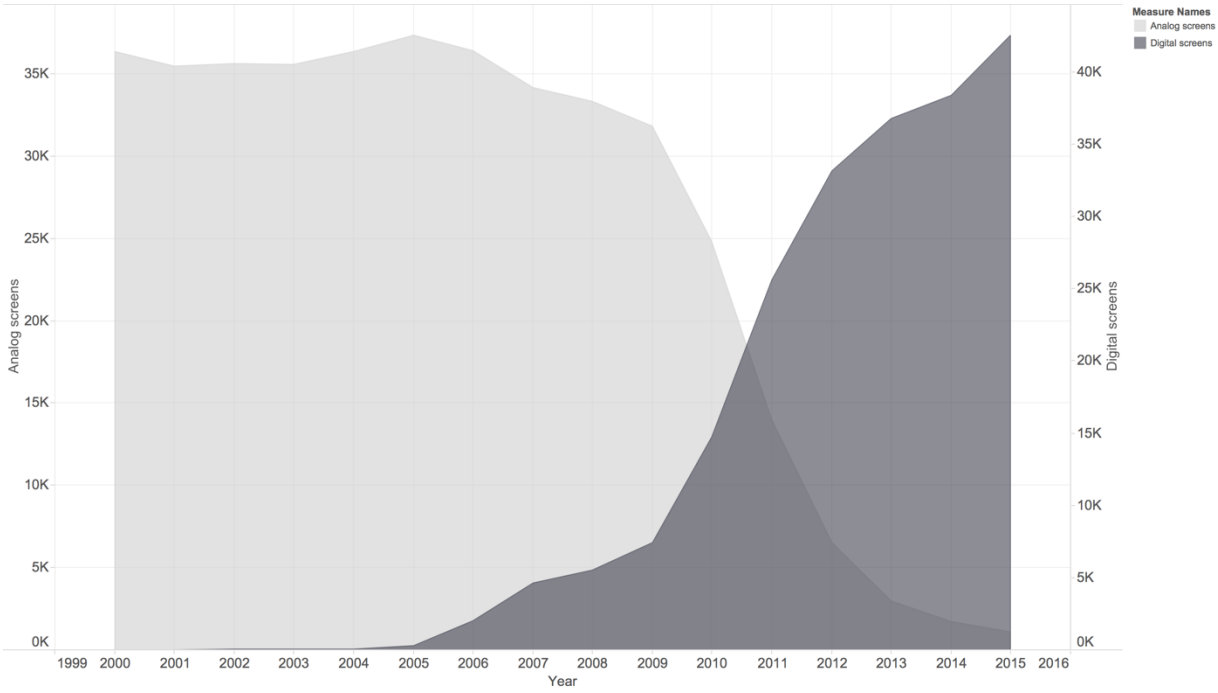

Figure 3 - Analog and digital cinema screens in the United States

It was not possible to obtain data on the degree of digitalization for the Canadian market, which is a restriction of the research. Historically, the market in Canada is highly dependent on the market in the United States, therefore it is not expected to get a significant bias through this restriction (Melnyk, 2004).

4.1.3 Constructed variables

For the statistical analysis further variables were computed and discussed in this subchapter.

Standard deviation of changes in theater count

To test H2 a volatility measure of theater count was constructed. The data of Box Office Mojo contained the count of theaters a movie was shown in every week. A change variable was computed through the first difference in the count of theaters for all movies in the dataset.

This variable has been aggregated by month and the standard deviation of the monthly measures was estimated. The respective monthly standard deviation of the aggregated changes in the theater count is used as a volatility measure. The same calculation was used to obtain the monthly standard deviation of independent movies and major movies. This is a standard measure of volatility that has been used in research before, especially on the stock market (see i.e. Schwert, 1990). A low value would indicate that the data points are close to the mean, a high value would indicate a high variation of theater changes. It is expected from the characteristics of digital distribution and exhibition that a higher level of digitization in the cinema leads to a higher volatility as digital prints can be produced and shipped more quickly to cinemas. Exhibitors and distributors can also react more efficiently to changes in demand which could also increase the volatility.

Table 3 presents the descriptive statistics of the calculated volatility measure for all movies, major movies and independent movies. The descriptive statistics are hard to interpret detached from the model but guarantee the transparency of this research. Furthermore, the results indicate a higher volatility in major movies than independent movies.

Table 3 - Descriptive statistics volatility measure

		Volatility all movies	Volatility major movies	Volatility independent movies
N	Valid	192	192	192
	Missing	0	0	0
Mean		351.35	376.11	295.81
Median		344.07	361.95	286.89
Std. Deviation		67.85	86.16	87.26
Minimum		225.72	221.27	106.73
Maximum		589.61	720.78	513.13

HHI

To test H3, the Herfindahl-Hirschman index, a standard way of analyzing market concentration, was conducted. The index is computed through the market share of single companies in relation to the total market. High values of the HHI are indicators for a market which is highly concentrated on single companies.

The weekly box office data has been aggregated to obtain the monthly box office grosses. The corresponding market shares of the unique studios have been calculated and Equation 1 is used to obtain the monthly HHI of the motion picture market.

$$HHI = (MS_{Studio1})^2 + (MS_{Studio2})^2 + \ldots + (MS_{Studion})^2 \qquad (1)$$

Weeks where Box Office Mojo was not able to report the complete top 50 box office have been excluded for the analysis as a bias in the HHI is expected.

The descriptive statistics of the monthly market concentration measure are represented in table 4. The mean HHI of the dataset is 1432.48 which is slightly below 1,500 which would indicate a "moderately concentrated" market according to the United States Department of Justice. The maximum monthly HHI was 3295,92 which indicates a "high concentrated market" (Herfindahl-Hirschman Index, 2015). De Vany and Kim (2003) observed a high volatility in the market concentration due to the seasonality of the industry. Therefore, the HHI was seasonally decomposed using the same statistical method as above. The seasonal factor of the HHI follows the general trend of the seasonality in the grosses. Market concentration peaks in Mai which is a bit before the summer peak in the grosses. This could be related to release strategies of smaller independent studios. May is generally low in revenues and also just a bit before the blockbusters are released, so smaller studios could tend not to release movies in May which leads to a more concentrated market. Figure 4 shows the combined seasonal factor of the HHI and the total grosses.

***Table* 4** - *Descriptive statistics concentration measure*

		HHI
N	Valid	192
	Missing	0
Mean		1432.48
Median		1335.42
Std. Deviation		424.28
Minimum		792.95
Maximum		3295.92

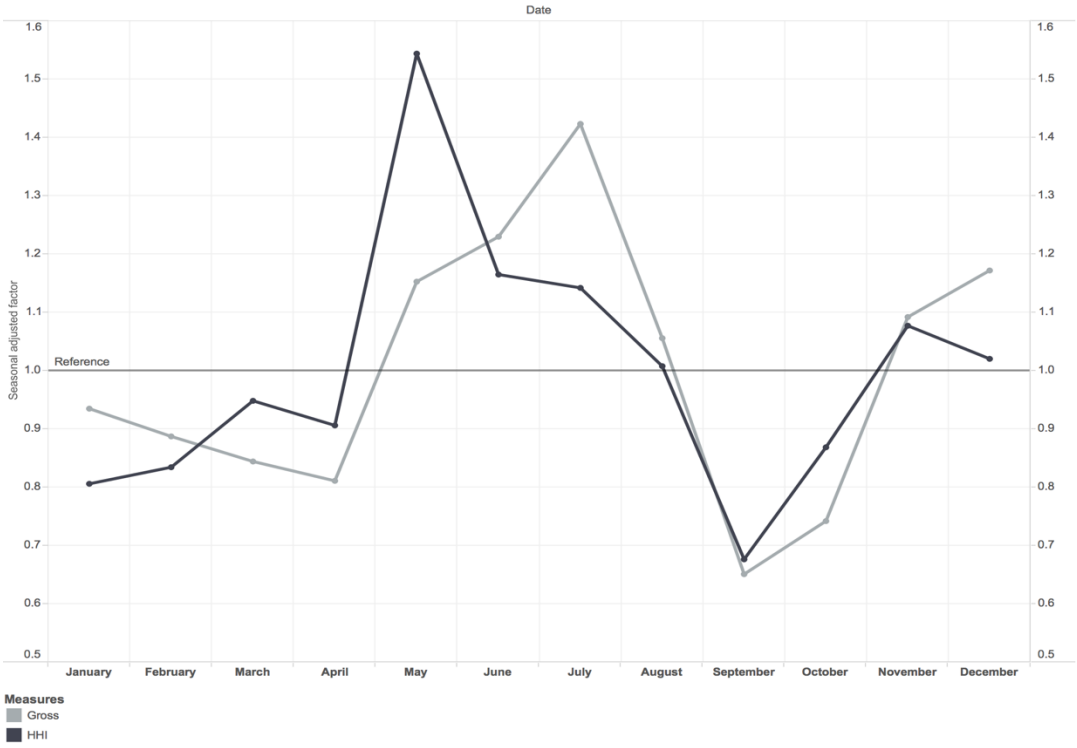

Figure 4 - Seasonal adjusted factor gross and HHI

Figure 5 is a representation of the monthly HHI in the year 2015. The average HHI in 2015 is 1985 which is considered as "moderately concentrated" according to the United States Department of Justice. In May, June, July and December the HHI exceeds the mark of 2,500 which is an indicator for a "highly concentrated" market (Herfindahl-Hirschman Index, 2015).

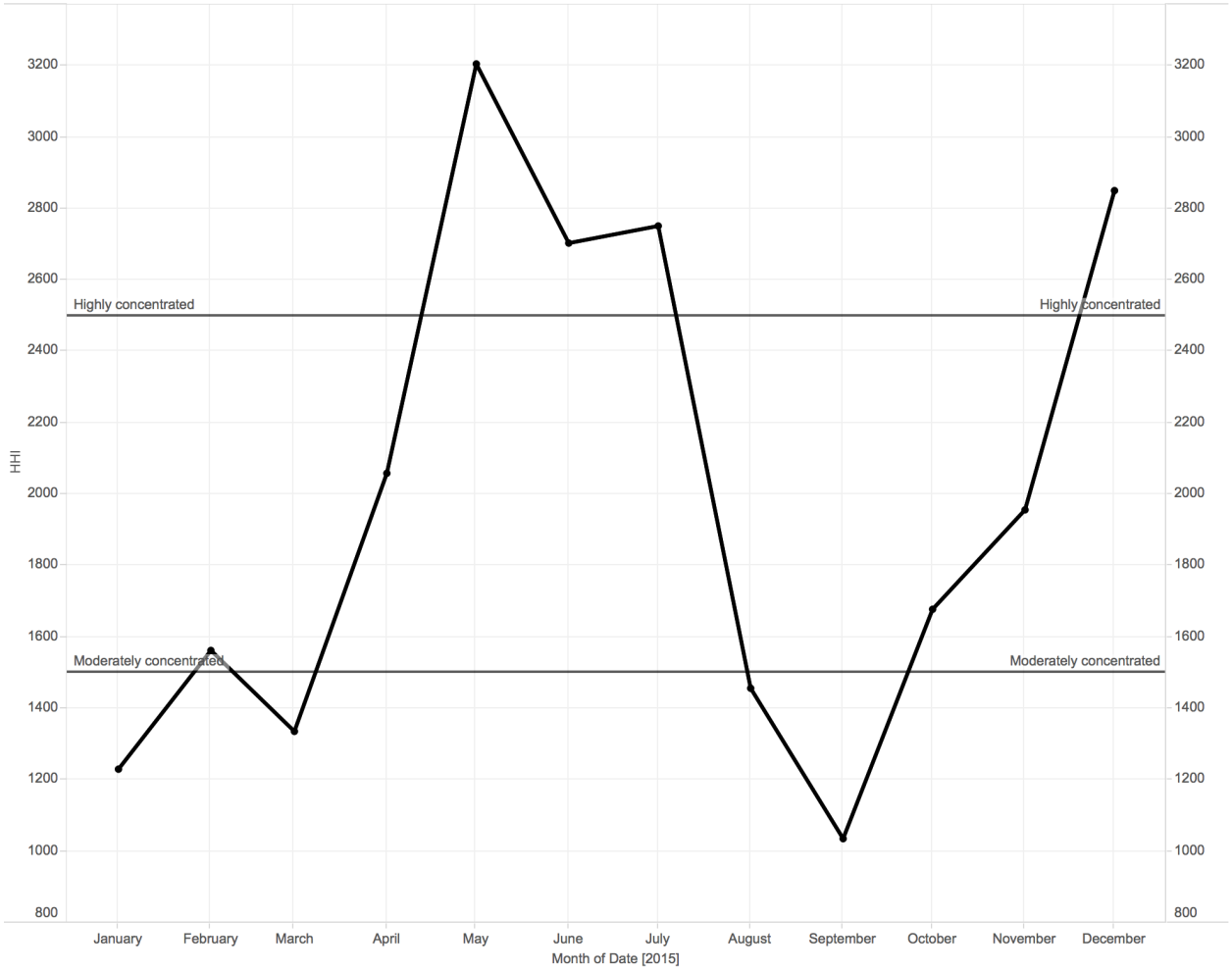

Figure 5 – Market concentration in the motion picture industry in 2015

4.1.4 Additional Variables

Additional variables are used in the data analysis to control for specific effects and are discussed below.

Motion picture supply

Box Office Mojo traces the movies that have been brought to at least one cinema in the United States domestic market in a specific month. This will be used as a proxy for available motion pictures in the specific month for exhibitors and is an indicator for the possible motion picture supply. Table 5 represents the descriptive statistics of the motion picture supply.

Table 5 - Descriptive statistics motion picture supply

		Motion picture supply
N	Valid	192
	Missing	0
Mean		47.26
Median		47.00
Std. Deviation		12.78
Minimum		16.00
Maximum		81.00

Figure 6 shows the development of movie supply over the period of data collection. As in the whole motion picture industry there is also seasonality in the supply, in general there is an upwards trend visible.

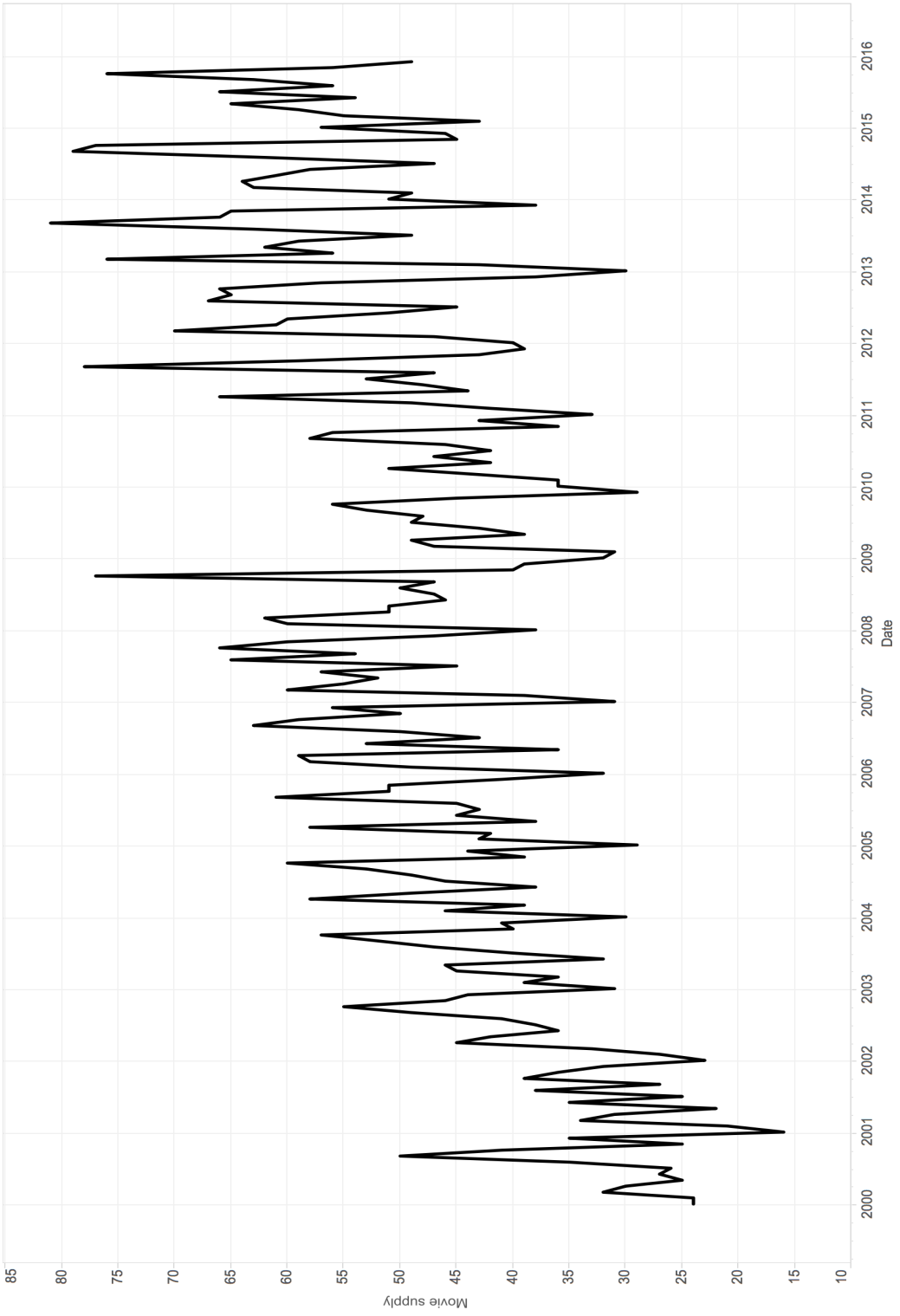

Figure 6 - Development of movie supply

Release Pattern

As discussed in De Vany and Walls (1997), the theater count in the first week of theatrical release is an indicator for the release pattern of a movie. This measure will also be used in this research. The descriptive data of the theater count of all monitored movies, major movies and independent movies in their respective first week of release is described in table 6.

Table 6 - Descriptive statistics release pattern

		Theater count first week all movies	Theater count first week major movies	Theater count first week independent movies
N	Valid	4181	1861	2320
	Missing	0	0	0
Mean		1399.48	2152.95	795.08
Median		1000.00	2602.00	79.00
Std. Deviation		1403.26	1329.70	1144.63
Minimum		1	1	1
Maximum		4416	4404	4416

Major studio and independent studio dummy variable

A focus in this research is to control for significant differences in the implications of the digitalization for movies produced by major studios and independent studios.

The classification of major studios and independent studios has been discussed in literature before (see i.e. Elisashberg et al. 2006). Movies produced and distributed by Warner Brothers, 20th Century Fox, Paramount, Universal, Walt Disney and Columbia are considered as major studios, as these studios have a combined market share of 80% of the total domestic grosses in

the United States domestic market in 2015. (Studio Market Share 2015, 2016) Movies that are not produced by these studios are considered as movies produced and distributed by independent studios.

In total the data contains 1831 movies produced and distributed by major studios and 2300 movies produced and distributed by independent studios according to the stated definition. Table 7 and table 8 present the main descriptive findings in the summarized weekly box-office reports of major and independent movies. The descriptive data indicates a significant difference in the grosses but also in the lifetime of movies in the top 50 and in their average theater count.

Table 7 - Descriptive statistics major movies

		Total Gross (in US$)	Gross in first week (in US$)	Budget (in Mio. US$)	Weeks in top 50	Average Theater Count	Rank in first Week
N	Valid	1831	1831	1321	1831	1831	1831
	Missing	0	0	510	0	0	0
Mean		70,174,585	24,860,721	59.47	12.43	1,035.57	10.55
Median		43,309,450	15,301,605	40.00	11.00	1,143.86	4.00
Std. Deviation		84,087,499	32,658,766	51.27	13.20	532.92	13.18
Minimum		47,672	30,283	.1	1.00	2.00	1
Maximum		814,908,470	296,211,625	300.00	363.00	2,760.67	50
Skewness		2.60	2.99	1.43	16.83	-.42	1.57
Kurtosis		10.15	13.38	1.81	391.51	-.39	1.23

Table 8 - Descriptive statistics independent movies

		Total Gross (in US$)	Gross in first week (in US$)	Budget (in Mio. US$)	Weeks in top 50	Average Theater Count	Rank in first Week
N	Valid	2300	2300	729	2300	2300	2300
	Missing	0	0	1571	0	0	0
Mean		18,548,298	6,297,396	29.30	7.47	461.41	24.97
Median		2,350,224	442,285	20.50	5.00	128.58	25.00
Std. Deviation		44,166,153	15,942,646	27.18	16.25	561.04	16.13
Minimum		8,725	8,725	.07	1	.00	1
Maximum		553,825,554	226,067,558	195.00	659	2,579.38	50
Skewness		5.55	6.42	1.84	30.04	1.13	-.02
Kurtosis		41.86	61.63	4.71	1,149.10	.02	-1.40

IMAX Dummy

IMAX movies are using a special film format for a high quality projection. Not all theaters can screen these prints and normally just a few copies are made which are sent from cinema to cinema. Therefore, IMAX movies have a significantly higher lifetime in cinemas ("IMAX Technical Fact Sheet, 2016). For a lifetime analysis, IMAX movies should be excluded as a bias is expected.

In total, there are 31 movies in the dataset, their mean lifetime in the top 50 is 121 weeks which is way above the mean lifetime of the other movies in the dataset. The influence of the lifetime on the IMAX movies on the total amount of movies is described in table 9.

Table 9 - Weeks in top 50 IMAX

		Weeks in top 50 All movies	Weeks in top 50 IMAX movies	Weeks in top 50 All movies excluding IMAX movies
N	Valid	4181	18	4163
	Missing	0	0	0
Mean		9.68	161.78	9.02
Median		8.00	117.50	8.00
Std. Deviation		15.67	159.84	6.47
Minimum		1	5	1
Maximum		659	659	61

4.2 Methods

In order to test the stated hypothesis different analysis methods are introduced to this research. To test H1 and H2, three specific statistical instruments are used, which are mainly practiced in other fields: the Kaplan-Maier estimator, the Cox regression and a volatility analysis.

4.2.1 Lifetime analysis

The Kaplan-Meier estimator is a non-parametric test in lifetime analysis and is used in medical studies to evaluate the probability that an object will survive a certain amount of time after a specific treatment (Kaplan and Maier, 1958). In this research the Kaplan-Meier estimator is used to model the probability that a movie will stay in the top 50 for each specific week. The plotted survival functions will be used to illustrate possible differences in the lifetime of major and independent movies.

To examine the effect of digitalization on the survival functions, the Cox regression is used in this research. It is built up on the work of Kaplan and Maier (1958) and is a semi parametric model „to examine the covariate effects on the hazard function for the failure time variable" (Wei, 1992, p. 1871). The Cox proportional hazard model is particularly used in clinical studies (see i.e. Kirkwood, 1988) for testing the lifetime of patients after a treatment with different medicines. In clinical studies, the failure time variable would be represented through the death of a patient. Transferred to the movie market, the failure time is modelled as the weeks the movie stayed in the top 50 and the treatment is represented through the level of digitized screens. Additionally, the effect of movie supply, the gross of the movie in the first week of exhibition and release pattern on the lifetime of a movie will be controlled for.

According to Meschi and Wassmer (2013, p719) the Cox model can be written as:

$$H(t) = h(t)exp(\beta X_{tx}) \qquad (2)$$

where h(t) is the baseline hazard ratio with all covariates set at 0, "X_t is the vector of covariates (independent and control variables) at the time t within the period at risk and β is the associated vector of regression coefficients" (Meschi and Wassmer, 2013, p719).

The result of the Cox regression in this research is described through the hazard ratio, also called Exp(B), which is the probability that a movie will drop out of cinema in time t+1 if it is still in the cinema at time t. A hazard ratio > 1.0 indicates that the covariates have a negative effect on the survival time of the movies in cinema. As a consequence, a hazard ratio of < 1.0 has a positive effect and a hazard ratio of 1.0 indicates that the covariates have no effect on the the movie lifetime. The corresponding p-value indicates if these results are significant and are set at the 0.05 level (Garson, 2013).

De Vany (2004) used a similar model to test if weekly revenue and release pattern affect the lifetime of motion pictures in cinema. The Cox regression used in this research will use the

same covariates as De Vany introduced in his research and additionally the effect of digitization of cinemas and the number of competing movies at a certain period will be added as covariates. Due to the seasonality of the motion picture industry monthly dummy variables will be used to control for month specific effects.

4.2.2 Volatility analysis

The volatility analysis is a tool mainly used in finance especially on the stock's market (i.e. Andersen et al., 2001). In this research the constructed volatility measure will be used to test implications of digitization on the volatility of the motion picture exhibition market.

Multiple linear regressions will be run, with the volatility measure of all movies, major produced movies and independent produced movies as dependent variables and the digitalization measure as an independent variable while controlling for the total number of theaters in the United States and the number of competing movies at a given month. Monthly dummy variables will be used to control for month specific effects.

4.2.3 Market concentration analysis

As described in the data section, a monthly continuous measure of market concentration is introduced to the research.

This monthly HHI will be used in a linear regression to analyze the effect of the measure of digitalization on the market structure while controlling for the total number of theaters in the United States and the number of competing movies. As discussed above, there is also expected seasonality in the market concentration of the motion picture industry therefore monthly dummy variables are used to control for month specific effects.

5. Results

5.1 Lifetime - analysis

Figure 7 shows the plotted Kaplan-Meier survival function. It indicates a difference between the survival function of major and independent motion pictures.

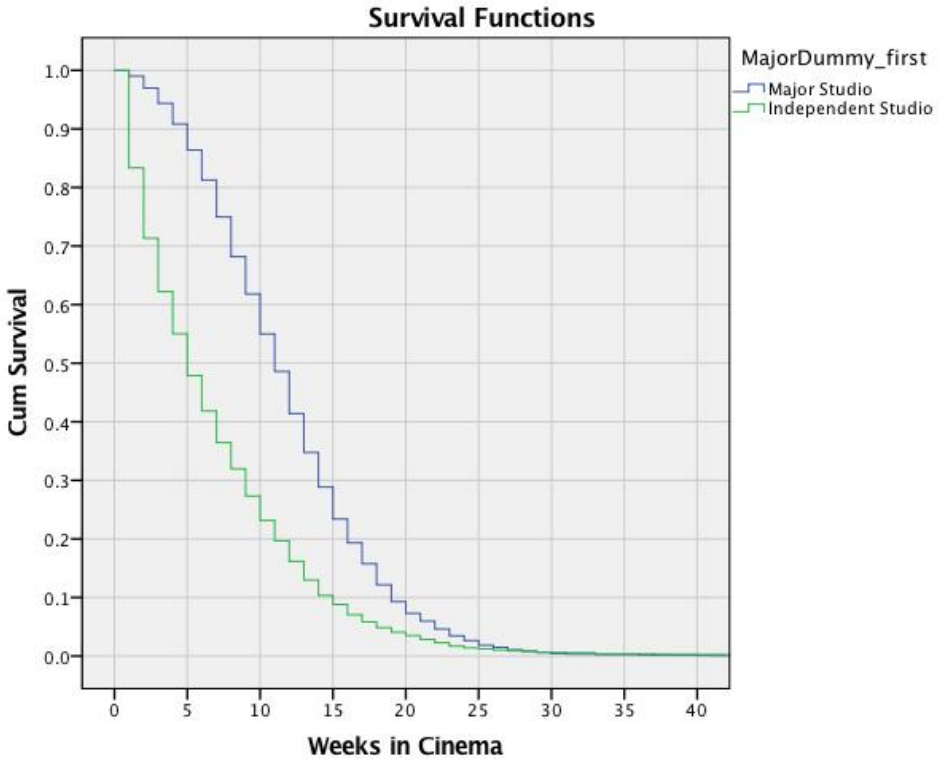

Figure 7 – Kaplan-Meier survival function

Excluding the IMAX movies, mean survival time of a motion picture according to the Kaplan-Meier estimator is 9.06 weeks with a 95% confidence interval of $8.87 < \mu < 9.26$.

The mean survival time of movies produced by major studios is 11.75, CI [11.48,12.02] and the mean survival time of independent produced movies according to the Kaplan-Meier estimator is 6.93, CI [6.68, 7.18].

After one week of theatrical exhibition, the probability that the movie will stay in cinemas drops to 83% for independent movies whereas motion pictures produced by major studios will run another week after their first week with a probability of 99%. The very high probability of survival

in the first weeks of major movies can partly be described through the distributor exhibitor contract which often inhabits a minimum week clause for movies produced by major studios as discussed above.

To control for effects of digitalization on the lifetime of independent and major movies three different Cox regressions were run. IMAX movies have been excluded again from the analysis.

The first Cox regression was containing all movies of the dataset that were observed from their first week in the top 50 until they dropped finally out of the top 50. Additional covariates were fitted into the model to control for the movie supply in the specific month, the release pattern of the movie and the gross of the movie in the first week of theatrical exhibition.

Seasonality was controlled for through monthly dummy variables that indicate in which month the movie has been released. January is taken as the reference month.

Including all movies monitored in the dataset, an increase of digitalization does not lead to a significant higher hazard ratio. A one percent increase of digitized theaters leads to a significant higher risk ratio, Exp (B)= 1.002, $p<0.05$, CI [1.001;1.003] for independent movies. For movies produced by major studios, digitalization decreases the risk ratio, Exp (B)=0.998, $p<0.05$, [0.996;0.999].

The release pattern and the opening gross of a movie does not influence the hazard ratio of a motion picture whereas a higher movie supply leads to a significant higher hazard ratio for independent motion pictures. See table 10 for the corresponding coefficients for the other covariates. Model 1 describes the corresponding coefficients in the Cox regression containing all monitored motion pictures. Model 2 reports the effect of digitalization on the lifetime of motion pictures for major movies and model 3 for independent motion pictures.

Without controlling for seasonality digitalization leads to a significant higher hazard ratio for the model including all movies and also for the model containing independent movies. The effect of digitalization on major movies is not statistically significant without controlling for seasonality. See appendix A for the corresponding coefficients.

Table 10 - Regression coefficients of theatrical lifetime analysis

	Model 1			Model 2			Model 3		
Variable	Exp(B)	95% CI		Exp(B)	95% CI		Exp(B)	95% CI	
		Lower	Upper		Lower	Upper		Lower	Upper
Digitalization	1.000	.999	1.001	0.998*	.996	.999	1.002*	1.001	1.003
Movie supply	1.007**	1.003	1.011	1.004	.999	1.010	1.008*	1.003	1.013
Opening gross	1.000**	1.000	1.000	1.000**	1.000	1.000	1.000**	1.000	1.000
Release pattern	1.000**	1.000	1.000	1.000**	1.000	1.000	1.000**	1.000	1.000
February	.908	.760	1.085	.884	.672	1.162	.959	.757	1.213
March	.682**	.566	.821	.693*	.519	.927	.651*	.509	.834
April	.738*	.619	.880	.801	.608	1.055	.692*	.549	.873
May	.713**	.593	.857	.694*	.523	.920	.713*	.558	.911
June	.738*	.616	.884	.726*	.552	.955	.715*	.560	.913
July	.767*	.646	.911	.808	.619	1.053	.701*	.558	.880
August	.812*	.679	.971	.884	.670	1.167	.749*	.591	.949
September	.843	.695	1.021	1.029	.759	1.395	.750*	.584	.963
October	.596**	.493	.721	.630*	.469	.846	.618**	.481	.794
November	.556**	.466	.664	.541**	.413	.710	.590**	.466	.748
December	.507**	.429	.601	.547**	.423	.708	.549**	.438	.688
Observations		4114			1822			2292	
Chi-square		630.941**			230.429**			235.766**	
df		15			15			15	

Note: *p<0.05; **p<0.01

5.2 Volatility analysis

Three linear regression were run to understand the effect of the digitalization of cinemas on the volatility in the exhibition market. The constructed volatility measure is used as dependent variable, the level of digitization, the total number of theaters in the United States and the movie supply as independent variables. Seasonality was controlled through monthly dummy variables. January is taken as the reference month.

Model 1 estimates the effect of digitalization on the volatility of the exhibition market including all movies in the dataset, model 2 estimates the volatility for movies produced and distributed by major studios and model 3 for independent movies.

There was linearity as assessed by partial regression plots and a plot of residuals versus predicted values. There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.978 (Model 1) , 2.014 (Model 2) and 1.959 (Model 3). There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1.

The measure of digitalization predicted the volatility in theater changes statistically significant while controlling for fixed effects in all three models. An increase in the digitalization of cinemas leads to an increase in the volatility of theater changes in the cinemas. This is an expected result according to the literature as the main characteristics of digital cinema lead to a fast supply of movie prints and to a more flexible planning in theaters. An increase of movie theaters in the United States leads to a significant decrease of volatility for major movies and independent movies. This is also an expected result, a higher concentration of theaters in a region will lead to a specialization of theaters on specific movies and a decrease of volatility.

The number of competing movies has no significant effect on the volatility of the exhibition market. See table 11 for the corresponding coefficients.

Without controlling for seasonal effects, there is also a significant increase of volatility in the model containing all movies and the model containing major movies. There is no significant effect in the model containing independent movies. See appendix B for the corresponding regression coefficients.

Table 11 - Regression coefficients of theatrical volatility analysis

	Model 1			Model 2			Model 3		
Variable	B	SE B	β	B	SE B	β	B	SE B	β
Constant	663.43	94.27		673.89	94.47		631.22	137.06	
Digitalization	0.26	0.12	0.14*	0.20	0.13	0.10*	0.05	0.18	0.02
Movie supply	0.62	0.39	0.12	0.63	0.39	0.13	0.71	0.56	0.11
Total cinemas	-0.05	0.01	-0.22**	-0.05	0.02	-0.24**	-0.06	0.02	-0.20*
February	-81.22	17.03	-0.33**	-83.12	17.37	-0.35**	1.82	24.76	0.01
March	-117.71	18.02	-0.48**	-116.00	18.44	-0.48**	-60.76	26.19	-0.19*
April	-108.96	18.36	-0.45**	-105.98	18.79	-0.44**	-67.99	26.70	-0.22*
May	-64.82	17.51	-0.27**	-55.04	17.79	-0.23**	-21.48	25.45	-0.07
June	-107.38	17.47	-0.44**	-103.74	17.83	-0.43**	-144.38	25.40	-0.46**
July	-75.87	17.31	-0.31**	-73.14	17.58	-0.30**	-97.59	25.17	-0.31**
August	-75.62	18.07	-0.31**	-69.82	18.49	-0.29**	-64.06	26.27	-0.20*
September	-68.85	18.51	-0.28**	-68.98	18.91	-0.29**	2.54	26.91	0.01
October	-47.39	19.68	-0.19*	-51.92	20.02	-0.22*	-15.65	28.61	-0.05
November	29.59	17.48	0.12	34.82	17.83	0.15	51.17	25.41	0.16*
December	-19.51	17.09	-0.08	-19.23	17.42	-0.08	-8.86	24.85	-0.03
Observations		192			192			192	
R^2		.543			.433			.416	
Adjusted R^2		.507			.368			.370	
F		15.04**			9.64**			9.02**	

Note: *p<0.05; **p<0.01

5.3 Market concentration analysis

A linear regression was used to predict the effect of the digitalization of cinemas on the market concentration of motion pictures. The computed Herfindahl-Hirschman Index was used the dependent variable, the measure of digitalization, the total count of theaters in the United States and the number of competing movies are used as independent variables.

Seasonality was controlled through monthly dummy variables. January is taken as the reference month.

There was linearity as assessed by partial regression plots and a plot of residuals versus predicted values. There was independence of residuals, as assessed by a Durbin-Watson statistic of 2.215 (Model 1). There was no evidence of multicollinearity, as assessed by tolerance values greater than 0.1.

An increase of 1% in digitalization leads to a statistically significant increase of the market concentration measure. Competing movies and total theaters in the United States have no significant effect on the market concentration.

See table 12 for the corresponding standardized and unstandardized regression coefficients.

Without controlling for seasonality there is as well a predicted significant increase of market concentration. See appendix C for corresponding coefficients.

Table 12 - Regression coefficients market concentration analysis

Variable	*B*	*SE B*	*β*
(Constant)	500.61	687.71	
Measure digitalization	252.86	85.49	0.21*
Movie supply	2.65	3.22	0.08
Total cinemas	0.09	0.10	0.06
February	-25.71	119.62	-0.02
March	118.55	129.20	0.07
April	64.84	132.55	0.04
May	964.80	124.28	0.59**
June	475.77	123.91	0.29**
July	417.54	122.40	0.26**
August	158.34	129.70	0.10
September	-314.13	141.89	-0.19*
October	-20.16	145.02	-0.01
November	307.24	124.00	0.19*
December	292.57	120.20	0.18*
Observations	192		
R^2	.502		
Adjusted R^2	.463		
F	12.749**		

Note: *p<0.05 **p<0.01

6. Discussion, limitations and concluding remarks

6.1 Discussion

The empirical analysis of the volatility and the lifetime in the motion picture industry confirms general findings in discussed empirical papers. While the digitization has a negative effect on the lifetime of independent motion pictures, digitization increases the lifetime of motion pictures produced and distributed by major studios in this model. This could be due to the market power of major studios who try to push their movies in various theaters over a long period of time. This is also represented in the increase of volatility in the exhibition sector and in the increase of market concentration.

The increase of volatility in the exhibition market, as stated in H2 was expected and can be directly related to the specific characteristics of digital exhibition which have been already developed in the literature. It indicates a higher flexibility in programming and could lead to an increasing audience choice in theaters, especially in rural areas. Further research monitoring the programming of cinemas in different regions of the United States would be beneficial to the model but was not possible due to limited time.

The research indicates that independent studios are not able to fully profit from the characteristics of digital exhibition yet. This could be related to the Virtual Print fee. Studios still have to pay a proportion of their savings of digital exhibition to theaters to contribute to the transformation process. The payments will stop over the next couple of years which could have additional effects on the lifetime of motion pictures, volatility in the market and on the market concentration.

The increase in market concentration, could also be related to the concentration of multiplex theaters in the United States. Due to limited data, it was not possible to obtain the exact numbers on multiplex and single theaters but literature suggests an increase of multiplex theaters over the last couple of years. Multiplex theaters often contain big screens with many seats, therefore they are more likely to program big commercial movies instead of niche independent movies.

In contrast to the United States, Europe uses a mixed strategy to cover the transition costs

of digitized projectors with governmental subsidies. There is little empirical research on this topic except for a study by the Netherlands Film Research Foundation (2014) which indicates a more diversified supply through digitization in the Dutch exhibition industry. An inherent goal of cultural policy is cultural diversity and this should also be represented in the motion picture industry as indicated by Karina Aveyard (2009). If smaller independent theaters are not able to finance the digital transition despite payments of the studios further mechanisms to cover transition costs should be reviewed and implemented. The high level of market concentration contradicts competition in the market of theatrical exhibition and would could lead to a concentration of the market on few blockbuster movies every season. Small cinemas are substantial for independent produced movies in order to secure exhibition.

Market concentration should be closely monitored over the next couple of years, as stated above, the market concentration measure already exceeded a critical limit set by the United States Department of Justice in some months. In the motion picture sector, major studios often took over smaller independent studios in order to diversify movie production. Future takeovers should be analyzed precisely to avoid an even more concentrated market.

6.2 Limitations

Although this research covers a period of 15 years, literature indicates contracyclical characteristics in the motion-picture industry. According to Vogel (2010): "…ticket sales often remain steady or rise during early to middle stage of a recession, faltering only near the recession's end." (p. 81). A longer period of data analysis would be more robust against cyclical movements.

This research is concentrated on theatrical distribution and exhibition. The value chain of film distribution can be divided in three different parts and the theatrical distribution is the first step in the value chain of distribution. After the theatrical distribution, movies are distributed to broadcasters (including pay TV) and to video distribution which represents the end consumer market including DVD and video on demand (VOD) (Stepan, 2013). For a long period of time there was a precise hierarchy in the value chain of distribution but lately studios are experimenting

with mixed forms of distribution. Day-and-date releases, where movies are brought to theaters and to DVD or VOD at the same time, was one of the most successful experiments over the last few years in Hollywood (Paris, 2014). Due to limited resources, the concentration on the theatrical exhibition was inevitable. Research about distribution windowing (i.e. Eliashberg et al. 2004) suggest a decline of the time span between theatrical and VOD distribution. This could have possible effects on the lifetime of movies in the theaters. Major studios could try to keep movies longer in cinemas to create already a buzz for the DVD and VOD release. On the other side movies could be taken out of cinemas earlier in order to avoid competition with the home video market.

Further control geographic control variables would be beneficial for the overall fit of the model. Scholars like Newman (2009) suggest that smaller theaters programmed with a higher proportion of independent movies are usually attended by an older audience with higher education than the multiplex cinemas. Due to limited data on visitor profiling this could not be implemented in this research.

6.3 Concluding remarks

Despite good available data in the United States, the motion picture distribution and exhibition sector is still under-researched. This research should contribute to a broader discussion about the effect of digitalization in the exhibition industry. Digitalization disrupted different sectors in the motion picture industry and extensive research would help to quantify the implications.

Unfortunately, data about the exhibition industry is still limited in Europe. The effects of different strategies in Europe to cover transition costs of digital projectors would be an interesting area for future research. Other big cinema markets, as for example in India or Nigeria are completely neglected by scholars. The growing importance of these markets are indubitable and should draw more attention in the academic discourse.

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Appendix

Appendix A

Table 13 - Lifetime analysis without seasonal factors

Variable	Model 1			Model 2			Model 3		
	Exp(B)	95% CI		Exp(B)	95% CI		Exp(B)	95% CI	
		Lower	Upper		Lower	Upper		Lower	Upper
Digitalization	1.002**	1.001	1.003	.999	.997	1.000	1.003**	1.001	1.004
Movie supply	1.006**	1.003	1.009	1.005*	1.001	1.009	1.005*	1.001	1.009
Opening gross	1.000**	1.000	1.000	1.000**	1.000	1.000	1.000**	1.000	1.000
Release pattern	1.000**	1.000	1.000	1.000**	1.000	1.000	1.000*	1.000	1.000
Observations		4114			1822			2292	
Chi-square		566.837**			211.458**			215.045**	
df		4			4			4	

Note: *p<0.05 **p<0.01

Appendix B

Table 14 - Theatrical volatility analysis without seasonal factor

	Model 1			Model 2			Model 3		
Variable	B	SE B	β	B	SE B	β	B	SE B	β
Constant	703.214	120.008		710.806	158.176		634.579	161.548	
Digitalization	.395	.155	.214*	.455	.205	.194*	.118	.209	.050
Movie supply	-.265	.408	-.053	-.516	.538	-.081	.347	.550	.054
Total cinemas	-.059	.019	-.267*	-.054	.024	-.194*	-.060	.025	-.212*
Observations	192			192			192		
R^2	.157			.091			.076		
Adjusted R^2	.143			.077			.061		
F	11.652**			6.309**			5.163**		

Note: *p<0.05 **p<0.01

Appendix C

Table 15 – Market concentration analysis without seasonal factor

Variable	*B*	*SE B*	β
(Constant)	1500.883	861.967	
Measure digitalization	325.174	110.242	.263*
Movie supply	-3.627	3.108	-.102
Total cinemas	.001	.132	.001
Observations	192		
R^2	.052		
Adjusted R^2	.037		
F	3.461**		

Note: *p<0.05 **p<0.01