Copenhagen Business School

# Consequences of TV 2 becoming a pay-TV channel

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July 2012

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Characters (incl. space): 160,814

Graphs (counting 800 characters each): 23

Number of pages: 179,214/2,275 = 78.7

# Executive Summary

This thesis investigates the effects of the change of the main channel TV 2 from free-to-air to pay-TV channel. Specifically, the effects regarding TV 2|DANMARK and its two main commercial broadcasting competitors are investigated.

In recent years, the channel TV 2 has based its earnings solely on advertising revenue making it sensitive to economic changes. This came into sight as the recent financial crisis affected the financial situation of TV 2 very negatively and triggered the decision to change the revenue base.

The pay-TV market can be characterised as a two-sided market. The market is comprised by an overall two-sided market with one two-sided market embedded. A good understanding of the two-sided markets on the pay-TV market, makes it possible to select which factors are determining, when the effects from the change of TV 2 are evaluated. The two different two-sided markets are both characterised by a few dominating players.

Distributors on the pay-TV market records an increase in subscribers related to the change of TV 2. Most of the new subscribers choose TV packages, which include TV channels from the commercial broadcasters, thus the change of TV 2 could have a positive spillover effect on the commercial broadcasters. The geographical location of the subscribers' household can affect the choice of distributor, as some areas in Denmark are only supported by a single subscription platform.

In order to see if the change of TV 2 affects the commercial broadcaster, the relationship between advertising revenue and number of viewers is evaluated. Regression models are developed for each of the three broadcasters in question. It is expected that advertising revenue is primarily explained by number of viewers, and that the two are positively related, which is verified by the regression models developed.

The regression models are used to predict the advertising revenue of the three broadcasters for the first quarter of 2012. This is done such that the actual advertising revenue can be compared with the estimated one in order to see, if the change of TV 2 has had an effect in the short run. The regression models are based on a very small sample, which makes it difficult to draw conclusions with respect to the estimated advertising revenue. Though, it seems as if the commercial broadcasters are positively affected by the change in the short run. Whether or not the change of TV 2 has a permanent effect on the pay-TV market and the commercial broadcasters only time will show.

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# 1 Introduction

In the fall of 2011 it was announced that the popular Danish TV channel TV 2 would no longer be available as free-to-air, but only as a pay-TV channel from 11th January 2012. Specifically, it meant that the airborne TV signal would no longer be transmitted without encryption. The households affected by the change were the ones receiving their TV signal via their own aerial. The estimated number of households who would lose access to the channel TV 2 was approximately 300.000. If the individual households were interested in continuing watching TV 2 after the conversion, they would have to subscribe to a distributor on the pay-TV market in order to receive the signal non-encrypted.

The decision to change the main TV channel TV 2 from a free-to-air to pay-TV channel was decided by the Danish Ministry of Culture based on an additional agreement to the Media Agreement for 2007-2010. In 2009 the additional agreement was signed, which among other things concerned a restructuring of TV 2|DANMARK A/S (Kulturministeriet, 2011): *"As a result of TV 2|DANMARK A/S's major economic troubles the additional agreement gave the company the possibility of receiving payment via subscription fees from the main channel, TV 2, from 1st January 2012",* (Own translation, Kulturministeriet 2011). Until the conversion from free-to-air to pay-TV channel, the main channel of TV 2 had solely made its revenue based on advertising. Thus, being the only free TV channel available since the license[1] to the channel stopped in 2004. Such behaviour is uncommon on the broadcasting market, where the majority of broadcasters base their income on both advertising and subscription fees. Thus, the objective of the decision to make TV 2 a pay-TV channel was to secure a strong public service channel by stabilising TV 2|DANMARK A/S's sensitive economy (TV 2|DANMARK, 2011-a).

Even though, the change of TV 2 from free-to-air to pay-TV channel is made in order to stabilise the economy of the TV channel TV 2 and thereby the broadcaster TV 2|DANMARK A/S, the change will most likely affect the whole broadcasting market in general, specifically the commercial broadcasting competitors. In relation to the change: *"The industry estimates TV 2 to lose between five and ten percent of the viewers when the main channel changes to a pay-TV channel,"* (Own translation, Seidenfaden, R.G., 2011). This statement is confirmed by TV 2 who states that they expect to lose approximately five percent of the viewers (TD, 2012). The information manager, Jesper Jürgensen, at the major commercial broadcaster SBS TV (hereafter referred to as SBS) states that the change: *"(…) will benefit us in two ways. TV 2 will transmit to fewer, while we will transmit to more. The distance between us and TV 2 will decrease. People, who have not previously been able to watch our channel, will choose a package with TV 2 and also get access to our channels. In that*

[1] Everyone above the age of 18 and owner of a device, which can receive radio programmes, TV programmes and the like must pay license to DR (DR, 2012).

*way we get more viewers."* (Own translation, Seidenfaden, R.G., 2011). Thus, the loss of penetration of TV 2 could change the way advertisers distribute their expenditure and the share of viewers may also shift around.

## 1.1 Problem Statement

In relation to the expected changes regarding the pay-TV market caused by the change of TV 2 from free-to-air to pay-TV channel it would be interesting to investigate, how TV 2 is affected, and whether the change does affect the commercial broadcasters on the pay-TV market. Various factors regarding the pay-TV market makes it interesting and not straight forward to determine, how the commercial broadcasters are affected by the change of TV 2.

### 1.1.1 Research Question

The research question, which will be the common thread throughout the thesis, is created with the prior discussion as a starting point and summed up in the following:

**How does the situation of TV 2|DANMARK and its commercial competitors on the subscription platforms change due to the main channel TV 2's change of status from a free-to-air to a subscription channel?**

In order to answer the research question thoroughly a few sub-question will be answered throughout the thesis. The two first sub-questions try to give a good understanding of the pay-TV market in general. The third question tries to capture, whether or not the change of TV 2 changes the basic conditions on the market with the use of the broadcasters advertising revenue as a benchmark. Thus, the first part of the thesis will be descriptive, whereas the second part will be analytical. The sub-questions are:

1. **What are the main characteristics of the Danish pay-TV market?**
2. **Which factors are decisive in determining the number of viewers of a broadcaster?**
3. **Does the change of TV 2 have a permanent effect on the advertising revenue of the broadcasters?**

The three sub-questions will be answered with the main research question in mind, in order to sustain the common thread.

## 1.2 Demarcations

As stated in the research question the main focus of the thesis will be on TV 2|DANMARK and the commercial competitors, which refer to the TV broadcasting competitors. Thus, other media competitors of TV 2|DANMARK will not be included. The public-service broadcaster DR is not included as a competitor even though they stand for a large share of the viewers on the market. The decision to leave out DR from the thesis is taking with respect to the objective of the channel, namely whether they act as a rational profit-maximizing agent. As DR is a public-service channel, their main objective is to provide diversified programs and not act as a profit-maximizing broadcaster.

In order to narrow down the scope of the thesis, only some of the commercial broadcasting competitors are being evaluated. As the purpose of the thesis is partly to investigate to which extent the commercial broadcasting competitors are affected by the change of TV 2, the competitors who will encounter the biggest affect are chosen. It is assumed that the two main competitors will be affected the most by the change of TV 2, and thus are chosen to represent the competitors throughout the thesis.

The two main competitors both operate internationally and with other broadcasting activities than TV, thus it should be mentioned that only their TV broadcasting activities in Denmark will be considered.

Furthermore, the time period after the change of the main channel TV 2 (from here the main channel will be referred to as TV 2) considered in the thesis will be delimited to the first quarter of 2012.

## 1.3 Structure of Thesis

The thesis is divided into three main parts. The first part of the thesis introduces the research question and the reasoning behind the change of TV 2. The second part describes the underlying basis of the pay-TV market and states the different aspects of the market, which influence the immediate changes in relation to the change of TV 2. The third part is comprised by an econometric analysis, which is used to predict the advertising revenue of the three broadcasters.

# 2 Background Information

## 2.1 TV 2 and the Reasoning Behind the Change

The channel TV 2 was aired for the first time in 1988 with the main purpose of being a competitor to the monopolistic public service channel Danmark's Radio (hereafter DR) in order to give the viewers the freedom to choose between two public service channels. The decision to establish TV 2 was decided by the national parliament of Denmark. In relation to the founding of TV 2, the channel TV 2 was obliged to perform as a public service channel, and it therefore received license from the government.

In 2002 the elected VK-government and Dansk Folkeparti entered into a media settlement regarding TV 2 being privatised. An amendment in the Danish Radio- and Television Act changed TV 2 into a private limited company by the name TV 2|DANMARK owned 100% by the state with the purpose of selling it off (Kulturstyrelsen, 2011). In relation to the desired privatising TV 2's *obligation* to exert public service was changed to a *permission* to exert public service. Additionally, the privatising meant that the license to TV 2 was withdrawn, though it is a widespread misunderstanding that TV 2 still receives license. This means that since 2004 the channel TV 2's earnings have solely been based on advertising revenue.

In 2004 TV 2|DANMARK is up for sale as the government is interested in selling off between 51% to 61% of the shares in the company, thus continuing as a minority shareholder (TV 2|DANMARK, 2009). The government has not succeeded in selling of shares as TV 2|DANMARK until this day is still 100% owned by the state.

Throughout the history of TV 2 several channels has been added to the portfolio. In 2000 the second TV 2 channel is launched, namely the channel TV 2 Zulu. In the beginning of 2003 TV 2 Zulu changed from a must-carry channel to being commercial, thus financed by advertising and subscription fees. In 2004 and 2005 follows the third and fourth channel of TV 2, namely TV 2 Charlie and TV 2 FILM. In 2006 and 2007 two more channels were added to the portfolio, namely TV 2 NEWS and TV 2 SPORT, of which the latter of the two are based on a joint venture owned by TV 2|DANMARK and the commercial broadcaster Modern Times Group (hereafter MTG) (TV 2|DANMARK, 2009). As a result, TV 2|DANMARK's portfolio of TV channels consist of the main TV 2 channel and six niche channels.

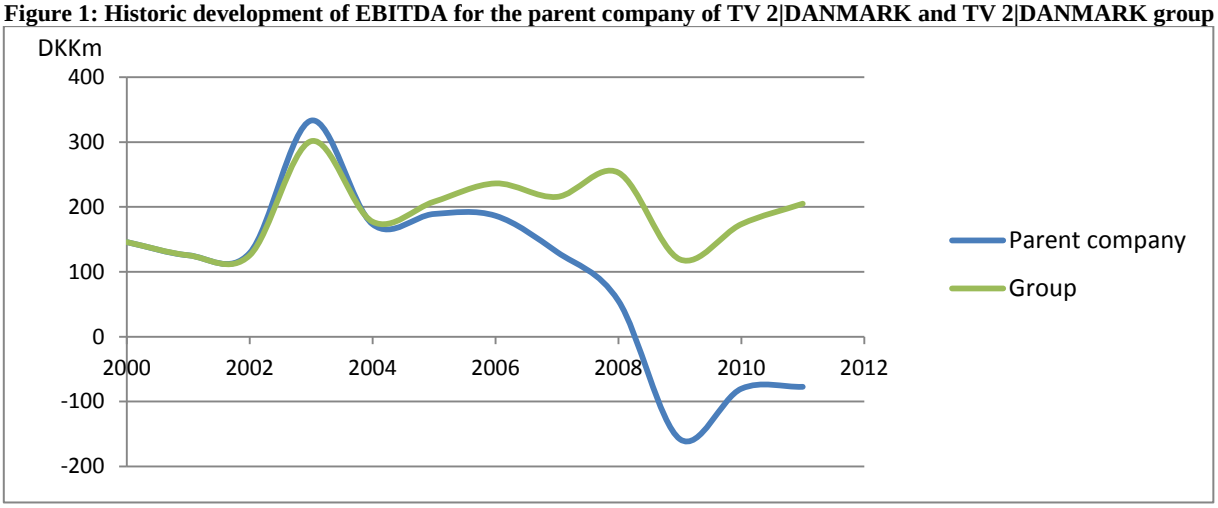
The niche channels are doing well with respect to earnings, whereas the main channel is suffering from large deficits. The straightforward logic behind the well-being of the niche channels and not the main channel is their different types of revenue base. The niche channels have a revenue base, which consist of both advertising revenue and subscription fees, whereas the main channel's revenue base only consists of advertising rev-

enue. Consequently, the public service channel TV 2 has been suffering from large deficits affecting the overall financials of TV 2|DANMARK.

Figure 1 shows the development of TV 2|DANMARK's EBITDA[2] from 2000 to 2011. The EBITDA is divided into two, where one represents TV 2|DANMARK as a group and the other represents the parent company of TV 2|DANMARK. The parent company of TV 2|DANMARK represents the public service business of the group. The parent company is not fully comprised by public service business, but the share of other business is reasonable small in order to use the development of the parent company's EBITDA as a benchmark for the performance of the public service business. The channel TV 2 is the cornerstone of the public service business, and therefore the performance of TV 2 is readable when looking at the parent company's EBITDA, which is represented by the blue line in the figure below.

Looking at Figure 1, the two EBITDA's follow each other in the beginning of the period, because all business conducted by the company in that period was related to public service. In 2003 the niche channel TV 2 Zulu is being commercialised, which makes the division of public service business and other business visible in the figure from there and onwards.

**Figure 1: Historic development of EBITDA for the parent company of TV 2|DANMARK and TV 2|DANMARK group**



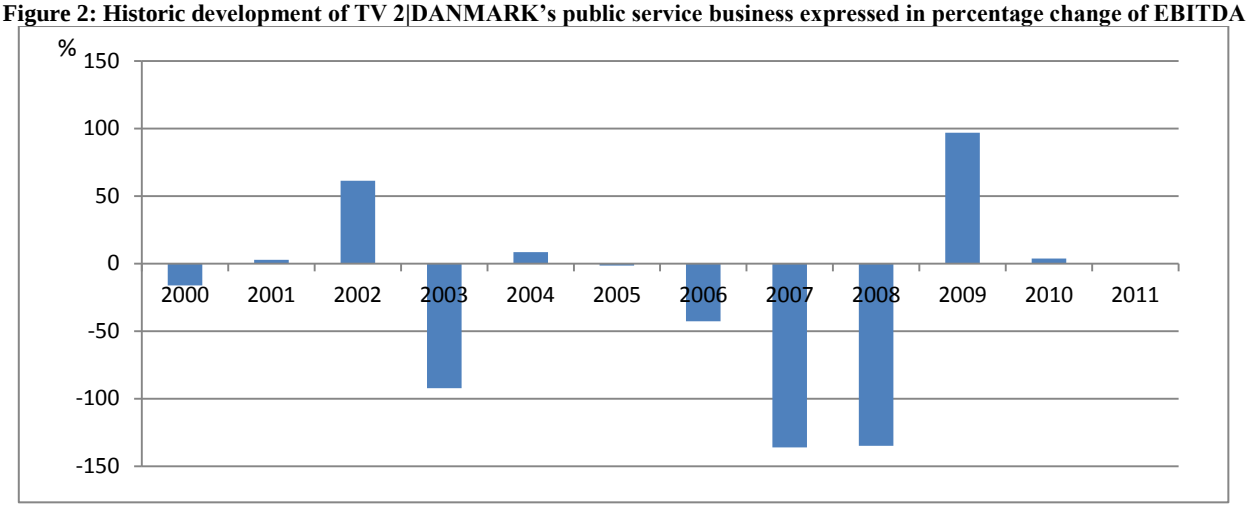

Source: Own creation based on data from (TV 2|DANMARK, 2003-2011) and public service report from 2002.

Furthermore, when looking at Figure 1 it can be seen that the EBITDA of the parent company is declining from 2006 until 2009. The slope of the decline is steepest in the period from 2008 to 2009 indicating the public service business' sensitivity to the recent financial crisis and as stated in TV 2|DANMARK's annual report from 2010: *"The revenue base for TV 2s main channel is too frail and cyclical, which is not sustainable in the long run"*, (TV 2|DANMARK, 2010, p. 4). The parent company's major dip in 2009 is so extensive that it affects the overall EBITDA for the TV 2|DANMARK group negatively.

[2] EBITDA is short for Earnings Before Interest, Taxes, Depreciation and Amortisation, and is an expression of a company's ability to create surplus.

The percentage change of the public service business' EBITDA is illustrated in Figure 2 below in order to show the significance of the recent financial crisis. The percentage change of EBITDA from 2007 to 2008 is equal to a disturbing -136.17% and from 2008 to 2009 equal to -135.02%.

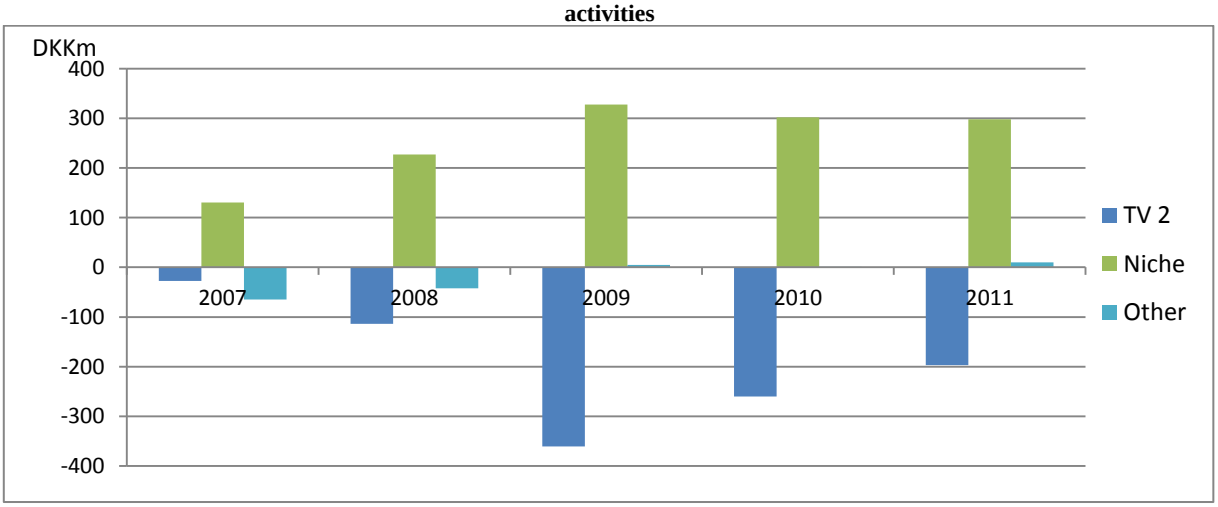
**Figure 2: Historic development of TV 2|DANMARK's public service business expressed in percentage change of EBITDA**




Source: Own creation based on data from (TV 2|DANMARK, 2003-2011) and public service report from 2002.

In TV 2|DANMARK's annual reports from 2007 and onwards the result before tax is divided between TV 2, the niche channels, and other activities. The three parts, which make up the overall result before tax, are illustrated in Figure 3 below. Figure 3 shows that TV 2 brings down the result before tax, and as already implied by the EBITDA in Figure 1 the negative impact is biggest in 2007 and 2008. On the other hand, the niche channels affect the result before tax positively and contrary to the main channel their result before tax does not seem to be sensitive to economic changes. Thus, when looking at the performance of the niche channels it makes sense to change TV 2's revenue base to one similar one.

**Figure 3: Historic development of TV 2|DANMARK's result before tax divided between TV 2, the niche channels, and other activities**




Source: Own creation based on data from (TV 2|DANMARK, 2003-2011).

In the light of TV 2's financial challenges, the government decided to take action in order to make TV 2|DANMARK a sustainable company. In order to stabilise the finances of TV 2|DANMARK the Media Agreement for 2007-2010 stated that TV 2|DANMARK could initiate subscription payments on their main channel from the 1st January 2012, and as stated by the former Minister of Culture, Per Stig Møller: *"The possibility to charge subscription fees is the only passable road to solve TV 2's financial challenges in the long run."* (Own translation, Kulturministeriet, 2011).

In the beginning of 2008 the management of TV 2|DANMARK had already taken measures in order to mitigate the financial problems, but the measures were insufficient in order to create enough cash-flow. Consequently, the Ministry of Culture granted TV 2|DANMARK a credit facility in order to keep the company running. The state-aid granted by the Ministry of Culture was cleared by the European Commission being characterised as a rescue and restructuring aid, which can be given to crisis-stricken companies (European Commission, 2008). As illustrated in both Figure 1 and Figure 2, the EBITDA in 2009 increased compared to 2008, as the number turned from negative to 96.88%. The quick pick-up is most likely caused by the state-aid granted by the government, thus not a true picture of TV 2|DANMARK's well-being. This is confirmed when looking at Figure 3, which shows that the result before tax for TV 2 is only slowly reducing the negative result.

In relation to the clearance from the European Commission the Danish authority made a restructuring plan running from 2009 to 2012 with the purpose of re-establishing the viability of TV 2|DANMARK. In relation to this, the Media Agreement for 2007-2010 stated that TV 2|DANMARK could initiate subscription fees on their main channel from 2012 as mentioned previously.

First, a model characterised by a "TV 2-only-card" was proposed and introduced as a bill. The model differentiated between households with free-to-air channels only and households with a subscription to pay-TV. The model suggested that households with a subscription to pay-TV should pay in order to have access to TV 2, whereas households with only free-to-air channels should not pay in order to watch TV 2, but receive a "TV 2-only-card" in order to be able to receive the channel free of charge. Because of many negative hearing statements the bill was thrown out. Instead, another model was suggested and approved. The model suggested that everyone interested in accessibility to TV 2 had to pay. *"The advantage of a model, where everyone is paying for TV 2 in relation to the "TV 2-only-card" model, is especially that it is not bureaucratic and place every household equally."* (Own translation, Kulturministeriet, 2011). Additionally, the distributors are equally placed in distributing TV 2, and they would not have to use resources in order to control the use of the "TV 2-only-cards". Furthermore, the model could be run at a lower price because of the lower costs in relation to administration, which results in a lower price offered to the distributors (Kulturministeriet, 2011). The price of TV 2 is set to 10 DKK per subscription per month in 2012 and 12 DKK in 2013 and 2014 (Hansen, M., 2011).

In order to make use of the model described it required clearance by the European Commission, because the model is a part of the ongoing restructuring plan for TV 2|DANMARK (Kulturministeriet, 2011). As of 20th April 2011 the changed model was approved by the European Commission, but in relation to the approval the European Commission stated that: *"In order to remedy anti-competitive behaviour the government suggested that TV 2 does not launch new channels. This must be valid until the period of the restructuring expires on 31st December 2012 or at least until the subscription payment has been implemented. Denmark is also obliged to secure that TV 2's capital structure is benchmarked to the capital structure in other comparable media companies, when the new business model is implemented",* (Own translation, Europa-Kommissionen, 2011). When the new business model is implemented and TV 2 has transformed its revenue base from solely based on advertising to also include subscription fees, like the rest of the channels in TV 2|DANMARK's portfolio, the capital structure of TV 2|DANMARK group can be compared somewhat to the commercial broadcasting competitors on the pay-TV market. Furthermore, the European Commission stated at the time of the settlement that since the restructuring was beginning to pay-off, the existing subsidy measures were revoked and any other subsidies granted would not be implemented (Europa-Kommissionen, 2011).

With the approval from the European Commission, TV 2|DANMARK launched a campaign in the fall of 2011 in order to inform the viewers of the change. Furthermore, TV 2|DANMARK negotiated with distributors during the fall of 2011 in order to get TV 2 placed in the distributors TV packages. With the reputation of being one of the most popular TV channels in Denmark it has most likely not been an issue for the distributors to enter into agreement with TV 2|DANMARK, as an exclusion of TV 2 could affect them negatively. As a matter of fact, all distributors on the pay-TV market has entered into agreement with TV 2|DANMARK regarding the channel TV 2 (TV 2|DANMARK, 2012-a). With the popularity of TV 2, all the distributors have chosen to put the channel in their basic TV packages.

The first distributor to enter into agreement with TV 2|DANMARK was BOXER TV A/S (from here referred to as Boxer), who informed the Ministry of Culture that they would offer TV 2 as an a la carte channel[3]. Thus, giving the viewers not interested in the rest of the pay-TV channels on the market the ability to subscribe to TV 2 only. The distributor TDC TV has later followed in the footsteps of BOXER TV A/S and also offers TV 2 as an a la carte channel.

The model became effective as of 11th January 2012, and everyone not already a subscriber at a distributor on the pay-TV market had to sign up to have continued access to TV 2.

[3] Choosing TV 2 a la carte includes access to the free-to-air channels, such as DR.

As TV 2 changes to a pay-TV channel, the privilege of being a must-carry channel is withdrawn, and consequently the penetration is expected to decrease. Furthermore, the change may shuffle the viewers on the pay-TV market, leading the commercial broadcasting competitors to gain viewers.

# 3 Methodology

Throughout the process of conducting the thesis, a number of methodical considerations are being made. The methodology that forms the foundation of the thesis will be described in the following. Firstly, the research strategy used in the thesis will be assessed followed by the research methods. The research strategy will describe the general approach used, whereas the research method will describe the methods used in order to collect and analyse data. The methodology section will round off by a review of the data used.

## 3.1 Research Strategy

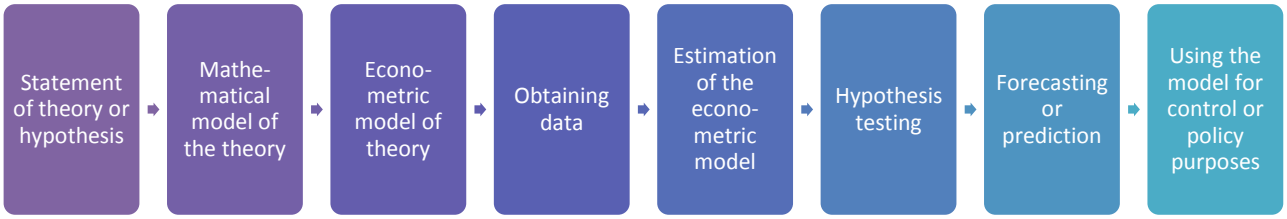
In the area of research strategies, the literature distinguishes between qualitative or quantitative approaches. The qualitative research strategy is often characterised as being inductive. An inductive approach takes the empirical settings in question as the starting point for the research in order to infer general correlations or patterns (Saunders et al., 2009). The inductive approach is often used in areas where existing theory is scarce. In relation to this, the inductive approach is said to be exploratory as it draws conclusion based on the empirical data collected. On the other hand the quantitative research strategy is generally characterised as being deductive. A deductive approach takes the current theory within the area of interest as the starting point in order to test it using specific observations. Thus, the deductive approach tests hypotheses stated by the already existing theory (Saunders et al., 2009). The hypotheses are generally tested with empirical data making the approach quantitative.

Often either the qualitative or the quantitative research strategy is applied, but one could also mix the two research strategies. The research method applied during the thesis will primarily be deductive, because the thesis is characterised by an empirical focus with emphasis on the quantitative data collected. Though, the inductive approach does also appear throughout the thesis, as the econometric analysis is used to develop regression models describing the relationship between advertising revenue and number of viewers for the three broadcasters TV 2|DANMARK, MTG and SBS.

The analytical part of the thesis belongs primarily to the discipline of econometrics. *"Econometrics is based upon the development of statistical methods for estimating economic relationships, testing economic theories, and evaluating and implementing government and business policy,"* (Wooldridge, 2009, p. 1). This statement fits in with the purpose of the thesis, as the main objective is to evaluate the government's decision to change TV 2 from free-to-air to pay-TV channel. The econometric analysis is quantitative in its approach, which is in line with the previous statement regarding the thesis' research strategy. Within the overall re-

search strategy a specific methodology comprising the basis of the econometric analysis will be used. The traditional econometric methodology proceeds along the steps illustrated in Figure 4.

**Figure 4: Anatomy of econometric modelling**




Source: Own depiction of the steps described by Gujarati and Porter in Basic Econometrics page 3 and page 9 (Gujarati & Porter, 2009).

## 3.2 Data

The data used to answer the research question is based on both qualitative and quantitative data, where the latter of the two comprises the majority.

In order to thoroughly answer the research question a good understanding of the TV broadcasting market is necessary, and therefore the thesis does encompass different aspects of the market. To do this, qualitative data are used. Especially, the Danish Competition and Consumer Authority's report concerning distribution of TV channels in Denmark published in November 2011 has been used in relation to this.

The two primary sources used to collect quantitative data are the Danish rating agency TNS Gallup's TV-Meter combined with annual and quarterly reports from the three broadcasters', TV 2|DANMARK, MTG SBS[4]).

Every week TNS Gallup publishes a press release with information on the TV viewing from the previous week based on data from their so-called TV-Meter. The TV-Meter equipment measures the TV viewing in 1000 chosen households or what corresponds to 2200 persons, thus a sample of households reflecting the behaviour of the population (TNS Gallup, 2012). The data collected from the weekly press releases define how much time an average viewer spends watching TV. TNS Gallup measures the TV viewing on behalf of seven broadcasters, namely DR, TV 2|DANMARK, MTG, SBS, Discovery, Turner Broadcasting and Viacom International Media Networks (TNS Gallup TV-Meter). In relation to this, the time spent on watching TV is divided between the seven broadcasters' channels and the remaining grouped together. The time spent on watching TV is measured in hours and minutes.

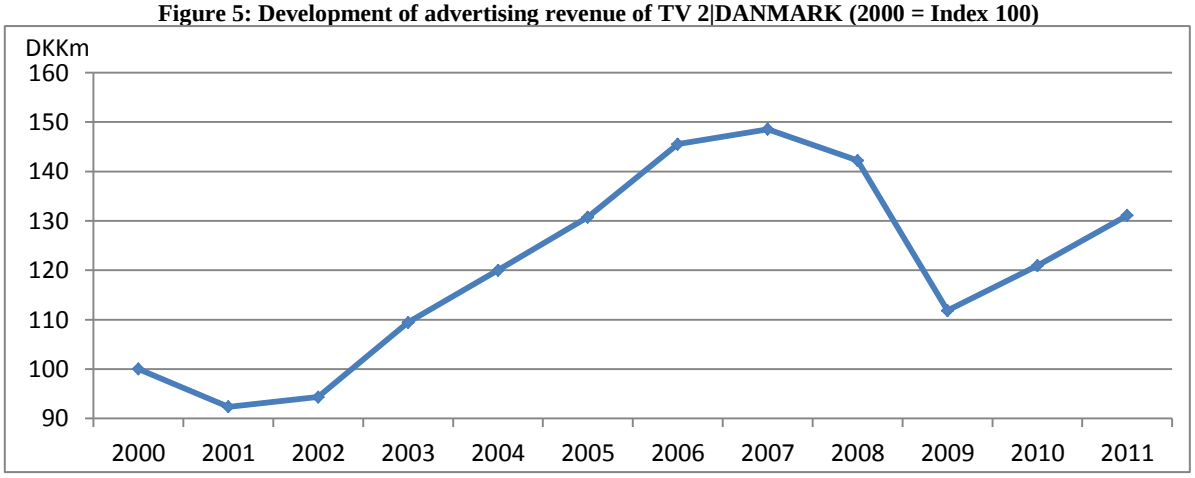
[4] SBS is owned by the European broadcaster ProSiebenSat.1.

The dataset used in the econometric analysis[5] in section 6 runs from 2009 until 2011 with quarterly intervals. In order to get matching observations in the dataset, the weekly data regarding viewers are summed up in quarterly intervals, as this is the frequency of which the broadcasters publish their reports.

Such a short time period does not leave many data points to use for a regression model even considering quarterly intervals. The intention in the beginning of this thesis was to use data as far back as possible, namely from 2000. The financial crisis occurring in the years around 2007 and 2008 has had a major impact on the time series of advertising revenue for TV 2|DANMARK and a less significant impact of the two commercial broadcasters' advertising revenue. The impact of the financial crisis of TV 2|DANMARK's advertising revenue is distinguished as a downturn in the year 2008 (see Figure 5 below), which disturbs the otherwise upward trend in the time series. After the downturn in 2008 the time series continues its upward trend making it considerable to omit the 2008 data point from the regression. As the 2008 data point makes the time series shift to a new lower level, omitting the 2008 data point does no good with respect to the regression. Furthermore, if the time period should run from 2000 to 2011 the interval between the observations would have been yearly instead of quarterly, as TV 2|DANMARK has not been obliged to report on their accounts quarterly before 2009. Considering both the yearly intervals and the omission of 2008 would decrease the small sample with a significant amount.

Instead, the new lower level with quarterly intervals running from 2009 to 2011 has been chosen as the starting point for the regression model. Preferably, the regression model should be conducted at a future period in time making it possible to construct a model without the low level data points, thus omitting the 2008 data point and the following years, until the normal level was regained. But as the purpose of the thesis is to shed light on the effects of TV 2 changing from free-to-air to pay-TV channel the before mentioned views would not be possible anyhow.

**Figure 5: Development of advertising revenue of TV 2|DANMARK (2000 = Index 100)**




Source: Own creation based on data from (TV 2|DANMARK, 2003-2011) and public service report from 2002.

[5] SAS Enterprise Guide 4.3 is used to perform the econometric analysis.

## 3.3 Data Review

The conclusion drawn in the thesis is based upon a general knowledge regarding the TV broadcasting market and the findings from the econometric analysis. Furthermore, the findings from the econometric analysis are based on regression models developed on the basis of historical data collected for the purpose. In the light of this, the overall validity and reliability of the thesis should be taken into consideration in order to estimate the credibility of the thesis' findings. In the following two sections the validity and reliability of the thesis will each be evaluated separately.

### 3.3.1 Validity

It is important to verify the validity when performing analyses, as it reveals whether or not the findings can be considered valid and relevant. The valid term implies whether the relationship between theory and empirical data are in agreement, whereas the relevance implies how well the empirical variables answers the research question (Andersen, 2004). The validity of the thesis cannot be measured but must be estimated.

In developing an empirical model it is possible to commit specification errors. There are different types of specification errors, namely omission of a relevant variable, inclusion of an unnecessary variable, wrong functional form, errors of measurement, incorrect specification of the stochastic error term and assumption regarding normality in the error terms (Gujarati & Porter, 2009). The regression models developed in the econometric analysis is a gross simplification of the real world. The dependent variable, advertising revenue, is most likely explained by a number of variables. Only one variable is used as explanatory variable, and if a relevant variable has been neglected and thereby omitted from the model, it could affect the validity. Though, the variable assumed to be of highest importance has been chosen as the single explanatory variable, namely number of viewers, in order to avoid including unnecessary variables. In the light of this, it is expected that the regression models will give a rough estimation of the advertising revenue for the three broadcasters and approach the true model with a fair amount. The simplification of the real world affects the validity of the findings from the regression models, and this will be kept in view throughout the thesis.

The assumption regarding normality in the error terms is taken into account when testing the models for the overall classical linear regression model assumptions, where the latter should help to uphold the validity. The rest of the specification errors mentioned above will be taken into consideration throughout the econometric analysis.

Furthermore, the sample used when performing the econometric analysis can affect the validity of the thesis, which is why, each sample will require some attention.

The sample selected in order to develop the regression models for each of the three broadcasters in question is rather small. The time period included in the sample runs from 2009 to 2011 with quarterly intervals. Thus, it is questionable, whether the regression models developed reflects the true relationship between the dependent and explanatory variable. Though, going further back would mean that the period of the financial crisis would have been included in the data forming the regression models. The financial crisis is assumed to be an unusual event and could therefore encounter a misspecified model, which would distort the outcome of the regression models. In relation to this, the validity is upheld by excluding the time period of the financial crisis even though it leaves a scarce sample.

Consequently, the regression models developed should be used with caution, if they are to predict values in the long run, as the basis is made upon such a short period of time. As the regression models are made with the purpose of only estimating values in the short run, the validity is expected to be uphold.

The explanatory variable is described as being influenced by seasonality in section 5.5. With the scarce sample it has not been possible to reflect the seasonality in the regression models developed. The exclusion of the seasonality could affect the validity, but as it is taken into account when interpreting the results, the validity is not affected. Considering both the exclusion of the seasonality in the explanatory variable and the small sample, the estimation precision of the regression models are affected negatively, which affects the validity.

### 3.3.2 Reliability

The reliability refers to whether the data collected are reliable (Andersen, 2004). Specifically, the reliability indicates, whether the data collection methods used are certain and precise in order to yield consistent findings and thus not being influenced by coincidences. Reliability is a prerequisite for achieving validity.

The quantitative data collected in order to develop the regression models in the econometric analysis are collected from TNS Gallup's TV-Meter and the three broadcasters' annual and quarterly reports (see section 3.2). Both TNS Gallup and the broadcasters' annual and quarterly reports are reliable sources, of which the first mentioned is a recognised source used by the TV broadcasting industry in general.

The data from the TV-Meter are collected automatically using a programme specifically developed in order to perform the task. This should mitigate the problems from data errors when collecting the data manually. The data from the annual and quarterly reports have been collected manually, which could cause typing errors. During the process of collection data manually this has been kept in mind in order to avoid typing errors. Thus, the overall data error is expected to be small, and thereby not affecting the reliability of the thesis.

In general, when collection both qualitative and quantitative data a critical approach has been applied. Hence, only sources considered reliable have been used.

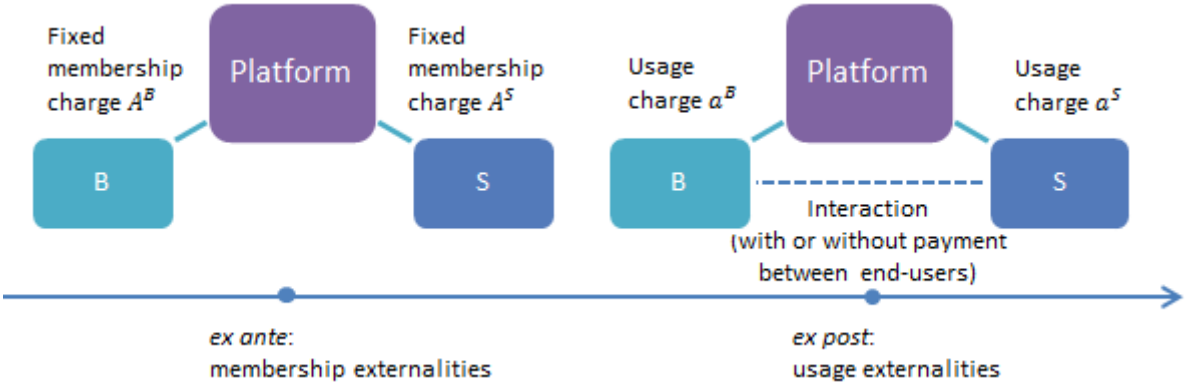
Being aware of the threats to reliability and validity, both are taken into account throughout the thesis in order to seek to control it.

# 4 Two-sided Markets

In the following section the theory regarding two-sided markets will be described. Furthermore, the theory will be applied to the Danish pay-TV market in order to justify, whether it can be characterised as two-sided.

"*Two-sided (or, more generally, multi-sided) markets are roughly defined as markets in which one or several platforms enable interactions between end-users and try to get the two (or multiple) sides "on board" by appropriately charging each side. That is, platforms court each side while attempting to make, or at least not lose, money overall.*" (Rochet & Tirole, 2006, p. 645). An illustration of a two-sided market *ex ante* and *ex post* is depicted in the figure below. The figure shows the different aspects of a two-sided market, which will be covered in the following.

**Figure 6: Illustration of a two-sided market according to Rochet & Tirole**




Source: Own depiction of figure 1 in the article *Two-sided markets: a progress report* by Rochet and Tirole (Rochet & Tirole, 2006).

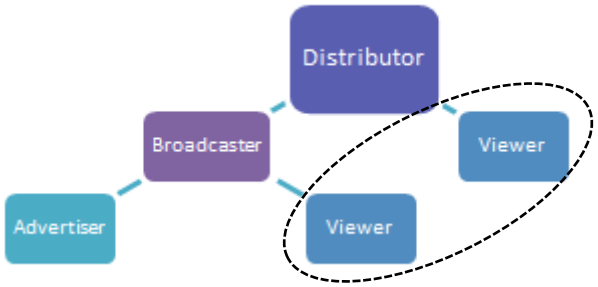
On the pay-TV market the platform is comprised by the distributors on the market. The distributors connect the viewers on the one side with the broadcasters on the other. A prerequisite for the distributor to act as a platform between the two sides is access to an infrastructure, which physically connects the two sides of the market. The infrastructure being managed by the distributor is used to transmit the TV signal from the broadcaster to the viewer. The different types and characteristics of subscription platforms will be explored in section 5.1.

The distributors on the pay-TV market constitute a bottleneck between the end-users, as they are not able to interact without both being connected to the distributor. Thus, both broadcasters and viewers need to get "on board"[6] as described by Rochet and Tirole.

[6] The phrase is commonly used in relation to two-sided markets, but be aware of its simplicity.

Embedded in the two-sided market described above, another two-sided market is apparent on the pay-TV market. The platform in the nested two-sided market is comprised by the broadcasters on the market. The two sides needed to get "on board" are the advertisers and the viewers. The overall two-sided market and the nested two-sided market are illustrated in Figure 7 below. The viewers on both markets are circled with a dotted line in order to show that they compromise one single unit, thus there are not two groups of viewers on the Danish pay-TV market.

**Figure 7: Illustration of the overall and nested two-sided market on the Danish pay-TV market**




Source: Own creation with the article *Two-sided markets: a progress report* by Rochet and Tirole as basis (Rochet & Tirole, 2006).

In the following the overall two-sided market will be referred to as (A), whereas the nested two-sided market will be referred to as (B). The labelling is done in order to avoid mixing the two.

The distributor platform on market (A) needs to attract viewers in order to persuade the broadcasters to buy or produce programmes, and they need programmes in order to attract viewers to subscribe. The nested broadcaster platform on market (B) has a different point of departure. The broadcaster platform does not only connect the two sides of the market, but does also contribute to attract the one hand side, namely the viewers. On the one side, the broadcaster needs to attract viewers in order to convince the advertisers to use their platform as a tool to reach their market segment. Persuading the advertisers to join the platform will make it possible for the broadcaster to buy and develop programmes, as the broadcaster cash in on the advertisers, thus making it possible to attract the viewers.

In general, if the platform is not able to persuade both sides of the market, and the two sides are capable of trading directly, the platform is unnecessary and the market cannot be characterised as two-sided.

The basic presence of the platforms on market (A) and (B) has now been described. According to Rochet and Tirole a two-sided market does not only encounter the two sides getting "on board", as this would mean that almost any market could be characterised as two-sided. Thus, a two-sided market is more specifically defined as: "*(...) one in which the volume of transactions between end-users depends on the structure and not only on the overall level of fees charged by the platform. A platform's usage or variable charges impact the*

*two sides' willingness to trade once on the platform and, thereby, their net surpluses from potential interactions; the platforms' membership or fixed charges in turn condition the end-users' presence on the platform.*" (Rochet & Tirole, 2006, p. 646). Furthermore, Rochet and Tirole states that the: *"the failure of the Coase theorem is necessary but not sufficient for two-sidedness."* (Rochet & Tirole, 2006, p. 645). The Coase theorem states that gains from trade between the two end-users does only depend on the price level[7] and not the price structure[8], and thus markets are considered one-sided. This does not hold in this case, as the price structure does matter.

In the following section the transaction between the end-users on both markets (A) and (B) will be described followed by a section, which will look into the structure of the fees charged by the platforms.

The transaction between broadcaster and viewer on market (A) occurs, when the viewer watches the TV channels transmitted by the broadcaster. Both parties on the two-sided market gain from the trade. The viewer achieves pleasure when watching a preferred TV programme, and the broadcaster achieve ratings when the viewer watches their TV channels.

On market (B) the transaction between advertiser and viewer happens when the viewer watches the TV advert made by the advertiser. Whether the two parties both gain from the trade is not as straightforward as on the overall (A) market. The advertiser will gain from the trade, whereas the viewer will most likely perceive the trade, the TV advert, as a nuisance.

Considering the structure of the fees charged by the platforms, Rochet and Tirole distinguish between membership charges and usage charges, and between membership externalities and usage externalities (Rochet & Tirole, 2006), which are depicted in Figure 6. Firstly, the usage charges and usage externalities will be described and applied followed by a description of the membership charges and externalities.

### 4.1.1 Usage Charges and Externalities

Rochet and Tirole states that: "*Gains from trade between end-users almost always arise from usage,*" (Rochet & Tirole, 2006, p. 647). In relation to this the amount of usage is dependent on how much the platform charges for usage. The total usage charge is divided between the two end-users on the market, referred to as the buyer and seller by Rochet and Tirole, and it is expressed as the following:

$$a = a^B + a^S$$

[7] The price level is the total price charge by the platform (Rochet & Tirole, 2006).
[8] The price structure refers to the allocation of the total price between the end-users (Rochet & Tirole, 2006).

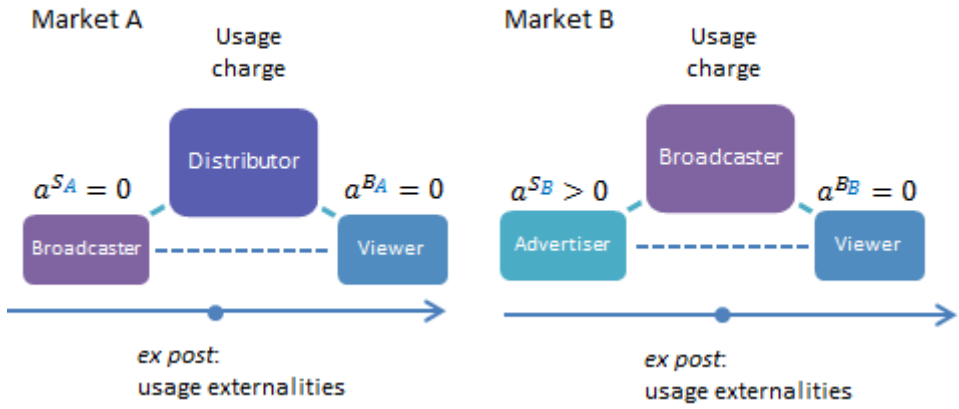
Where $a$ represents the aggregate price level between the buyer and the seller. $a^B$ and $a^S$ represent the per access charge to the buyer and the seller, respectively.

The broadcasters' usage charge will be represented by $a^{S_A}$ and the viewer's usage charge will be represented by $a^{B_A}$, where the subscript A refers to the two-sided market (A). Likewise, the usage charge of the advertisers will be represented by $a^{S_B}$ and the usage charge of the viewers will be represented by $a^{B_B}$, where the subscript B here refers to the two-sided market (B).

On the overall two-sided market (A) the distributor does not charge any of the end-users for usage, thus both $a^{S_A} = 0$ and $a^{B_A} = 0$. Instead, the distributor makes money on the membership charges, which will be described later.

The broadcaster acting as a platform on market (B) does charge for usage. The advertisers are charged for usage in the sense that the price of a time slot increases when the number of viewers usage increase, thus $a^{S_B} > 0$. The rating used in this relation is called TRP, which is explained in section 5.4. The viewers, on the other hand, are not being charged by usage which entails that $a^{B_B} = 0$.

**Figure 8: Illustration of usage charges on market (A) and (B)**




Own creation with the article *Two-sided markets: a progress report* by Rochet and Tirole as basis (Rochet & Tirole, 2006).

The reason why viewers are not charged for usage on either market (A) or market (B) is the difficulties with measuring the usage. As described in section 3.2 TNS Gallup measures the time viewers spend on individual TV channels with their TV-Meter. Though, the data from the TV-Meter only apply to a sample of the whole population making it impossible for the platforms to charge the viewers for individual usage.

Being unable to charge the end-users on both sides of the platform, caused by difficulties to monitor the interaction, the platforms can instead charge a membership fee. A further look into the membership charges will be done in the following paragraph. Firstly, the usage externalities will be described.

"*Usage externalities arise from usage decisions.*" (Rochet & Tirole, 2006, p. 647). If the end-users on the two-sided market benefit from using the service enabled by the platform, they will exert a positive usage externality. Contrary, if using the service is a drawback to the end-users, they will exert a negative usage externality. Though, the end-users will most likely not join the platform, if it is a drawback to use the service.

If the viewers, who subscribe to a distributor on market (A), benefits from watching TV then the broadcaster exerts a positive usage externality on the viewer. It is assumed that this holds, as it would not make sense for the viewer to join the platform otherwise. Likewise, if the broadcaster benefits from the viewers watching TV, then the viewers would exert a positive usage externality on the broadcaster. In this case, it is also assumed that the statement holds, as the viewer's usage would increase the broadcasters' viewer ratings, which would enable them to increase their advertising revenue.

The nested market (B) does encounter both positive and negative usage externalities. It is assumed that the viewers do not benefit from watching TV adverts, thus the advertisers exert a negative usage externality on the viewers. Contrary, it is assumed that the advertisers benefit from the viewers watching the TV adverts, thus the viewers exert a positive usage externality on the advertisers.

Summing up, the distributor on the overall two-sided market (A) does not charge either viewer or broadcaster a usage charge. On the nested two-sided market (B) the broadcaster, who act as a platform, charges the advertiser per usage, whereas the viewers are not being charged. On both markets it is not possible for the platform to usage charge the viewers as the interaction cannot be perfectly monitored.

### 4.1.2 Membership Charges and Externalities

The membership fees are independent from the interaction and are charged in advance by the platform. The membership fees are fixed and represented by $A^S$ and $A^B$, where the former refers to the seller and the latter refers to the buyer (Rochet & Tirole, 2006). Using the same notation as previously, a subscript A and B will be added to the fixed fee symbols and refers to the market in question.

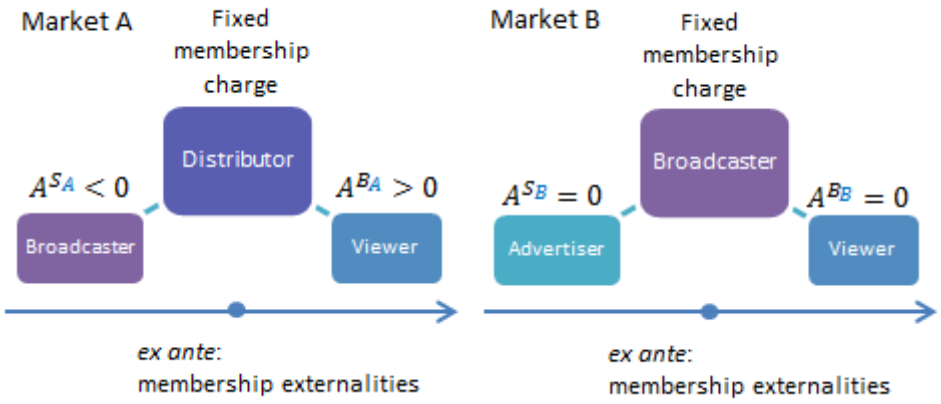
As the distributor on market (A) is not able to charge the end-users per usage, a fixed membership fee is charged in advance instead. In this situation the distributor charges the viewers a subscription fee in exchange for joining the platform. The size of the subscription fee varies, as the distributor offers different types of membership. The different types of membership are related to the different bundles of TV packages

offered by the distributor. The viewer's willingness to pay will thereby be reflected by the choice of TV package, and ultimately the presence on the platform. All in all the membership charge for the viewers is $A^{B_A} > 0$.

The other side of market (A) namely the broadcasters are not charged a membership fee according to the analysis *"Distribution af tv-kanaler"* published by the Danish Competition and Consumer Authority (Konkurrence- og Forbrugerstyrelsen, 2011). Instead the distributor pays the broadcasters to get hold of their TV channels, and thereby the membership charge is $A^{S_A} < 0$.

The circumstances with respect to membership fees on market (B) are not as straightforward as the ones on market (A) just described. The reason for this is that market (B) is embedded in market (A). In relation to this the viewers need only to subscribe once to appear on both markets. Practically, the viewers only subscribe to the distributors, who act as a platform on the overall market (A). Thus, the membership charge for the viewers on the nested market (B) is $A^{B_B} = 0$. The membership charge for the advertisers apparent on market (B) is much simpler. The reason for this is that the advertisers' interaction with the viewers enabled by the broadcaster does not interfere with the overall market (A). The membership charge for the advertisers is $A^{S_B} = 0$, as the broadcaster only charges the advertisers per usage.

**Figure 9: Illustration of membership charges on market (A) and (B)**




Own creation with the article *Two-sided markets: a progress report* by Rochet and Tirole as basis (Rochet & Tirole, 2006).

Turning to membership externalities Rochet and Tirole express it by stating: "*To the extent that an end-user on side i derives a strictly positive net surplus from interacting with additional end-users on side $j \neq i$, membership decisions generate membership externalities.*" (Rochet & Tirole, 2006, p. 647). In the context of the overall two-sided market (A), the above statement says that if the viewers or broadcasters derive a strictly positive net surplus from interacting with each other, membership decisions generate membership externalities. Likewise, on the nested market (B) membership decisions would generate membership externalities, if the advertisers and viewers would derive a strictly positive net surplus from interacting with each other.

Summing up, the distributor on the overall two-sided market (A) charges the viewers a membership fee, whereas the broadcasters incur a negative membership charge, as they are being paid to join the platform. The broadcaster acting as a platform on the nested two-sided market (B) does not charge the advertisers or the viewers a membership charge.

### 4.1.3 Multi-homing

The pay-TV market entails another feature of being characterised as a two-sided market, namely multi-homing: "*Multi-homing stems from the users' desire to reap the benefits of network externalities in an environment of noninterconnected platforms.*" (Rochet & Tirole, 2006, p. 659). On both markets described previously, namely the overall two-sided market (A) and the nested two-sided market (B), multi-homing could incur.

Considering the overall two-sided market (A), the broadcasters are using the advantage of multi-homing. The different distributors on the market differ with respect to accessibility. Thus, if the broadcasters were to only join one platform, the possible viewer share would depend on the distributor's accessibility. Considering the limitations regarding the accessibility of the different distributors on the Danish pay-TV market such a situation is nearly inevitable. Accordingly, the common trend for broadcasters on the pay-TV market is to join all the available distributors on the market making the possible viewer share as large as possible.

Likewise, the advertisers on the nested two-sided market (B) make use of multi-homing. With the same point of departure as described above, namely to reach the largest viewer share as possible, the advertisers make agreements with several broadcasters. In the light of this, the advertisers make use of the noninterconnected broadcasters on the market in order to expose as many viewers as possible to their TV adverts.

The viewers salience on both markets would not benefit from multi-homing. The distributors on the overall two-sided market (A) offer bundles of TV packages to the viewers. Together with a substantial membership charge, the viewers would not benefit from subscribing to several distributors, thus multi-homing. As described by Rochet and Tirole: "*Multi-homing becomes less frequent when platforms can demand exclusivity*." (Rochet & Tirole, 2006, p. 660). In some geographical areas of Denmark only one distributor is available making multi-homing impossible if such were of interest for the viewers.

Concluding, the Danish pay-t v market can be characterised as a two-sided market in accordance with the definition given by Rochet and Tirole.

# 5 The Danish Pay-TV Market

## 5.1 Market Structure and Concentration

### 5.1.1 Market Structure

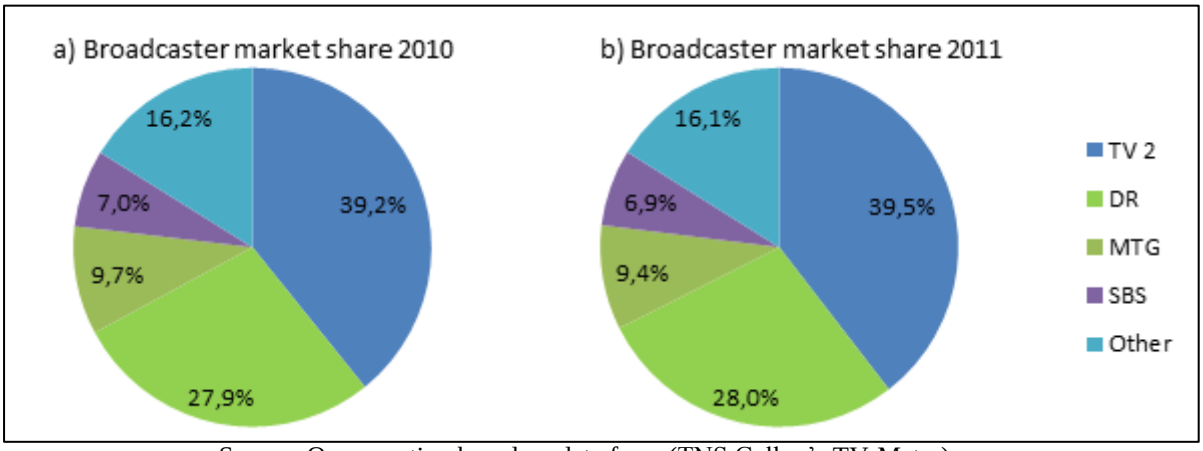
In order to answer the research question in depth it is relevant to evaluate the market structure of the pay-TV market as : *"(...) market structure or, the way the industry's producers are organized, affects what happens in the market place."* (Pepall et al., 2008, p. 44). Whether the conversion of TV 2 will affect the pay-TV market in the long run or not is interesting, but will not be distinct within the scope of this thesis, as only the short run effects are considered. Though, the immediate changes in relation to the conversion might give a clue to whether or not the market structure will be affected in the long run.

First and foremost, market structure will be described in general followed by an examination of the current structure of the pay-TV market.

Market structure can be defined by its two extreme poles, namely perfect competition and monopoly. The price on a perfect competitive market is determined by the interaction of all the firms and consumers on the market, thus no individual firm can affect the market price, and the competitive firm thereby acts as price-taker (Pepall et al., 2008). Contrary, a monopoly is characterised by one firm being able to influence the price, thus being a price-setter (Pepall et al., 2008).

The viewers on the pay-TV market is a crucial factor with respect to the performance of the broadcasters on the market as previously described. As viewers plays such an important role on the pay-TV market, the distribution of viewers between the broadcasters on the market has been evaluated. The findings are illustrated in the figure below.

**Figure 10: Distribution of viewer share divided by broadcasters in 2010 and 2011**




Source: Own creation based on data from (TNS Gallup's TV-Meter).

The two pie charts show that the TV market is dominated by four big players, namely DR, TV 2, MTG and SBS. As mentioned in the demarcation paragraph, DR will not be considered as a competitor in this thesis, because of their status as a public-service broadcaster. Thus, excluding DR, the pay-TV market in question is dominated by TV 2, MTG and SBS. These three make up 55.8% of the viewers on the market in 2011. In 2010 the percentage share was 55.9%, showing that the three broadcasters have lost point one percentage point from 2010 to 2011.

TV 2 increased their market share from 2010 to 2011 with point three percentage points, whereas MTG lost point three percentage points and SBS gained point one percentage point. Assuming the viewers have access to a given channel, the crucial factor becomes the range of programs and the placement of the programs.

Out of the three main players TV 2 has the largest viewer share, as they make up over half of the three broadcasters total market shares, making them the most dominating broadcaster on the market. The two main competitors of TV 2, MTG and SBS, together comprise 29.2% of the viewers of the three broadcasters total market shares.

### 5.1.2 Market Concentration

Besides looking at the overall market structure of the pay-TV market, the market concentration will also be evaluated. The market concentration can be summarized with a single parameter or index, namely the concentration ratio or the Herfindahl-Hirschman Index (HHI). The HHI is preferred over the concentration ration as: *"(...) the HHI reflects the combined influence of both unequal firm sizes and the concentration of activity in a few large firms. That is, rather than just reflect a single point on the concentration curve, the HHI provides, in a single number, a more complete sense of the shape of that curve."* (Pepall et al., 2008, p. 47). The HHI is defined by the following formula:

$$HHI = \sum_{i=1}^{N} s_i^2 \tag{5.1}$$

Where $N$ is the number of firms in the industry and $s_i$ is the market share of the $i^{th}$ firm (Pepall et al., 2008). The HHI ranges between monopoly and perfect competition, the two extremes of market structure.

The market share used to calculate the HHI is defined by number of viewers. The HHI for the pay-TV market in 2011 is equal to a HHI value of 1958. The calculated HHI should be compared to the value of the two

extremes of market structure. A perfect competitive market would return a HHI value close to zero, whereas the maximum HHI value equals 10,000 which represents a pure monopoly. *"The US merger guidelines stipulates an a priori assumption that markets with a HHI below 1000 is unconcentrated, a HHI between 1000 and 1800 is moderately concentrated, and a HHI above 1800 highly concentrated."* (Konkurrencestyrelsen, 2003). According to the guidelines stated by the US Department of Justice, a HHI value of 1958 implies that the TV market is highly concentrated, which is consistent with the previous description of the market.

A prerequisite for the usefulness of the HHI is a well-defined definition of the market in question, thus a definition of the market will shortly be described. First of all, it is necessary to make clear that the only broadcasting activities included are the ones concerning TV. Second of all, it is relevant to distinguish between the overall TV broadcasting market and the pay-TV broadcasting market, as the huge broadcaster DR is excluded.

In conclusion, the market structure of the pay-TV market is dominated by the three broadcasters, TV 2|DANMARK, MTG and SBS. The market concentration evaluated by the HHI implies that the market is highly concentrated.

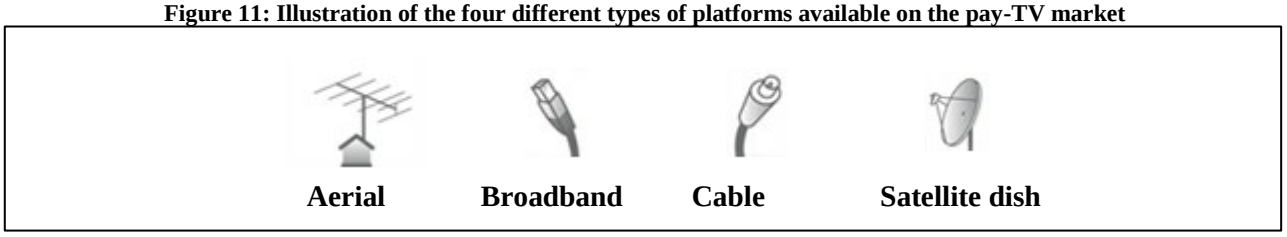
## 5.2 Subscription Platforms

The Danish pay-TV market is described as a two-sided market (see section 4). Both subscription platforms as well as distributors act as an intermediary between the two sides. The subscription platforms cannot act on their own on the pay-TV market, and thus they will be implicit when referring to the distributors as the intermediate between the two sides of the market.

A distributor can choose to broadcast via one or several subscription platforms. In order to evaluate the differences and consequences of subscription platform type, the different types available will be described in the following.

There are four different types of subscription platforms available on the pay-TV market illustrated by Figure 11. The four different types of subscription platforms differ in penetration, capacity, technical differences and receiver equipment making them imperfect substitutes (Konkurrence- og Forbrugerstyrelsen, 2011).

**Figure 11: Illustration of the four different types of platforms available on the pay-TV market**




Source: Pictures from (TV 2|DANMARK, 2012-a) with own translation of text

According to the Danish Competition and Consumer Authority's analysis "*Distribution af tv-kanaler"* the penetration is 70 percent for cable TV, 30 percent for fibre-optic broadband, 90 percent for broadband via the phone grid, and 100 percent for aerial and satellite dish[9]. Thus, the subscribers' choice of platform is contingent upon the geographical location of the household. Some households do not have a choice when it comes to selecting a subscription platform, as their geographical location only encounter one type, whereas others have several platforms to choose between.

Besides the differences in penetration, the market for subscription platforms is characterised by very few distributors and a high market concentration, which delimits the choice additionally. The distribution of market shares between the different distributors on the market is illustrated in Figure 12. The market shares are both expressed in terms of subscribers as well as revenue.

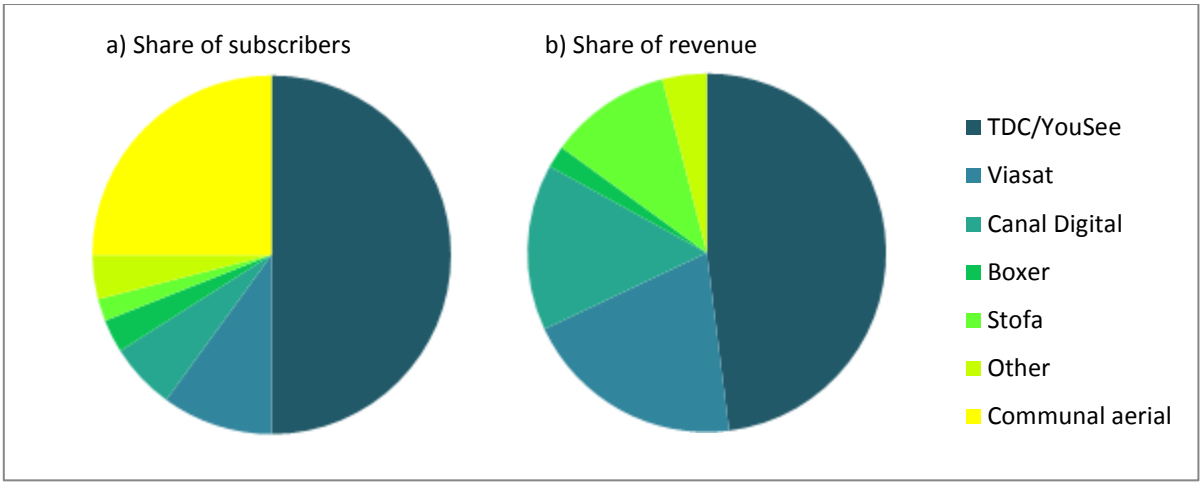
Looking at pie chart a) comprised by the share of subscribers it shows that TDC/YouSee[10] is the biggest distributor with 50% of the subscribers. The large market share of TDC/YouSee is divided between TDC TV, who has a share of the broadband subscribers, and YouSee[11], who has a large share of the cable TV subscribers (Konkurrence- og Forbrugerstyrelsen, 2011). The rest of the market is shared between communal aerial and individual distributors. More specifically, the communal aerial accounts for a large part of the subscribers, namely 25%. The remaining quarter of the pie is divided between the rest of the distributors on the market. However, pie chart a) comprising the share of subscribers does not give a full picture of the distributor market share on its own, and therefore is pie chart b), showing the distributors share of the total revenue, included.

Looking at pie chart b) showing the market share based on revenue, TDC/YouSee still make up around half the pie, thus having a slightly lower market share of 48%. The three distributors Viasat, Canal Digital and Stofa make up a larger part of the total compared to pie chart a). The reason why the three aforementioned distributors' share of the pie increases in b) can be explained by their large share of sales to television associations. A television association forwards the transmitted signal from the distributor to a group of households.

[9] Though, it should be mentioned that there can be district plans prohibiting aerial and satellite dishes, as well as bad reception (Konkurrence- og Forbrugerstyrelsen, "*Distribution af tv-kanaler"*).
[10] TDC/YouSee distributes via cable and broadband via the phone grid.
[11] YouSee is owned by TDC.

Thus, one television association actually implies a whole group of subscribers, whose subscription is not registered individually. Consequently, pie chart b) gives a better overview of the distributors' market share.

**Figure 12: Distribution of market share between distributors on the pay-TV market measured in number of subscribers and revenue in 2010**




Source: Own creation based on data from the report "*Distribution af tv-kanaler"* published by Konkurrence- og Forbrugerstyrelsen (Konkurrence- & Forbrugerstyrelsen, 2011).

### 5.2.1 Two-sided Market Dependency

The distributors on the pay-TV market act as a bottleneck between the two sides of the market making both sides either dependent or limited by the distributor.

The broadcasters are interested in getting a high penetration to attract as many viewers as possible. A large viewer share will make the broadcaster able to earn more money with respect to selling advertising space. As the household is limited in the choice of subscription platform and thereby distributor, the broadcasters are consequently dependent on entering into agreement with the distributors. In order to attract many viewers, the broadcasters must preferably bargain with a distributor with high penetration. The bargaining power between the two parties is reliant on the distributor's penetration and the broadcaster's popularity. Additionally, the bargaining power is determined by the availability of distributors in specific geographic areas. As TDC/YouSee has half of the subscribers on the market, they are in a strong position, when bargaining with broadcasters about benefits and prices (Konkurrence- og Forbrugerstyrelsen, 2011).

The viewers on the other side must connect to a distributor to be able to view the TV channels they find attractive. The type of subscription platform as well as distributor available determines the range of TV channels available. Only the cable TV distributors and broadband distributor TDC TV supply all the Danish channels available (Konkurrence- og Forbrugerstyrelsen, 2011).

The broadcaster MTG owns the distributor Viasat and thus acts as both. In order to defend Viasat's position on the distributor market, MTG only enters into agreement with certain distributors with respect to their TV-

channels. More specifically, MTG does not enter into agreement with Canal Digital and Boxer. The reasoning behind MTG deselecting certain distributors is most likely caused by an intention to not loose footing for their own distributor Viasat. Contrary to MTG deselecting certain distributors in terms of its distributor role, the broadcaster SBS does not enter into agreement with Viasat (cf. Konkurrence- og Forbrugerstyrelsen, 2011), which could affect Viasat as the choice of distributor negatively in the light of SBS's missing channels.

### 5.2.2 Subscription Platform Owner

The strong market position of TDC does not only apply to the role as distributor, but also as subscription platform owner. TDC has a history of being a public company and together with the privatising also followed the ownership of the cobber grid covering all parts of Denmark. The cobber grid is used by TDC TV to transmit TV by broadband called IPTV. Additionally, TDC owns a large part of the cable TV grid in Denmark through their subsidiary YouSee. (Konkurrence- og Forbrugerstyrelsen, 2011). The head of office, Jakob Willer, from the Danish IT & Tele Authority states that: *"We have in Denmark a unique competitive situation, where the greatest owner of the cobber grid also owns the greatest cable tv grid, that is two very significant infrastructures,"* (Breinstrup, T., 2009). Furthermore, TDC owns the fibre-optic infrastructure in North Zealand, which they bought from DONG Energy in 2009. The rest of the fibre-optic infrastructure in Denmark is owned by the electric and optical fibre companies in Denmark and managed by the distributor Waoo. Waoo was actually established with the purpose of challenging TDC on the private broadband market. As TDC owns such a large part of the subscription platforms the competition on the distributor market is limited.

Caused by TDC's strong position as subscription platform owner, the Danish IT & Tele Authority has imposed TDC to offer YouSee's cable TV grid to other suppliers of broadband solutions, such that the obligation to provide access for wholesale broadband is expanded from cobber to also include the cable TV grid (IT & Telestyrelsen, 2009). Third party access to YouSee's cable TV grid will make it possible for other distributors on the pay-TV market to sell TV via broadband, thus intensifying the competition with respect to IPTV. Though YouSee's cable TV grid is now accessible for third party distributors, no one has yet made use of the possibility, which may be caused by very high entry costs: *"The IT & Tele Authority has paid regards to TDC not having to incur a number of unnecessary investments merely because another supplier requests access to broadband. This means, among other things, that new suppliers commit to buying capacity corresponding to a use of one million kroner [Editor's note: Danish] by requesting access and further 1.5 million kroner [Editor's note: Danish] when signing of an agreement."* (Politiken, 2011).

Overall, the circumstances on the intermediary market make it opaque, delimits the competition and makes it difficult for a new distributor to enter.

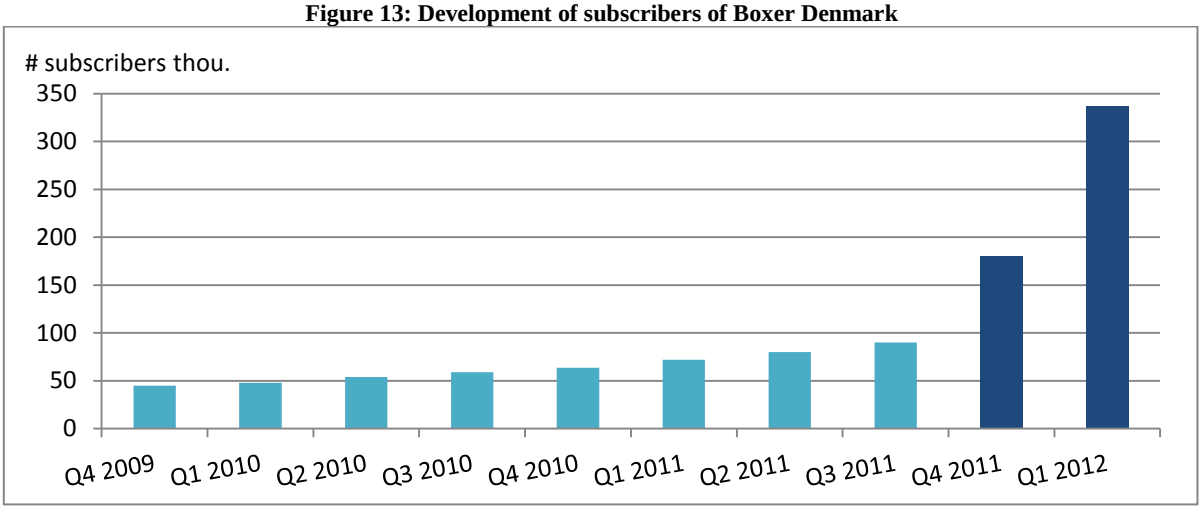
## 5.3 Subscriber Effect

In order to determine if TV 2's change from free-to-air to pay-TV channel has any effect on the two main commercial competitors it is first and foremost relevant to investigate, if the different platforms available have had any changes in their number of subscribers. Specifically, it is expected that the platforms experience an increase in the number of subscribers in relation to the change of TV 2. The possible increase in number of subscribers at the different platforms is essential for the broadcasters, as the platforms comprise a bottle neck between viewers and broadcasters[12]. If the viewers, who lose the availability of watching TV 2, are willing to subscribe to at platform in order to be able to watch TV 2, it could have a spillover effect on the commercial competitors.

The different distributors on the pay-TV market compete against each other in trying to catch as many of the new subscribers as possible. Boxer, whose operations started in December 2009, expected an increase in the number of subscribers in relation to the conversion of TV 2[13], and in order to catch the subscribers: *"(...) the company will offer Tv2 for just DKK 49 per month as part of a mini-package. The channel will also be offered for DKK 199 per year as a single, Pay-TV channel,"* (Teracom Group, 2011-a, p. 2). Additionally, Boxer launched a major advertising campaign during the fourth quarter of 2011 in order to catch the attention of possible new subscribers. Boxer is able to reap the benefits of their major marketing effort as they increase their subscriber base. Their subscriber base is quadrupled from the third quarter of 2011 to the first quarter of 2012. More specifically, Boxer increased the number of subscribers from 90.000 in the third quarter of 2011 to 180.000 in the fourth quarter of 2011, thus a 100% increase from the third to the fourth quarter in 2011 (Teracom Group, 2011-a). The increase continues until the latest quarter, namely the first quarter of 2012. The increase from the fourth quarter in 2011 to the first quarter in 2012 is equal to 87.2%. The subscriber increase of Boxer can be seen in the figure below.

[12] Excluding the airborne TV-channels, which are free-to-air.
[13] Stated in Teracom Group Interim Report January – September 2011

**Figure 13: Development of subscribers of Boxer Denmark**




Source: Own creation based on data from (Teracom Group, 2009-2010), (Teracom Group, 2011-a), (Teracom Group, 2011-b) and (Teracom Group, 2012).

The large intake of subscribers is primarily caused by the conversion of TV 2 as stated in their press release from January 2012: "*The accession of customers has mainly been powered by TV 2 changing to a pay-TV channel and that many household, who until then had TV 2 not encrypted, wanted to ensure continued access to the channel*," (Own translation, Boxer, 2012).

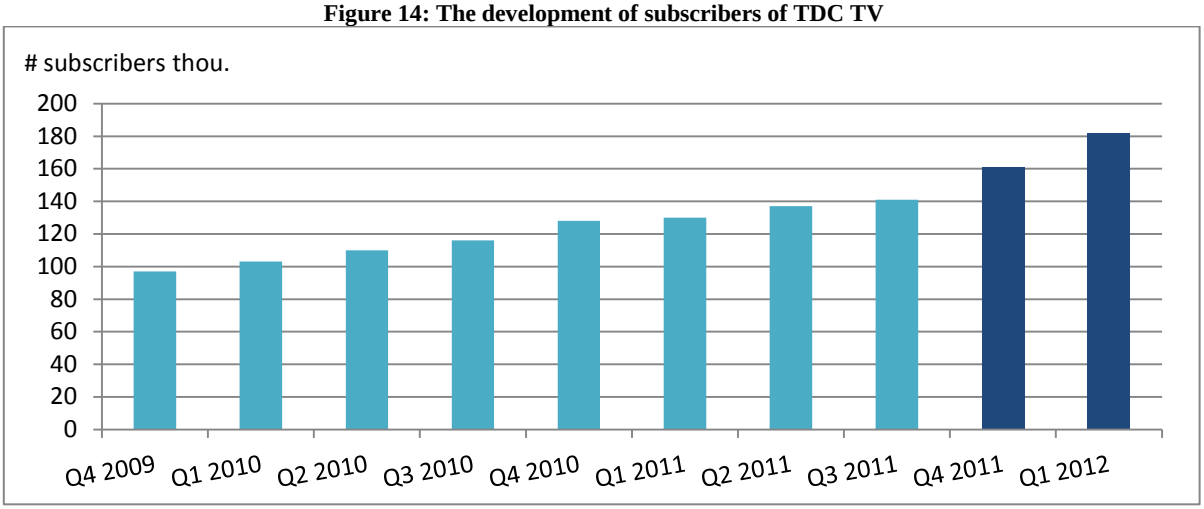
Boxers' large intake of subscribers is among other things caused by their platforms accessibility. As Boxer is present on the aerial platform, their accessibility is 100% contrary to for example cable, which has an accessibility of approximately 70% (Konkurrence- og Forbrugerstyrelsen, 2011). Additionally, the requirements when joining Boxer is rather affordable and practicable.

Turning to a big player on the distributor market, namely TDC, their ability to catch some of the households losing the possibility to watch TV 2 will be evaluated in the succeeding paragraph. TDC as a distributor is two-sided, as they offer TDC TV and YouSee. TDC TV operates on the broadband platform, whereas YouSee operates on the cable platform. The accessibility of TDC's two distributors is not as widespread as Boxer (see section 5.1). TDC TV has managed to increase their subscriber base in relation to the conversion of TV 2, as their number of subscribers from the third to the fourth quarter of 2011 increases from 141.000 to 161.000 subscribers, thus an increase of 14.2%. In the fourth quarter of 2011 TDC launches the product called HomeTrio Mini in order to comply with the viewers, who are no longer capable of watching TV 2. The product was a success according to TDC's first quarterly report in 2012: *"Strong net growth on TV-RGU's*[14] *after TV2 converted to a pay-TV channel and the closing of MPEG2 led by the popular start product HomeTrio Mini – launched in Q4 2011,"* (TDC, 2012-a1, p. 7). More specifically, TDC TV increases the

[14] RGU is an abbreviation for Revenue Generating Unit and refer to the number of customer relationships generating revenue for TDC (TDC, 2011).

number of subscribers from the fourth quarter in 2011 to the first quarter of 2012 by 13% percent. The development of TDC TV's subscriber base is illustrated in Figure 14.

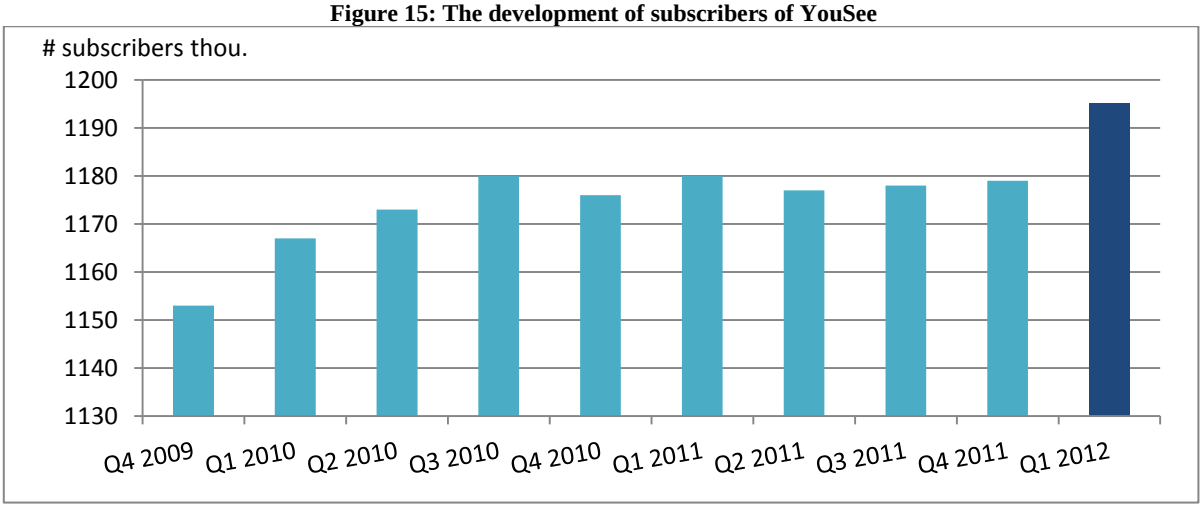
**Figure 14: The development of subscribers of TDC TV**




Source: Own creation based on data from TDC Dataark 1. kvartal 2012 (TDC, 2012-a2).

YouSee does increase their subscriber base in the third quarter of 2011, but the increase is very small and could be explained by other factors than the conversion of TV 2. However, in the first quarter of 2012 YouSee experiences an increase of 1.4%, which is the highest in the period considered. In the first quarterly report from 2012 it is stated that: *"The conversion of TV 2 to pay-TV channel has had a benign effect on the market and YouSee's pay-TV-RGU's in the 1st quarter of 2012".* (Own translation, TDC, 2012-a1, p. 11), thus the intake of subscribers is caused by the conversion of TV 2.

**Figure 15: The development of subscribers of YouSee**

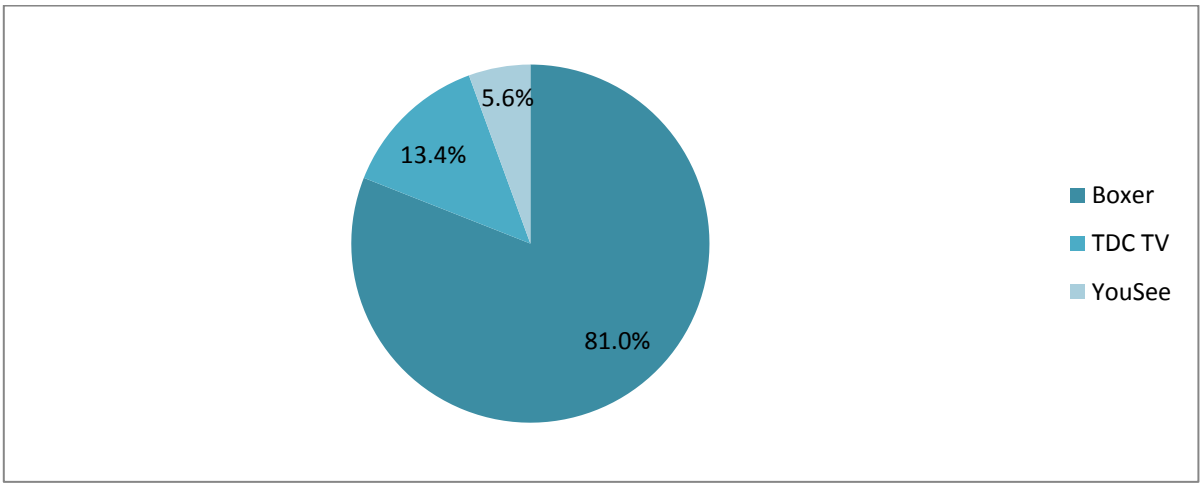



Source: Own creation based on data from TDC Dataark 1. kvartal 2012 (TDC, 2012-a2).

The intake of subscribers for TDC is quite substantial as expressed by the CEO Henrik Poulsen: "*I will point out our results on the TV area, where we have experienced the biggest customer intake ever. The TDC Group has gained 37.000 more TV-customers during the 1st quarter of 2012."* (Own translation, TDC, 2012-

b). Even though, TDC has experienced the biggest customer intake ever, they cannot match the intake of Boxer, who has snatched the majority of the new subscribers related to the conversion of TV 2. The distribution of subscriber intake from the third quarter of 2011 to the first quarter of 2012 is distributed with 81%, 13.4% and 5.6% to Boxer, TDC TV and YouSee, respectively. Thus, the winner in the competition of gaining subscribers in relation to the conversion of TV 2 is Boxer. Though, the conversion of TV 2 has had a positive effect on all the distributors considered.

**Figure 16: The distribution of subscriber intake from Q3 2011 to Q1 2012 for Boxer, TDC TV and YouSee**




Source: Own creation based on data from Teracom Group Interim Report January - March 2012 (Teracom Group, 2012) and TDC Dataark 1. kvartal 2012 (TDC, 2012-a2).

### 5.3.1 Spillover Effect on Commercial Broadcasting Competitors

In order for the distributors intake of subscribers to have an effect on TV 2's commercial competitors, the packages subscribed to must include TV-channels from the commercial competitors and not only TV 2.

As mentioned earlier Boxer has offered its new subscribers the possibility to only subscribe to TV 2, but: "*Many chose to buy a package with more channels than TV 2, when they had to take out a subscription on TV anyway (...).*" (Own translation, Boxer, 2012)[15] and: *"(...) the majority of our new customers happily signed up for subscriptions with more channels than just TV2."* (Teracom Group, 2011-b, p. 2). The packages offered by Boxer entails TV channels from the commercial broadcaster SBS, but none from the commercial broadcaster MTG, thus only SBS could encounter a positive spillover from the subscriber intake of Boxer. TDC TV and YouSee do not offer a subscription only on TV 2, thus one must choose between packages with bundles of TV channels. TDC TV and YouSee offer TV channels from both SBS and MTG, thus both commercial broadcasters could encounter a positive spillover from the intake of subscribers for TDC TV and YouSee.

[15] "*Mange valgte at købe en pakke med flere kanaler end TV 2, når de alligevel skulle tegne et tv-abonnement (...).*"

Whether or not the commercial broadcasters SBS and MTG are affected by the change of TV 2, it is to be expected that it is observable by the change in number of viewers on their TV-channels. The previous investigation shows that the viewers without access to TV 2 have subscribed to different distributors on the market, thus verifying that the conversion of TV 2 could affect the commercial broadcasters SBS and MTG, as they could benefit from a spillover effect.

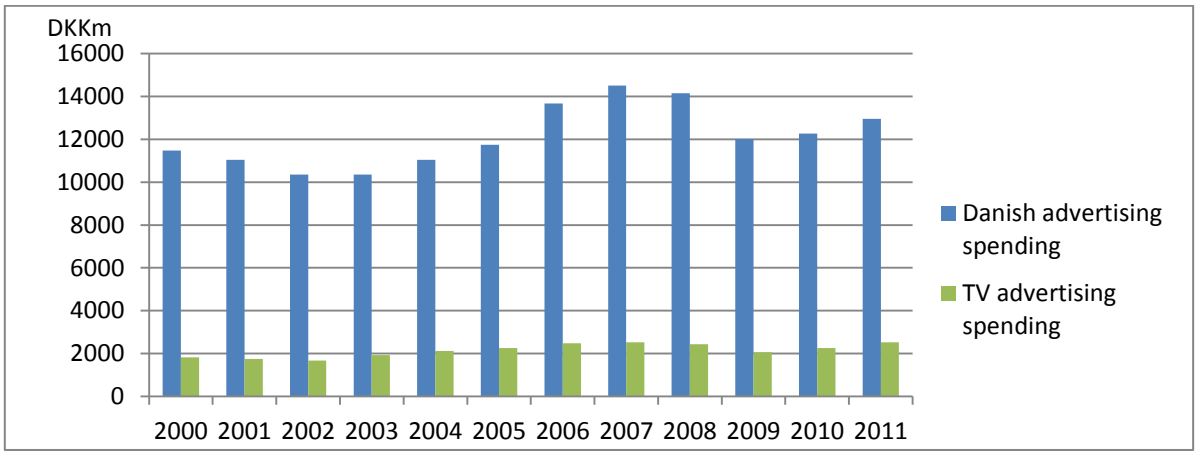
## 5.4 The Danish Advertising Market

The Danish advertising market will be evaluated in general to get a good idea of, which factors influence the market, and how the market has developed over time. Additionally, the advertisers comprise one of the sides in the nested two-sided market (B) described in section 4.

In order for the advertising sender to affect the right target group, the broadcasters use a term called TRP or GRP when price setting advertising space on their TV-channels. TRP and GRP stand for Target Rating Point and Gross Rating Point, respectively. TRP is the most common used term when selling or buying advertising space in the broadcasting industry, and therefore only TRP will be further described. TRP is a part measure of a target group and ranges from one to one hundred describing the percentage of the target group that will be reached (TV 2|DANMARK, 2012-b). Additionally, the price of 1 TRP depends on the type of target group to be reached (TV 2|DANMARK, 2012-b). Higher TRP leads to more expensive advertising space. The TRP rating of television programmes indicates the popularity of the programme. The higher TRP, the more popular is the programme. The TRP can therefore help an advertiser in choosing the placement of the advertising spot. The TRP is based on the number of viewers watching television, thus such a measurement is crucial in relation to the advertising market. In relation to this, the broadcasters must attract viewers to their TV-channels, such that they can increase their advertising revenue by achieving higher TRP ratings.

The development of the Danish advertising spending can be seen in Figure 17 below. Additionally, the figure shows, how much of the total advertising amount is spent solely on TV. It can be seen that the TV advertising spending has increased from 2000 to 2011. The TV advertising spending make up 19.4% of the total advertising spending, thus the TV advertising spending has a large influence on the market in general.

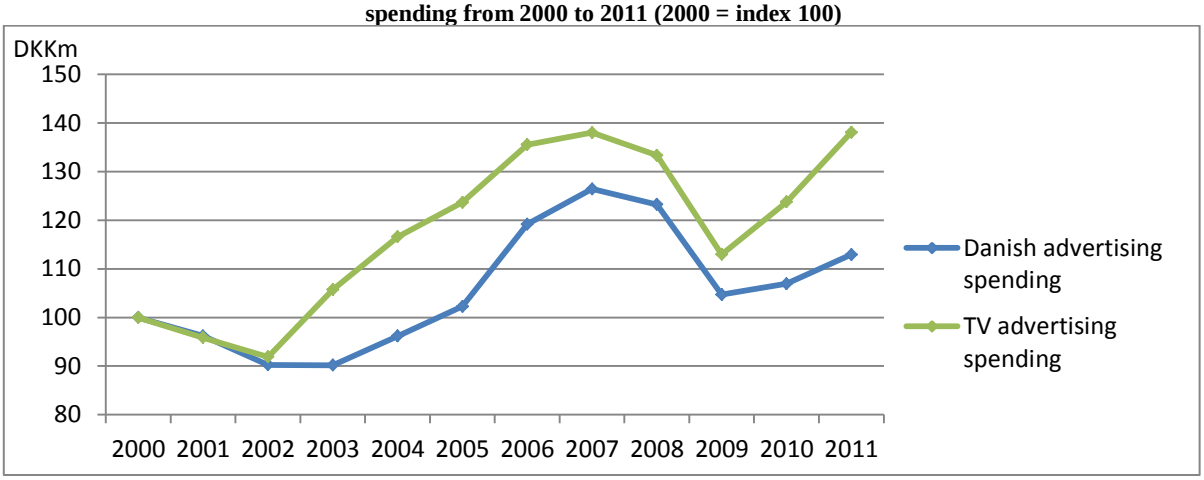
**Figure 17: Development of Danish advertising spending and TV from 2000 to 2011**




Source: Own creation based on data from (The Danish Advertising Expenditure Survey, 2002-2011).

In order better to see whether the Danish advertising spending and the TV advertising spending, follow each other over time, they are both indexed with the base year 2000. The figure below shows that the two variables roughly follow each other over time.

**Figure 18: Development of the Danish advertising spending and the TV advertising spending from 2000 to 2011 (2000 = index 100)**




Source: Own creation based on data from (The Danish Advertising Expenditure Survey, 2002-2011).

Both figures showing the development of the Danish advertising spending and the TV advertising spending show a decrease in spending from 2007 until 2009 implying that the advertising spending was affected by the recent financial crisis. The graph implies that the recent financial crisis no longer has a grip on the general advertising spending, as the development from 2009 to 2011 is increasing with a growth rate of 3.9% in 2010. The development of advertising spent solely on TV is looking even better, as the growth rate for 2010 equals 11.6%, thus emphasising the significance of TV advertising spending on the market in general.

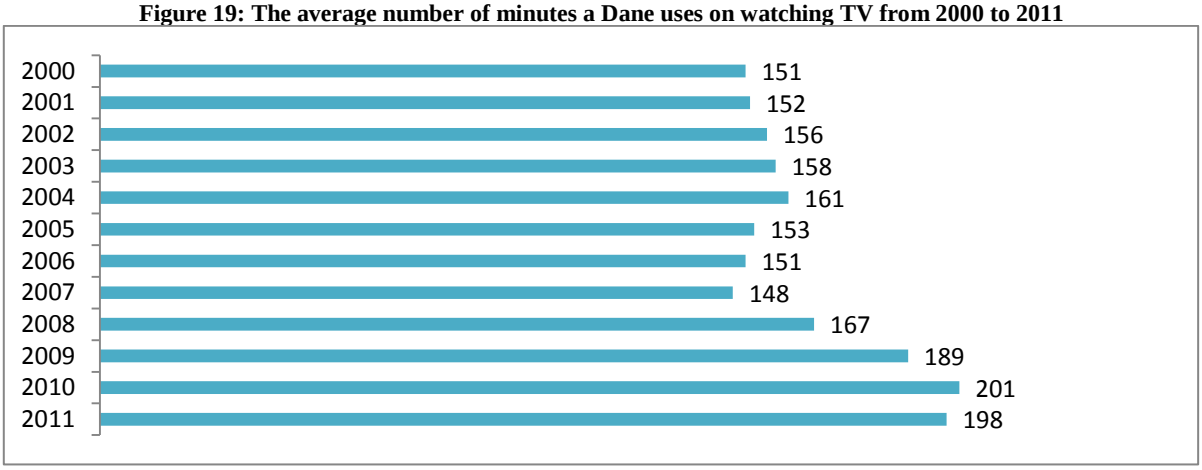
From 2004 and till the change of TV 2 in January 2012, TV 2/DANMARK had solely based its income related to the main channel on advertising. As can be seen from Figure 17 and Figure 18, the advertising spending in Denmark is most likely sensitive to economic changes. Consequently, as TV 2 is dependent on the general advertising spending in Denmark, they are also sensitive to economic changes, which is also stated as an argument for the change of TV 2's status.

## 5.5 Viewers

The viewers on the pay-TV market play an important role. This section will therefore go through the different aspects concerning viewers on the pay-TV market. Firstly, the consumption of TV in Denmark is evaluated followed by a look on the behavioral pattern of viewers.

In 2011 an average viewer in Denmark watched 198 minutes of TV corresponding to 3 hours and 18 minutes per day. The time spent on watching TV has increased from 2000 to 2011, as illustrated in Figure 19 below. From 2007 to 2011 the time spent on watching TV increased yearly by 13% in 2008 and 2009 and 6% in 2010, thus an average increase of 11% overall. In 2011 the time spent on watching TV levels out, as the growth declines by 1%. However, the Danes still uses a lot of time in front of the television making it an appropriate platform for advertisers to expose the viewers for adverts.

**Figure 19: The average number of minutes a Dane uses on watching TV from 2000 to 2011**

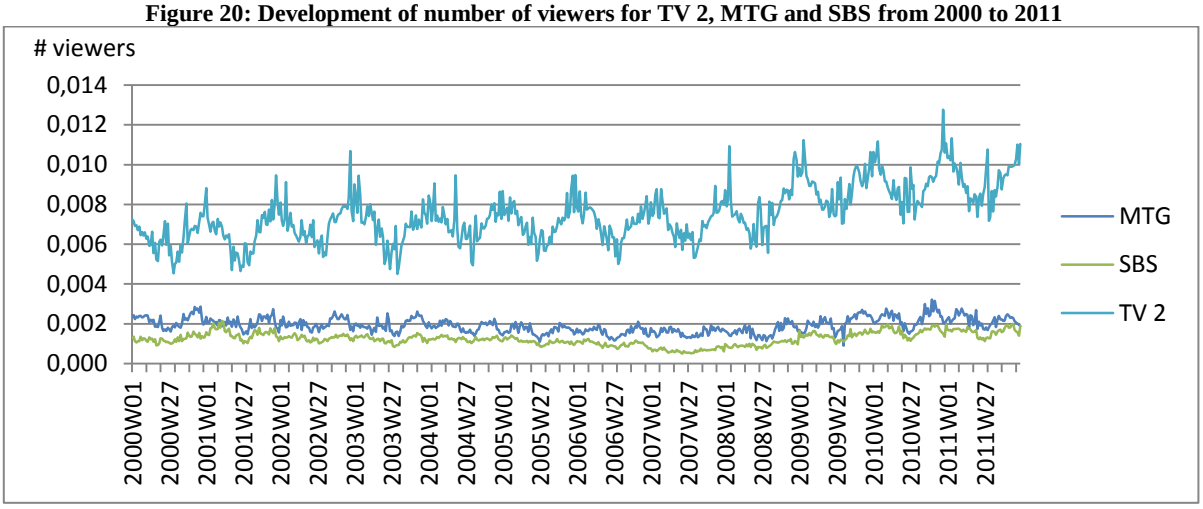



Source: Own creation based on data from (TNS Gallup's TV-Meter).

Turning to the behavioral pattern of viewers, Figure 20 and Figure 21 show that viewers are marked by seasonality. The summer period comprised by the second and third quarter of a year makes up the off-season, and the winter period comprised by the fourth quarter of a year, and the following first quarter makes up the peak season. One important factor, which can affect the number of viewers and the cycle of the season, is international sporting events, which often attract many viewers. In relation to this, TV 2|DANMARK expect to increase their penetration during the year of 2012, as great sporting events such as the European Football Championship, the Olympic Games and Tour de France are expected to attract the viewers, who have not yet signed up at a distributor.

Figure 20 shows the development of the three broadcasters, TV 2|DANMARK, MTG and SBS from 2000 to 2011. The seasonality for the viewer of TV 2|DANMARK is easily spotted, whereas the seasonality of the two commercial broadcasters is more vague.

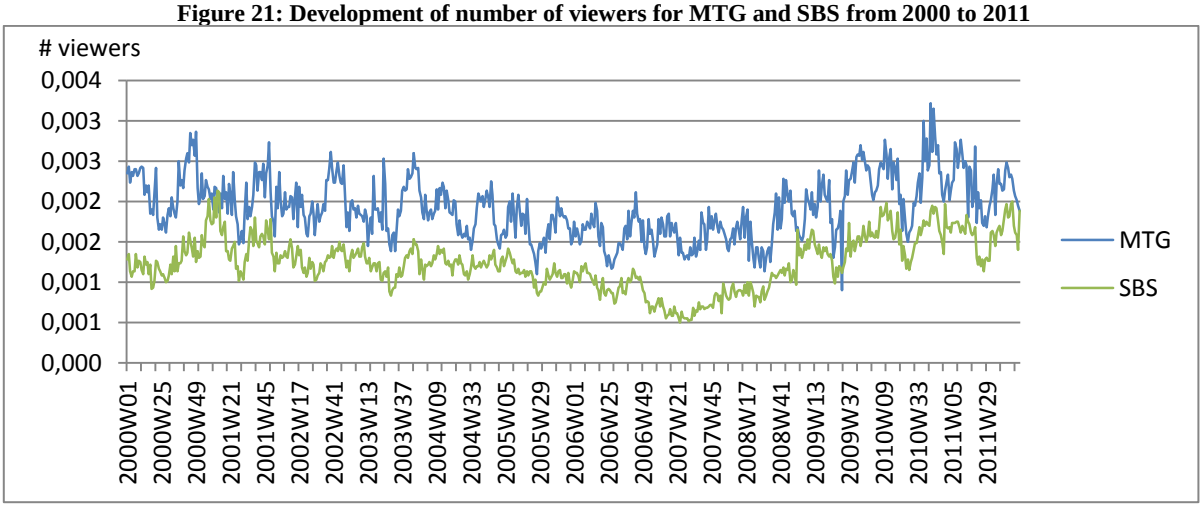
**Figure 20: Development of number of viewers for TV 2, MTG and SBS from 2000 to 2011**




Source: Own creation based on data from (TNS Gallup's TV-Meter).

Therefore, the two commercial broadcasters are plotted without TV 2|DANMARK in Figure 21, where the seasonality of the two is much more distinct.

**Figure 21: Development of number of viewers for MTG and SBS from 2000 to 2011**




Source: Own creation based on data from (TNS Gallup's TV-Meter).

The two figures also show that TV 2|DANMARK has increased its number of viewers from 2000 to 2011, whereas the number of viewers for MTG and SBS is somewhat stable.

# 6 Econometric Analysis

## 6.1 Introduction

In the section 5.3 it has been established that the distributors on the pay-TV market has gained subscribers in relation to the change of TV 2 from free-to-air to pay-TV channel. As the distributors have gained more subscribers, the commercial broadcasting competitors might incur a positive spillover effect in terms of more viewers. The number of viewers is the pivot of the pay-TV market, and is the single most important variable with relation to the success or failure of a TV channel, as they influence the advertising revenue to a large extent.

The number of viewers is first and foremost dependent on the accessibility of the channels, measured by penetration. Thus, the higher penetration, the more viewers it is possible to attract. With the distributors gaining subscribers in relation to the change of TV 2, the first hurdle in the process of commercial broadcasters gaining more viewers is over. Whether or not the commercial broadcasters are actually gaining viewers after the change of TV 2 can be read off directly in the data from TNS Gallup's TV-Meter, though increases caused by popular programmes should be taken into consideration.

The broadcasters are dependent on the number of viewers of their TV channels, when pricing their advertising space, as the pricing is related to the estimated TRP (see section 5.4). It is assumed that more viewers will be expressed in higher advertising revenue, as more viewers will raise the TRP making the advertising space more costly. Thus, as the broadcasters on the pay-TV market are expected to be dependent on the number of viewers in relation to the advertising revenue, it is relevant to investigate, whether the relationship between number of viewers and advertising revenue is significant. More specifically, it is expected that the number of viewers is significant as an explanatory variable for the advertising revenue.

It is expected that an increase in the number of viewers will affect the advertising revenue of the broadcasters positively, and that the relationship between the two are linear. Thus, the estimated $\beta_2$ coefficient for number of viewers is expected to be positive. Based on the previous mentioned expectations, the null hypothesis and alternative hypothesis, which each regression model will be tested for, is stated below:

$H_0: \beta_2 > 0$ *Number of viewers* positively affects the *advertising revenue* of a broadcaster

$H_1: \beta_2 \leq 0$ *Number of viewers* does either affect the *advertising revenue* of a broadcaster negatively or not at all

The relationship between number of viewers and advertising revenue will be tested for TV 2 and the two main commercial broadcasting competitors MTG and SBS. The expectation stated above will be applied to each of the broadcasters' number of viewers and advertising revenue.

If the number of viewers can explain the development of advertising revenue, it is possible to use the models to forecast the expected advertising revenue of MTG and SBS without the change of TV 2 being considered. Comparing the forecasted values with the actual advertising revenue for the first quarter of 2012 it should be possible to read off, whether the change of TV 2 has affected the two commercial broadcasting competitors financially.

With the general expectation in mind the following analysis will verify whether or not number of viewers can explain the advertising revenue for TV 2, MTG and SBS, respectively.

## 6.2 Theory

In the following econometric analysis the two variables *advertising revenue* and *number of viewers* will be evaluated separately and afterwards together using the OLS method for each of the three broadcasters. Firstly, a description of the data used and the factors, which follow, will be described. Secondly, the relevant classical linear regression model's (from here referred to as CLRM) assumptions will be described in order to get an introduction to the different terms, before the assumptions are tested in practice.

### 6.2.1 The Econometric Characteristics of the Data

The data used when testing the expectation stated previously are characterised as time series, which by Gujarati and Porter is defined as: *"(...) a set of observations on the values that a variable takes at different times."* (Gujarati & Porter, 2009, p. 22). Most empirical work based on time series data assumes that the underlying time series is stationary: *"In short, if a time series is stationary, its mean, variance, and autocovariance (at various lags) remain the same no matter at what point we measure them; that is, they are time invariant."* (Gujarati & Porter, 2009, p. 741). If the time series is not stationary, it is not possible to generalise to other time periods, as each time period would be different. Consequently, the estimated regression models developed in the following would be irrelevant, as they are developed with the purpose of being able to forecast the advertising revenue for each of the three broadcasters. Thus, the assumption regarding stationarity must hold, and therefore the time series of *number of viewers* and *advertising revenue* shall each be tested for stationarity.

In the light of the small sample being considered it can be difficult to draw conclusions from the tests performed. As stationarity is an important factor when using time series to predict future values, precautions will be taken with respect to the stationarity tests throughout the econometric analysis.

As described in section 3.2 the time series *number of viewers* is restricted by the time series *advertising revenue*. Considering the time series individually, the time series *number of viewers* will be evaluated both in the short run, running from 2009 to 2011, and in the long run, running from 2000 to 2011. The long run is included as this period entails a larger sample, which will give rise to a much more credible interpretation of whether the time series is stationary or not.

The nature of the time series *number of viewers* has already been described in 5.5 as being marked by seasonality. As stated in section 3.2 the time period being investigated in relation to the econometric analysis is running from 2009 to 2011 with quarterly intervals. When looking at the short time period from 2009 to 2011 the seasonality is not easily spotted, as the time period is too short to demonstrate the seasonality and could be interpreted as fluctuations caused by other factors. Additionally, the three quarters do not make up enough observations in order to transform the time series with seasonal difference, if it is not stationary to begin with. Preferably, the starting point for finding an applicable model describing the relationship between number of viewers and advertising revenue would take seasonality in the time series of viewers into consideration, but the data set being considered too small to make meaningful tests when including seasonality. Thus, the seasonality in the time series of number of viewers will not be considered throughout the econometric analysis.

### 6.2.2 Stationarity

Stationarity can be detected both graphically and numerically. Graphically one should look at a scatter plot showing the dependent variable versus time as well as the ACF[16] and PACF[17] correlograms to get an intuitive feeling. A trend in the scatter plot would imply a non-stationary time series. The pattern of the ACF and PACF correlograms depends on the type of model in question. In this case, the ACF should decay exponentially towards zero and/or with damped sine wave pattern and the PACF should show a significant spike through lags $p$. (Gujarati & Porter, 2009). Numerically there are a handful of tests[18], which could be conducted in order to identify, whether or not a time series is stationary. The chosen method used is the unit root test known as the Dickey-Fuller (DF). When applicable the Augmented Dickey-Fuller (ADF) test should be

[16] ACF is an abbreviation for Autocorrelation Function.
[17] PACF is an abbreviation for Partial Autocorrelation Function.
[18] Besides the unit root test one could make a joint hypothesis that all $\rho_k$ up to a certain lag are equal to zero by using the Q statistic developed by Box and Piece or by using the Ljung-Box (LB) statistic (Gujarati & Porter, 2009, p. 753-754).

used. The DF test is estimated in three different forms, namely a random walk, a random walk with drift or a random walk with drift and deterministic trend distinguished by their stochastic or deterministic behaviour. A random walk and a random walk with drift are called difference stationary processes (DSP), whereas a random walk with drift and deterministic trend is called a trend stationary process (TSP) (Gujarati & Porter, 2009). The null hypothesis and alternative hypothesis put forward for all three different forms when performing the DF test is stated below:

$H_0: \delta = 0$ Non-stationarity in the time series

$H_1: \delta < 0$ Stationarity in the time series

If the null hypothesis cannot be rejected, there is a unit root, and the time series is non-stationary, which is not preferable. Otherwise, the null hypothesis is rejected, and the time series fulfil the assumption regarding stationarity in the time series. The basis for deciding, if the null hypothesis should be rejected or not, is as follows: *"If the computed absolute value of the tau statistic* $(|\tau|)$ *exceeds the absolute DF or MacKinnon critical tau values, we reject the hypothesis that* $\delta = 0$*, in which case the time series is stationary."* (Gujarati & Porter, 2009, p. 756).

If the null hypothesis cannot be rejected, the time series must be transformed from non-stationarity to stationarity. *"The transformation method depends on whether the time series are difference stationary (DSP) or trend stationary (TSP)."* (Gujarati & Porter, 2009, p. 760). If the time series is characterised as DSP and has a unit root, it can be transformed to stationarity by taking the first difference. Is the time series instead characterised as a TSP: *"(...) the simplest way to make such a time series stationary is to regress it on time and the residuals from this regression will then be stationary."* (Gujarati & Porter, 2009, p. 761). It should be noted that if the time series need to be transformed by taking differences, the long run relationship between the variables is lost, and thus only the short run relationship between the variables holds. Though, testing the variables for co-integration could justify whether the variables did actually have a long run relationship.

### 6.2.3 Autocorrelation

In relation to determining whether or not the time series are stationary, a test for autocorrelation will be performed. Additionally, the developed regression models will each be tested for autocorrelation, and therefore a short description of the term and the test used is relevant.

*"The term autocorrelation may be defined as 'correlation between members of series of observations ordered in time [as in time series data] or space [as in cross-sectional data]'."* (Gujarati & Porter, 2009, p. 413). The CLRM assumes that there is no autocorrelation in the error terms, meaning that the error term re-

lating to any observation is not influenced by the error term relating to any other observation (Gujarati & Porter, 2009).

In order to check if the time series *number of viewers* and *advertising revenue* is suffering from autocorrelation in the error terms, the Breusch-Godfrey test, also referred to as the LM[19] test, is used. The LM test is chosen, as it allows lagged values of the dependent variable as explanatory variables contrary to the Durbin-Watson d test, which also can be used to identify autocorrelation. Furthermore, the LM test makes it possible to test serial correlation up to the fourth order, whereas the Durbin-Watson d test only tests up to first order serial correlation (La Cour, 2009-a). Thus, the LM test has some superior advantages to the Durbin-Watson d test and will therefore be used when testing for autocorrelation.

The null hypothesis and the alternative hypothesis put forward when testing for autocorrelation states that there is no autocorrelation and that there is autocorrelation, respectively. If the null hypothesis cannot be rejected, it can be concluded that the subject in question does not suffer from autocorrelation, which fulfils the CLRM's assumption.

There are a handful of consequences if autocorrelation is present in the error terms. The OLS estimators are no longer efficient, and there is a lack of trust in the t-test and F-test. Furthermore, the $R^2$, which measures the goodness of fit of a regression model, is unreliable. Thus, the interpretation of a regression model suffering from autocorrelation could be very misleading.

If the regression model in question is suffering from autocorrelation, there are some remedial measures, which can be used in order to transform the model. One such measure is the generalised least-square (GLS) method. Contrary to the OLS, the GLS make use of the information contained in the unequal variability of the dependent variable, which makes it capable of producing estimators that fulfil the CLRM assumptions (Gujarati & Porter, 2009). An alternative method is the Newey-West method. The Newey-West method can be used, when the model suffers from both autocorrelation and heteroscedasticity. However, the method will not be used, as it only suitable for large samples, which is not the case for this particular econometric analysis.

### 6.2.4 Heteroscedasticity

*"An important assumption of the classical linear regression model (Assumption 4) is that the disturbances $u_i$ appearing in the population regression function are homoscedastic; that is, they all have the same variance."* (Gujarati & Porter, 2009, p. 365).

[19] The test is also known by the name LM as the test is based on the Lagrange multiplier principle (Gujarati & Porter, 2009).

It is important to verify, whether or not the regression models developed throughout the econometric analysis suffer from heteroscedasticity, as it can cause the t-test and F-test to be unreliable.

The method used in order to detect whether or not the developed regression models suffer from heteroscedasticity is the White's test. The null hypothesis put forward when testing for heteroscedasticity states that there is no heteroscedasticity, thus the error terms of the regression model is homoscedastic. The alternative hypothesis state that there is heteroscedasticity, thus the null hypothesis should not be rejected in order to fulfil the CLRMs fourth assumption.

If the test reveals a problem of heteroscedasticity, two remedial approaches exist. The heteroscedasticity can be removed by using the method of weighted least squares (WLS) or White's heteroscedasticity-consistent variances and standard errors (Gujarati & Porter, 2009). The sources of heteroscedasticity could be caused by changes in data collecting techniques, presence of outliers or that the regression is misspecified.

### 6.2.5 Normality

The last assumption of the CLRM, which will be described, is the assumption stating that the error terms should be normally distributed. If the assumption is not fulfilled, the OLS estimation cannot be trusted. In small samples, where the number of observations is less than one hundred, the normality assumption plays a critical role (La Cour, 2009-b). Thus, it is particular important that this assumption is fulfilled, as the sample size is very small.

The Jarque-Bera test will be used in order to check, if the regression models developed fulfil the assumption regarding the error terms being normally distributed. The null hypothesis put forward states that the residuals are normally distributed, whereas the alternative hypothesis states the contrary. Thus, the null hypothesis should not be rejected in order to fulfil the assumption. The Jarque-Bera test is directed to large samples, and therefore a graphical analysis including a histogram and a quantile-quantile (hereafter Q-Q) plot of the residuals will also be made in order to verify that the result from the Jarque-Bera test also holds for the small sample in question. Gujarati and Porter states that: *"(…) for a normally distributed variable the skewness (a measure of symmetry) should be zero and kurtosis (which measures how tall or squatty the normal distribution is) should be 3."* (Gujarati & Porter, 2009, p. 130). Thus, this is the pattern to look for, when the histogram of the residuals is being interpreted. The Q-Q plot implies normality in the error terms, if the pattern shows a linear relationship.

## 6.3 Test for Stationarity and Autocorrelation

The time series used to model the relationship between number of viewers and advertising revenue will first of all be tested for stationarity and secondly for autocorrelation. When checking for stationarity in the time series both a graphical analysis and a numerical test will be considered. The plots used in the graphical analysis are available in appendix 1-3.

### 6.3.1 Stationarity and Autocorrelation Tests for TV 2

#### 6.3.1.1 Time Series: *number of viewers* of TV 2

As described in section 6.2.1 *number of viewers* will be considered both in the short and long run in order to come as close as possible to the true interpretation of, whether the time series is stationary or not. The time series will firstly be considered in the short run, as this is the primary period of interest followed by an evaluation of the time series in the long run.

**Short run**

*Number of viewers* has been plotted against time to get an intuitive glimpse of whether the time series is stationary (see appendix 1) in the short run. As described already in section 5.5 the behavioural pattern of viewers is marked by seasonality in the long run. Though in the short run considered, the data do not reveal itself as being seasonal, and will therefore not be considered here. The plot showing *number of viewers* against time implies that the time series can be described as a random walk with drift. The ACF implies stationarity, as it decays fast and in a wave like pattern (appendix 1). Furthermore, the seasonality can be spotted in the ACF, as there is a significant spike semi-annually referring to the fourth and first quarter of a year, where the number of viewers peaks. Additionally, the PACF has a significant spike at the second lag (appendix 1). Thus, the graphical tests imply that the time series is stationary.

Before testing for stationarity numerically, a test for autocorrelation in the error terms is conducted. The PACF showed a significant spike at the second lag implying autocorrelation for the first two lags. The Breusch-Godfrey's Lagrange multiplier (LM) test is used to identify autocorrelation. Specifically, the test is used to find the lag, after which no autocorrelation is present. The LM statistic computed from running the equation (6.1) below returns a value for $p = 2$ equal to 2.8740, which is lower than the critical value of 5.99147. The critical value is found on the basis of two degrees of freedom and a five percent significance level. As the computed LM statistic is lower than the critical value, the null hypothesis of no autocorrelation cannot be rejected. Thus, the time series does not suffer from autocorrelation.

$$\Delta TV2viewers = \beta_1 + \beta_2(TV2viewers_{t-1}) + \beta_3(\Delta TV2viewers_{t-1})^{20} \quad (6.1)$$

Turning to the numerically stationarity test, the ADF test is used, as it allows lags in the equation contrary to the normal DF test. The result from doing the ADF test is a tau value equal to -8.11. The critical tau value relevant in this situation is equal to -3.00. As the absolute tau value from running the regression is bigger than the absolute critical tau value $|-8.11| > |-3.00|$, the null hypothesis of non-stationarity is rejected. Thus, the numerical ADF test confirms what has already been implied by the graphical analysis, namely that the time series is stationary.

**Long run**

*Number of viewers* will now be considered in the period from 2000 to 2011 to see, if the outcome can back up the conclusion of the short run stationarity tests.

Firstly, the time series plotted against time implies that the time series can be characterised as a random walk with drift. The ACF decays in a wave like pattern, and the PACF has a significant spike at lag three, both implying stationarity.

Using the LM test to identify autocorrelation based on equation (6.2) below, the output with $p = 4$ is equal to 7.1783, which is lower than the critical value of 7.81473[21]. Thus, there is no problem with autocorrelation, as the null hypothesis cannot be rejected.

$$\begin{aligned} &\Delta TV2viewers = \\ &\beta_1 + \beta_2(TV2viewers_{t-1}) + \beta_3(\Delta TV2viewers_{t-1}) + \beta_4(\Delta TV2viewers_{t-2}) \end{aligned} \quad (6.2)$$

The ADF test returns a tau value equal to -0.08, which is lower than the critical value equal to -2.93[22] in absolute terms, thus the null hypothesis of non-stationarity cannot be rejected. It is a prerequisite that the time series is stationary in order to use the regression models developed later to predict future values of the dependent variable. Therefore, the time series must be transformed in order to achieve stationarity. A time series considered as a random walk can be transformed into being stationary by taking the difference of the time series, until stationarity is achieved. The ADF test is run again based on the first difference of the time series. The tau value has decreased to -6.33, which is higher than the critical value of -2.93 in absolute terms. Thus, the first difference of the time series has changed it to being stationary. A quick glance at the first dif-

[20] $\Delta$ refers to the difference of the time series and the subscript $t - p$ refers to the number of lags.
[21] The critical LM value has increased compared to the previous short run LM test because the number of explanatory variables in the equation has increased.
[22] The critical tau value has decreased compared to the previous short run critical tau value because the number of observations has increased.

ference plotted against time as well as the ACF and PACF (see appendix 1) shows a much more compelling picture of the time series stationarity.

Concluding, the initial graphical tests implied stationarity, whereas the numerical test implied non-stationarity. When transforming the time series by taking the first difference, the graphical and numerical analysis of stationarity were aligned. As described previously, the time series in the long run is marked by seasonality, which could be the reason, why the graphical analysis of stationarity did not align with the numerical tests of stationarity, before the time series was being transformed.

As the tests for stationarity in the long run implies non-stationarity, this will be taken into consideration when developing the regression model for TV 2.

#### 6.3.1.2 Time Series: *advertising revenue* of TV 2

A graphical analysis of *advertising revenue* implies that the time series is stationary, and it can be considered a random walk with drift. The ACF declines fast and in a wave like pattern, but the PACF does not show any significant spikes (see appendix 1). Before performing the numerical stationarity test, the time series is tested for autocorrelation. Running the LM test the output with $p = 2$ equals 1.1625, which is lower than the critical value of 5.99147. Thus, the null hypothesis cannot be rejected, which means that the time series does not suffer from autocorrelation. The LM test was based on the following equation:

$$\Delta TV2advrev = \beta_1 + \beta_2(TV2advrev_{t-1}) \tag{6.3}$$

The ADF test returns a tau value equal to -4.07, which in absolute terms is bigger than the critical tau value of -3.00, thus the null hypothesis of non-stationarity is rejected, meaning that the time series is stationary.

The analysis of the two variables *number of viewers* and *advertising revenue* for TV 2 has indicated that both time series are stationary in the short run. Contrary, the long run which applies to *number of viewers* showed that the time series were not stationary and needed to be transformed by taking first difference in order to be stationary. The two time series' output from the numerical stationarity test is summed up in the table below. Section 6.4 will take the outcome from both the short run and long run tests into account.

**Table 1: Augmented Dickey-Fuller Unit Root Test statistics**

| Variables – TV 2 | Type | Tau | Pr < Tau |
|---|---|---|---|
| **Short run** | | | |
| *Number of viewers* | Single mean | -8.11 | <.0001 |
| *Advertising revenue* | Single mean | -4.07 | 0.0128 |
| **Long run** | | | |
| *Number of viewers* | Single mean | -0.08 | 0.9454 |
| *Number of viewers with 1st difference* | Single mean | -6.33 | 0.0001 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (TV 2| DANMARK, 2003-2011).

### 6.3.2 Stationarity and Autocorrelation Tests for MTG

#### 6.3.2.1 Time Series: *number of viewers* of MTG

**Short run**

Looking at the scatter plot showing viewers of MTG plotted against time (see appendix 2) in the short run shows no trend, and can be considered as a random walk with drift. The ACF could imply stationarity, but it is difficult to conclude anything regarding stationarity. The PACF shows no significant spikes implying non-stationarity. Thus, the graphical analysis is of little use in order to get an idea whether the time series is stationary or not.

The LM test is performed to check for autocorrelation. The LM output from running equation (6.4) below equals 5.3344, which is lower than the critical value of 5.99147. Thus, the null hypothesis of no autocorrelation cannot be rejected.

$$\Delta MTGviewers = \beta_1 + \beta_2(MTGviewers_{t-1}) \quad (6.4)$$

The ADF test returns a tau value equal to -2.68, which is lower than the critical value of -3.00 in absolute terms. As the computed tau value is lower than the critical tau value the null hypothesis of non-stationarity cannot be rejected, and the time series must be transformed. The time series is considered a random walk with drift as described above, and thus the difference of the time series is taken, until the time series is stationary. The first difference of the time series is taken in order to see, if the tau value increases in absolute terms. The output from running the ADF test again is a tau value equal to -3.28, which in absolute terms is bigger than the critical tau value. Thus, the null hypothesis can be rejected, and the time series is transformed to being stationary.

**Long run**

The graphical analysis based on the long run is easier to interpret, because the sample consists of a larger number of observations. Looking at appendix 2 the ACF implies stationarity, as it decays in a wave like pattern. Additionally, the PACF has significant spikes at lag four and five. The time series can be characterised as a random walk with drift. Testing for autocorrelation using the equation below, the LM statistic for $p = 4$ equals 4.7156, which is lower than the critical value. Thus, there is no autocorrelation after the fifth lag.

$$\Delta MTGviewers = \beta_1 + \beta_2(MTGviewers_{t-1}) + \beta_3(\Delta MTGviewers_{t-1}) + \beta_4(\Delta MTGviewers_{t-2}) + \beta_5(\Delta MTGviewers_{t-3}) + \beta_6(\Delta MTGviewers_{t-4}) \quad (6.5)$$

The ADF test returns a tau value equal to -1.66, which is lower than the critical tau value in absolute terms. Thus, the time series is non-stationary. The first difference is taken in order to transform the time series to being stationary. The ADF test is run again with the first difference of the time series, and the tau value is still lower than the critical value. Therefore, the second difference of the time series is taken, and the ADF test run once again. The tau value has increased in absolute terms and now exceeds the critical value meaning that the time series has transformed to being stationary.

The long run analysis has supported the short run analysis in the way that the time series is not stationary to begin with. The time series according to the short run is transformed to being stationary, when the first difference is taken, whereas the long run requires the second difference to be taken, before the time series is transformed into being stationary.

#### 6.3.2.2 Time Series: *advertising revenue* of MTG

The graphical analysis of the *advertising revenue* time series implies stationarity. Checking equation (6.6) below for serial correlation, the LM statistic with $p = 2$ equals 1.9323, which is lower than the critical value, and therefore the time series does not suffer from autocorrelation.

$$\Delta MTGadvrev = \beta_1 + \beta_2(MTGadvrev_{t-1}) \quad (6.6)$$

The absolute tau value from the ADF test exceeds the critical tau value, as $|-6.72| > |-3.00|$, thus the time series is stationary.

Section 6.3.2.1 showed that time series of *number of viewers* had to be changed to first difference in order to be stationary in the short run, whereas the second difference was needed in the long run to transform the time

series into being stationary. The time series of *advertising revenue* did not need any transforming, as it was stationary in its basic form. The results from the ADF test are plotted in the table below.

**Table 2: Augmented Dickey-Fuller Unit Root Test statistics**

| Variables – MTG | Type | Tau | Pr < Tau |
|---|---|---|---|
| **Short run** | | | |
| *Number of viewers* | Single mean | -2.68 | 0.1090 |
| *Number of viewers with 1st difference* | Single mean | -3.28 | 0.0458 |
| *Advertising revenue* | Single mean | -6.72 | 0.0227 |
| **Long run** | | | |
| *Number of viewers* | Single mean | -1.66 | 0.4452 |
| *Number of viewers with 1st difference* | Single mean | -1.59 | 0.4766 |
| *Number of viewers with 2nd difference* | Single mean | -4.42 | 0.0010 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (MTG, 2000-2011).

### 6.3.3 Stationarity and Autocorrelation Tests for SBS

#### 6.3.3.1 Time Series: *number of viewers* of SBS

**Short run**

The scatter plot showing the time series of *number of viewers* of SBS plotted against time in appendix 3 can be characterised as a random walk with drift. The ACF implies stationarity, as it decays fast towards zero as well as in a wave like pattern. The PACF shows no significant spikes.

The LM test based on equation (6.8) below returns a LM statistic with $p = 2$ equal to 1.7459, which is lower than the critical value equal of 5.99147. Consequently, the null hypothesis of no autocorrelation cannot be rejected.

$$\Delta SBSviewers = \beta_1 + \beta_2(SBSviewers_{t-1}) + \beta_3(\Delta SBSviewers_{t-1}) \quad (6.7)$$

The ADF test returns a tau value equal to -2.68, which is lower than the critical tau value in absolute terms, thus the null hypothesis of non-stationarity cannot be rejected. The first difference of the time series is taken in order to see, whether it changes to being stationary. The tau value has decreased to -6.72, which exceeds the critical tau value in absolute terms, and therefore the time series has transformed to being stationary.

**Long run**

The long run analysis confirms the conclusions drawn on basis of the short run analysis to some extent. The time series in the long run can also be characterised as a random walk with drift. The ACF and PACF could

both imply stationarity. The LM test implies that there is no autocorrelation after the fifth lag based on the equation below:

$$\Delta SBSviewers = \beta_1 + \beta_2(SBSviewers_{t-1}) + \beta_3(\Delta SBSviewers_{t-1}) + \beta_4(\Delta SBSviewers_{t-2}) \quad + \beta_5(\Delta SBSviewers_{t-3}) \tag{6.8}$$

The tau value from running the ADF test does not exceed the critical value, and therefore the first difference of the time series must be taken. The tau value from running the ADF test on the time series in first difference does still not exceed the critical value, and thus the second difference of the time series must be taken. The ADF test is run once again, and this time the tau value exceeds the critical tau value as $|-3.50| > |-2.93|$.

The long run supports the short run analysis of stationarity to the extent that the time series is not stationary to begin with. The short run analysis implies that the first difference transforms the time series into being stationary, whereas the long run analysis states that the second difference should be taken in order to transform the time series into being stationary.

#### 6.3.3.2 Time Series: *advertising revenue* of SBS

The graphical analysis of the time series of *advertising revenue* of SBS implies non-stationarity. Furthermore, the scatter plot showing *advertising revenue* plotted against time shows that the time series can be considered as a random walk with drift. The LM test is run based on the following equation:

$$\Delta SBSadvrev = \beta_1 + \beta_2(SBSadvrev_{t-1}) \tag{6.9}$$

The LM statistic with $p = 2$ is equal to 3.1296, thus the null hypothesis of no autocorrelation cannot be rejected. The ADF test returns a tau value lower than the critical tau value as $|-2.29| > |-3.00|$. In order to transform the time series to being stationary, the first difference is taken. The tau value decreases to -8.47, which results in the null hypothesis of non-stationarity to be rejected.

The analysis of the two time series variables of SBS showed that both needed to be transformed into being stationary by taking the first difference of the time series. The output from the ADF test is summed up in Table 3.

**Table 3: Augmented Dickey-Fuller Unit Root Test statistics**

| **Variables – SBS** | **Type** | **Tau** | **Pr < Tau** |
|---|---|---|---|
| **Short run** | | | |
| *Number of viewers* | Single mean | -2.68 | 0.1117 |
| *Number of viewers with 1st difference* | Single mean | -6.72 | 0.0009 |
| *Advertising revenue* | Single mean | -2.29 | 0.1913 |
| *Advertising revenue with 1st difference* | Single mean | -8.47 | <.0001 |
| **Long run** | | | |
| *Number of viewers* | Single mean | -2.01 | 0.2823 |
| *Number of viewers with 1st difference* | Single mean | -2.09 | 0.2498 |
| *Number of viewers with 2nd difference* | Single mean | -3.50 | 0.0126 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (ProSiebenSat.1 2000-2011).

Concluding, the time series *number of viewers* and *advertising revenue* for each of the broadcasters TV 2, MTG and SBS have all been tested for stationarity, and if the time series were not already stationary, it has been transformed to fulfil the assumption regarding stationarity.

The next step in the econometric analysis is to set up the regression models for each of the three broadcasters based on the knowledge just gained.

## 6.4 Regression modelling

In this section the relationship between the two stationary variables *number of viewers* and *advertising revenue* for each of the three broadcasters, TV 2, MTG and SBS will be assessed. As stated in the introductory section 6.1 to the econometric analysis, it is expected that number of viewers can explain the development of advertising revenue, thus *number of viewers* is the explanatory variable, whereas *advertising revenue* is the dependent variable in the following regression models.

### 6.4.1 Regression Model for TV 2

When testing the time series *number of viewers* for stationarity, both a short and long run analysis was conducted. The short run analysis of *number of viewers* implied that the time series was stationary. Additionally, *advertising revenue* which is only being evaluated in the short run, also implied stationarity. The long run analysis of *number of viewers* had a different outcome. The long run analysis stated that *number of viewers* was not stationary and that first difference had to be taken in order to transform the time series into being stationary. In the light of the two different outcomes from the short and long run analysis respectively, two regression models will image the relationship between number of viewers and advertising revenue for TV 2.

MODEL A.1 is based the short run analysis, whereas MODEL A.2 is based on the long run analysis.

#### 6.4.1.1 MODEL A.1

The short run analysis of the two time series implied that both were stationary, thus MODEL A.1 is as follows:

MODELA.1 $$TV2advrev = \beta_1 + \beta_2(TV2viewers) \quad (6.10)$$

The above regression model is run in SAS, and the estimates of $\beta_1$ and $\beta_2$ are stated in the table below together with other relevant output from the regression.

**Table 4: Parameter estimates for MODEL A.1**

| Variable | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 57.20700 | 205.27307 | 0.28 | 0.7862 |
| TV2viewers | 30.15327 | 22.57025 | 1.34 | 0.2112 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (TV 2|DANMARK, 2003-2011).

As expected, the estimated $\beta_2$ for *number of viewers*, which is equal to 30.15327, is positive meaning that a positive change of one unit in viewers increases the dependent variable of advertising revenue for TV 2 by approximately 30.15. The t-value for *number of viewers* is equal to 1.34, which is lower than the critical

value of 1.812 with ten degrees of freedom at a five percent significance level. The variable is borderline significant at a ten percent significance level, where the critical value is equal to 1.372. The $R^2$ is equal to 0.1515 implying that the *number of viewers* is not sufficient in explaining the development of *advertising revenue*. The adjusted $R^2$ is equal to 0.066, which implies that approximately 7% of the changes in advertising revenue can be explained by the number of viewers, which is far below the initially expected.

Each of the regression models, developed throughout the econometric analysis, will be tested for the CLRM assumptions regarding normality, no autocorrelation and no heteroscedasticity in the error terms. It is not relevant to test for multicollinearity, as there is only one explanatory variable in the regression models.

In the following paragraph, the first model developed, namely MODEL A.1, will be tested for the assumptions stated above.

Firstly, a graphical and numerical analysis will be performed in order to test the residuals of the regression for normality. A histogram and Q-Q plot of the residuals will each be evaluated, and they are both generated by SAS. The histogram of the residuals shows a bell-shaped curve, thus implying normality. The residuals are approximately normally distributed when looking at the Q-Q plot, as a straight line seems to fit the data reasonably well. Thus, the graphical analysis implies that the residuals are normally distributed.

Testing for normality numerically, the JB test is run. The JB test returns a value of 0.6156, smaller than the critical value of 5.99147 at a five percent level, thus the null hypothesis of normality cannot be rejected. Thus, both the graphical and numerical state that the residuals are normally distributed.

Secondly, the LM test is run in order to test the model for autocorrelation. The LM output with $p = 2$ is equal to 6.0403, which is larger than the critical value of 5.99147, meaning that the null hypothesis of no autocorrelation is rejected, and the model suffers from autocorrelation in the error terms. The consequences of autocorrelation is among others that the t-test is no longer reliable as well as the $R^2$.

Thirdly, the White's test is used to check the model for heteroscedasticity. The analysis is performed on the residuals of the regression model. The test statistic $Q$[23] is equal to 3.0384, which is lower than the critical value of 5.99147, thus the null hypothesis of no heteroscedasticity cannot be rejected.

[23] $Q = n \cdot k$, where $n$ is the number of observations and $k$ is the number of explanatory variables in the auxiliary regression excluding the intercept term.

In the preceding paragraph it was stated that MODEL A.1 suffers from autocorrelation, thus the model should be transformed such that it does not have a problem of autocorrelation in order to fulfil the OLS regression assumptions stated previously. In order to remove the problem of autocorrelation the method of generalised least squares (GLS) is used. The transformation of the regression models is based on the generalised difference equation (6.11) stated below:

$$(Y_t - \rho Y_{t-1}) = \beta_1(1-\rho) + \beta_2(X_t - \rho X_{t-1}) + \varepsilon_t \qquad (6.11)\ [24]$$

The $\rho$ (= rho), which is a part of the GLS equation is known as the coefficient of autocovariance and lies in the interval between $-1$ and $+1$ (Gujarati & Porter, 2009). SAS reports an estimated value of $\rho$ when running the initial model. The estimated value of $\rho$ when running MODEL A.1 is $-0.476$ and will be used when applying the GLS method.

In the process of transforming the model, the first observation is lost, because it has no antecedent. In order to avoid losing the first observation the Prais-Winsten transformation is used. The first observation of $Y$ and $X$ is transformed by using the following: $Y_1\sqrt{1-\rho^2}$ and $X_1\sqrt{1-\rho^2}$ (Gujarati & Porter, 2009).

The new parameter estimates from running the transformed model are stated in Table 5 below.

**Table 5: Parameter estimates for MODEL A.1 corrected for autocorrelation**

| Variable | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | -134.7526 | 107.9169 | -1.25 | 0.2402 |
| TV2viewers | 46.7741 | 8.3105 | 5.63 | 0.0002 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (TV 2|DANMARK, 2003-2011).

The t-value regarding number of viewers has increased from 1.34 to 5.63 making the explanatory variable *number of viewers* significant at a five percent significance level. The t-value has increased so much that *number of viewers* is also significant at a one percent significance level. Additionally, the standard error has decreased and the $R^2$ and the adjusted $R^2$ have increased to 0.7601 and 0.7361, respectively. According to the adjusted $R^2$ approximately 74% of the changes in advertising revenue can be explained by the number of viewers, which are much more aligned with the prior expectation.

The LM test is run again in order to check that autocorrelation is not present in the transformed model. The LM output with $p = 2$ equals 0.6518, thus being lower than the critical value. Therefore, the model does no longer suffer from autocorrelation. The assumptions regarding normality and no heteroscedasticity are both still fulfilled, as the computed statistics are lower than the matching critical values. Additionally, the graphical test of normality is also still fulfilled.

[24] Gujarati & Porter, 2009, p. 442.

#### 6.4.1.2 MODEL A.2

Turning to MODEL A.2, the long run analysis of the time series *number of viewers* is the point of departure. The time series *number of viewers* was not stationary to begin with and needed to be transformed by taking the first difference. Normally, it is expected that both time series in the regression is either stationary or non-stationary. The advertising revenue has only been tested for stationarity in the short run, which is a fragile basis considering the small sample. Considering the normal conditions of the variables of a regression model just described and the doubtful stationarity test for *advertising revenue*, MODEL A.2 will assume that the *advertising revenue* has the same stationarity characteristics as *number of viewers*. Thus, MODEL A.2 is as follows:

MODEL A.2 $$\Delta TV2advrev = \beta_1 + \beta_2(\Delta TV2viewers) \quad (6.12)$$

The parameter estimates from running the regression in SAS are stated in Table 6 below.

**Table 6: Parameter estimates for MODEL A.2**

| Variable | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 13.1550 | 30.0719 | 0.44 | 0.6721 |
| ΔTV2viewers | 16.9217 | 27.7690 | 0.61 | 0.5573 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (TV 2|DANMARK, 2003-2011.

MODEL A.2 supplies a positive $\beta_2$ as expected, though it is not significant. Before continuing to interpret the parameter estimates, the model will be tested for the assumptions regarding normality, autocorrelation and heteroscedasticity.

The assumptions regarding normality and heteroscedasticity are both fulfilled. Though, the assumption regarding autocorrelation is not fulfilled. The LM statistic for $p = 2$ is equal to 9.4894, which exceeds the critical value, and gives rise to the null hypothesis of no autocorrelation cannot be rejected.

As done in a similar situation previously, the model will be transformed using the method of GLS. The SAS estimated $\rho$ used in the GLS equation is -0.865. The parameter estimates from the transformed model are stated in Table 7 below.

**Table 7: Parameter estimates for MODEL A.2 corrected for autocorrelation**

| Variable | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 14.04442 | 11.84796 | 1.19 | 0.2662 |
| ΔTV2viewers | 21.94399 | 8.93344 | 2.46 | 0.0364 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (TV 2|DANMARK, 2003-2011).

The $\beta_2$ is still positive, which is in line with the expectations stated in the introductory section Introduction6.1. The t-value regarding *number of viewers* is now significant at a five percent significance level, as the t-value exceeds the critical value of 1.833. Furthermore, the $R^2$ has increased from 0.0396 to 0.4014, which

indicates that the corrected model is a better fit. The adjusted $R^2$ has also increased and is now equal to 0.3348. This means that approximately 34% of the changes in advertising revenue can be explained by the number of viewers.

The corrected model is tested for the three assumptions regarding normality (see appendix 5), autocorrelation and heteroscedasticity. The three assumptions are fulfilled, and the parameter estimates from the regression model can therefore be trusted.

### 6.4.2 Regression Model for MTG

The procedure of the regression model for MTG will follow the one already performed for TV 2. Thus, two regression models will image the relationship between *number of viewers* and *advertising revenue* for MTG.

The stationarity tests performed with regards to the short run implied that *number of viewers* were non-stationarity and needed to be transformed, whereas *advertising revenue* was stationary. Normally, the two time series would either be stationary or non-stationary, which makes the short run stationarity outcome questionable. In the light of this, the regression model with the short run as point of departure will be disregarded, though an evaluation of the model is available in appendix 6.

Instead, the regression model for MTG will take its point of departure from the long run stationarity analysis.

#### 6.4.2.1 MODEL B.2

The long run stationarity analysis stated that *number of viewers* was not stationary and the second difference should be taken in order to transform the series into being stationary. Following the same procedure as previously done for MODEL A.2, *advertising revenue* is assumed to have the same stationarity characteristics as *number of viewers*. The model is stated below:

MODEL B.2 $$2\Delta MTGadvrev = \beta_1 + \beta_2(2\Delta MTGviewers)^{25} \quad (6.13)$$

The parameter estimates from running the regression in SAS are stated in Table 8.

[25] The number 2 before the Δ in the equation implies that it is the second difference of the time series.

**Table 8: Parameter estimates for MODEL B.2**

| Variable | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 3.65492 | 32.29172 | 0.11 | 0.9127 |
| 2ΔMTGviewers | 182.43045 | 80.94741 | 2.25 | 0.0543 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (MTG, 2000-2011).

The $\beta_2$ value is positive as expected and is moreover significant as the t-value exceeds the critical value. Before interpreting any further, the model is tested for normality, autocorrelation and heteroscedasticity.

The JB test returns a value equal to 0.5098, which is lower than the critical value of 5.99147. Therefore, the null hypothesis of normality cannot be rejected, and the model fulfils the assumption regarding normality.

Testing for autocorrelation in the error terms, the output from the LM test for $p = 2$ is equal to 6.9122, which exceeds the critical value of 5.99147. Hence, the null hypothesis of no autocorrelation cannot be rejected, and the model suffers from autocorrelation in the error terms.

The model does not suffer from heteroscedasticity, as the computed $Q$ statistic, equal to 2.3384, is lower than the critical value.

As the model suffers from autocorrelation, it should be transformed, otherwise the OLS estimates are not trustworthy. The method of GLS will be used in order to transform model such that it does not suffer from autocorrelation. The $\rho$ used in the GLS equation (6.11) when transforming MODEL B.2 is equal to -0.801. The parameter estimates from the transformed model are stated in Table 9 below.

**Table 9: Parameter estimates for MODEL B.2 corrected for autocorrelation**

| Variable | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 1.61144 | 10.50784 | 0.15 | 0.8819 |
| 2ΔMTGviewers | 76.33465 | 25.86587 | 2.95 | 0.0184 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (MTG, 2000-2011).

The $\beta_2$ is still positive as expected. Furthermore, the t-value regarding *number of viewers* is significant at a five percent significance level, as the computed t-value of 2.95 exceeds the critical value of 1.860. The $R^2$ has increased from 0.3883 to 0.5212, hence the corrected model is a better fit. Additionally, the adjusted $R^2$ is equal to 0.4614 meaning that approximately 46% of the changes in *advertising revenue* can be explained by *number of viewers*.

MODEL B.2 corrected for autocorrelation is tested for the assumptions regarding normality, autocorrelation and heteroscedasticity. The JB test, testing for normality returns a value of 0.7241, which is lower than the critical value. Hence, the null hypothesis of normality cannot be rejected, and the assumption is fulfilled.

Furthermore, the model does not suffer from either autocorrelation or heteroscedasticity. The LM test with $p = 2$ equals 4.9323 is lower than the critical value of 5.99147. The $Q$ statistic equals 0.2472, which is also below the matching critical value. Consequently, the null hypothesis of no autocorrelation cannot be rejected

and the null hypothesis of no heteroscedasticity cannot be rejected, meaning that the assumptions regarding autocorrelation and heteroscedasticity are fulfilled.

### 6.4.3 Regression Model for SBS

The relationship between *number of viewers* and *advertising revenue* of SBS will be evaluated with respect to the short and long run analysis of stationarity. Thus, two regression models named MODEL C.1 and MODEL C.2 will be evaluated.

#### 6.4.3.1 MODEL C.1

The regression model taking the short run stationarity analysis as point of departure is stated below:

MODEL C.1 $$\Delta SBSadvrev = \beta_1 + \beta_2(\Delta SBSviewers) \quad (6.14)$$

Both variables in the model needed to be transformed by taking first difference in order to be stationary. In relation to this, the first difference was taken, which induces a loss of the long run relationship between *number of viewers* and *advertising revenue* for SBS. This should be taken into consideration, when the model is used to forecast values of the dependent variable. More specifically, the model should not be used to forecast values in the long run, but only in the short run.

The estimated $\beta_2$ coefficient is positive as expected. One positive unit change of *number of viewers* will increase the dependent variable with 62.563. The t-value of the model is equal to 1.72, which is lower than the critical value of 1.833 at a five percent significance level. Changing the significance level to ten percent instead changes the significance of the explanatory variable. At the ten percent significance level the t-value of 1.72 exceeds the critical value of 1.383, thus the explanatory variable changes to being significant.

**Table 10: Parameter estimates for MODEL C.1**

| Variable | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 3.76410 | 6.64916 | 0.57 | 0.5852 |
| ΔSBSviewers | 62.56270 | 36.29444 | 1.72 | 0.1188 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (ProSiebenSat.1, 2000-2011).

In order to be able to rely on the conclusions drawn on the basis of the t-statistic and the $R^2$ value, the CLRM's assumptions must be fulfilled. The assumptions regarding normality, autocorrelation and heteroscedasticity will each be tested in the following.

Firstly, the model is tested for normality in the error terms. The graphical analysis implies that the residuals of the regression model are normally distributed. The histogram is somewhat bell-shaped, but the histogram

should be supported by the Q-Q plot, as the interpretation of the histogram could be misleading. The Q-Q plot implies normality in the error terms, as the residuals are approximately normal distributed. Turning to the numerical JB test, the output from running the test is 1.1719, which is smaller than the critical value. As the before mentioned statement holds, the null hypothesis of normality cannot be rejected, and the assumption is fulfilled.

Secondly, the LM test is performed in order to test for autocorrelation. The LM statistic with $p = 2$ equals 8.9040, which exceeds the critical value. Therefore, the null hypothesis of no autocorrelation cannot be rejected.

Thirdly, the White's test is used to test for heteroscedasticity. The $Q$ statistic is equal to 0.6666, which is lower than the critical value, meaning that the null hypothesis can be rejected. Thus, the model does not suffer from heteroscedasticity.

The LM test has identified a problem of autocorrelation in the regression. The problem of autocorrelation must be handled in order to use the regression model prospectively. The method of GLS is used to transform the regression model. The result from applying the GLS method is stated in the table below.

**Table 11: Parameter estimates for MODEL C.1 corrected for autocorrelation**

| Variable | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 5.07590 | 2.60166 | 1.95 | 0.0828 |
| ΔSBSviewers | 47.97436 | 11.73941 | 4.09 | 0.0027 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (ProSiebenSat.1, 2000-2011).

The t-value for *number of viewers* has increased to 4.09, which makes the variable significant at a five percent significance level. Furthermore, the variable is significant at a one percent significance level, as the t-value exceeds the critical value of 2.821. Besides, the standard error has decreased, and both the $R^2$ and the adjusted $R^2$ have increased. The $R^2$ has increased from 0.2482 to 0.6498 and the adjusted $R^2$ has increased from 0.1647 to 0.6109, thus both implying that the corrected model is doing far better than the first one.

The CLRM assumptions are checked again for the corrected model. The LM test returns a statistic for $p = 2$ equal to 0.0176, which is lower than the critical value of 5.99147, thus the corrected model does not suffer from autocorrelation.

The tests for normality and heteroscedasticity are performed with a positive result, and both assumptions are fulfilled.

#### 6.4.3.2 MODEL C.2

Both the short and long run stationarity tests stated that the time series *number of viewers* was not stationary to begin with. The short run stationarity test furthermore stated that the *advertising revenue* was not stationary to begin with. Both time series were transformed into being stationary by taking the first difference. The long run stationarity test states that *number of viewers* is transformed into stationarity, not by only taking first difference, but by taking second difference. As mentioned earlier, it is most common that the time series in a regression model has the same stationarity characteristics. Because of this and with the *advertising revenue*'s fragile basis for stationarity testing in mind, it is assumed that the *advertising revenue* has the same stationarity characteristics as *number of viewers* in the long run. Hence, the second model representing the relationship between *advertising revenue* and *number of viewers* is as follows:

MODEL C.2 $$2\Delta SBSadvrev = \beta_1 + \beta_2(2\Delta SBSviewers) \quad (6.15)$$

As the time series were not stationary to begin with, and needed to be transformed, one cannot interpret on the long run relationship between the variables in the regression model, as this information is lost when transforming the time series. This must be kept in mind, when the model is used to predict future values in section 7.

The parameter estimates from running MODEL C.2 in SAS are stated in Table 12 below.

**Table 12: Parameter estimates for MODEL C.2**

| Variable | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 0.43090 | 14.05898 | 0.03 | 0.9763 |
| 2ΔSBSviewers | 67.21464 | 55.27709 | 1.22 | 0.2587 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (ProSiebenSat.1, 2000-2011).

As expected the $\beta_2$ is positive, but *number of viewers* is not significant, as the t-value is lower than the critical value of 1.860, at a five percent significance level. Before interpreting further, the model will be tested for the CLRM's assumptions regarding normality, autocorrelation and heteroscedasticity.

The JB test returns a value equal to 1.2867, which is lower than the critical value, hence there is normality in the error terms, which fulfil the assumption.

Running the LM test returns a value for $p = 2$ equal to 8.9268, which exceeds the critical value. Because of this, the null hypothesis of no autocorrelation cannot be rejected, and the regression model suffers from autocorrelation in the error terms.

Testing for heteroscedasticity using White's test, the $Q$ statistic is equal to 5.0328, which is lower than the critical value meaning that there is no problem with heteroscedasticity.

The model is transformed using the GLS method, as the assumption regarding no autocorrelation is not fulfilled. The GLS equation (6.11) is used, and $\rho$ in this particular situation is equal to -0.910. The transformed MODEL C.2 is run in SAS, and the parameter estimates are stated in Table 13 below.

**Table 13: Parameter estimates for MODEL C.2 corrected for autocorrelation**

| Variable | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 0.25028 | 3.53202 | 0.07 | 0.9452 |
| 2ΔSBSviewers | 50.48639 | 10.92426 | 4.62 | 0.0017 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (ProSiebenSat.1, 2000-2011).

The $\beta_2$ is still positive and is now significant at a five percent significance level. Additionally, the variable is significant on a one percent significance level, as the t-value 4.62 exceeds the critical value of 2.896. Hence, the null hypothesis cannot be rejected meaning that *number of viewers* positively affects the *advertising revenue* of SBS.

Once again the model should be tested for the CLRM's assumptions regarding normality, autocorrelation and heteroscedasticity.

The assumptions regarding normality and heteroscedasticity are both fulfilled as the test statistics do not exceed the matching critical values, which entail that the null hypotheses of normality and no heteroscedasticity cannot be rejected. Furthermore, the LM test is run to test for autocorrelation. The LM statistic for $p = 2$ equals 1.6131, which does not exceed the critical value, so the null hypothesis of no autocorrelation cannot be rejected, and the model does no longer suffer from autocorrelation in the error terms.

The $R^2$ has increased from $0.1560$ to $0.7275$ implying that the model suffering from autocorrelation was not the best fit. Though, the transformed model does a much better job in describing the relationship between the two variables in question. Additionally, the adjusted $R^2$ has increased from $0.0505$ to $0.6934$ meaning that approximately 69% of the changes in SBS's advertising revenue can be explained by their number of viewers.

# 7 Forecasting

The regression models developed in the previous chapter will here be used as an instrument to forecast the advertising revenue of the three broadcasters in the first quarter of 2012. For the two broadcasters, TV 2|DANMARK and SBS two models were developed, namely one based on the short run stationarity tests and one based on the long run stationarity tests. For MTG two models were also developed, though the one based on the short run stationarity tests was disregarded in favour of the model based on the long run stationarity test, and therefore only the latter of the two will be used in this section.

The actual advertising revenue of the three broadcasters is read off from their first quarterly report of 2012. The advertising revenues of TV 2|DANMARK, MTG and SBS are stated in the table below.

**Table 14: Advertising revenue for the three broadcasters for Q1 2012**

| Broadcaster | Advertising revenue for Q1 2012 |
|---|---|
| TV 2\|DANMARK | 309.5 *DKK million* |
| MTG | 354.1 *SEK million* |
| SBS | 92.89 *EUR million* |

Source: Own creation based on data from (TV 2 |DANMARK, 2012-c), (MTG, 2012) and (ProSiebenSat.1, 2012).

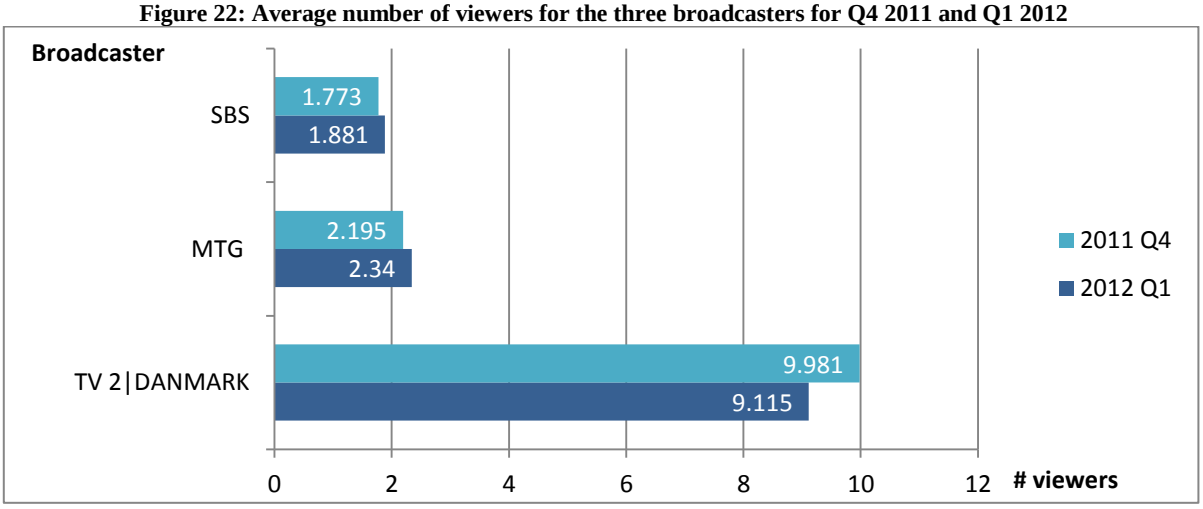
In order to find the estimated advertising revenues by using the developed regression models from section 6.4, the explanatory variable, *number of viewers*, for each of the broadcasters must be found. The *number of viewers* for each of the broadcasters can be read off from TNS Gallup's TV-Meter. In order to compare the predicted value of advertising revenue for each of the broadcasters with the actual advertising revenue, the number of viewers plugged into the developed regression models must represent the first quarter of 2012, thus match the period of the advertising revenue. Hence, the average number of viewers for the first quarter of 2012 is used to predict the estimated advertising revenue for the first quarter of 2012. Before the actual forecasting is performed, the viewer share between the broadcasters on the pay-TV market will be evaluated in order to see, if the change of TV 2 has had an impact.

## 7.1 Ex Ante[26] Effects on Number of Viewers

In order to see whether the change of TV 2 has had an impact on the number of viewers for the three broadcasters in question, the average number of viewers for the fourth quarter of 2011 will be compared with the average number of viewers for the first quarter of 2012. The average number of viewers for the two periods is shown in Figure 22 below.

[26] Ex ante refers to the period after the change of TV 2.

**Figure 22: Average number of viewers for the three broadcasters for Q4 2011 and Q1 2012**



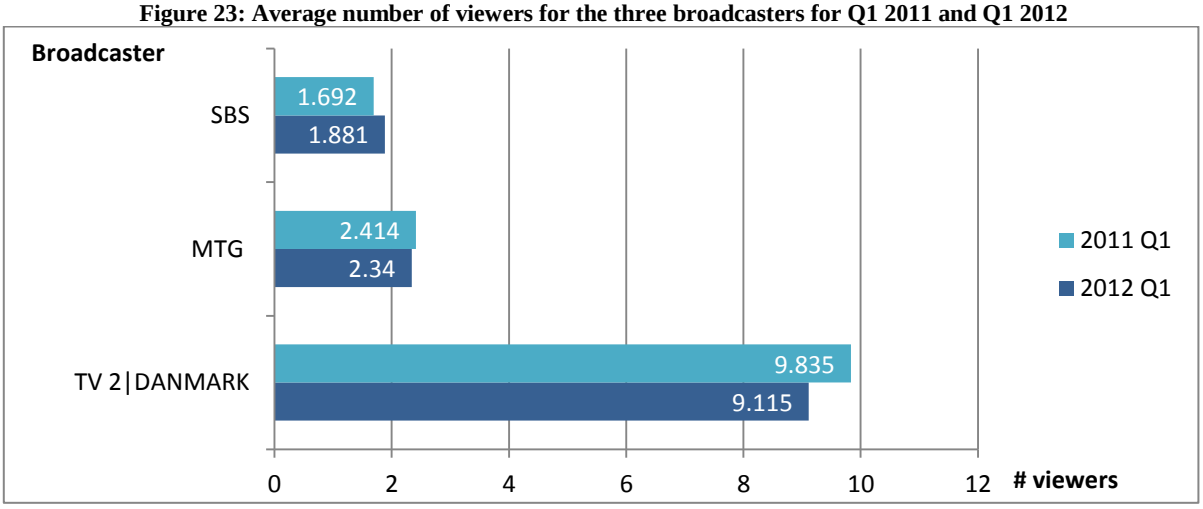

Source: Own creation based on data from (TNS Gallup's TV-Meter).

The figure shows that TV 2|DANMARK has lost viewers from the fourth quarter of 2011 to the first quarter of 2012. The average number of viewers for TV 2|DANMARK has been divided between the main channel and the niche channels in order to see, if the loss of viewers is linked to the change of TV 2. The main channel has decreased from 6.919 in the fourth quarter of 2011 to 6.124 in the first quarter of 2012. The niche channels have only decreased from 3.062 average number of viewers in the fourth quarter of 2011 to 2.992 average number of viewers in the first quarter of 2012. Hence, the main channel has decreased in number of viewers by 11.5%, whereas the niche channels have decreased in number of viewers by 2.3%. Consequently, the TV 2 group has decreased in number of viewers by 8.7% in total. Thus, the immediate effect of implementing subscription fees on the channel TV 2 has led it to lose viewers.

The two commercial broadcasters MTG and SBS have both gained viewers from the fourth quarter of 2011 to the first quarter of 2012. MTG's viewer share has increased with 6.6%, and SBS's viewer share has increased with 6.1%.

As mentioned in section 5.5, there is seasonality in the time series of *number of viewers* in the long run. Therefore, in order to make sure that the visible change from the fourth quarter of 2011 to the first quarter of 2012 is not caused by seasonality, a comparison between the first quarter of 2011 and the first quarter of 2012 is made and illustrated in Figure 23 below.

**Figure 23: Average number of viewers for the three broadcasters for Q1 2011 and Q1 2012**




Source: Own creation based on data from (TNS Gallup's TV-Meter).

The comparison between the two first quarters of 2011 and 2012, respectively, gives a slightly different outcome, as the average viewers of the broadcaster MTG has decreased from the first quarter of 2011 to the first quarter of 2012 contrary to the outcome shown in Figure 22. The decrease of MTG does only comprise approximately 3%, which could be caused by normal fluctuations in number of viewers. The tendency already shown in Figure 22 for TV 2|DANMARk and SBS is uphold by Figure 23 above. The broadcaster SBS has increased the number of viewers from the first quarter of 2011 to the first quarter of 2012. The increase is equal to 11.2%, which is a rather large increase for SBS. TV 2|DANMARK has lost viewers in the period, and the decrease is equal to approximately 7.3%. As only the first quarter of 2012 is included in Figure 22, the total effect of the change of TV 2 with respect to the broadcasting competitors is most likely not apparent yet. Hence, the most important indicator of the change of TV 2 is the number of viewers of TV2|DANMARK. This is true, because the immediate and most apparent effect of the change is the number of viewers, who do not subscribe to a distributor.

In the light of this, it seems like the commercial broadcasting competitors will gain viewers in the long run caused by the change of TV 2. In relation to this, the immediate shift of viewers is expected to be more apparent in the long run, as the viewers may take some time to adjust to the new settings on the pay-TV market. Specifically, it is expected that previous free-to-air viewers, who have subscribed to a package of TV channels, will change viewing behaviour, as their choice of channels has increased substantially.

Additionally, even though Figure 23 above shows a slightly different outcome than Figure 22, it is expected that Figure 22 is a good estimator of the effects of the change of TV 2, which shows an increase in number of viewers for the commercial broadcasting competitors. The reasoning behind the decision to deprioritise the comparison just described is caused by the seasonality's fluctuations. The season, which consists of four

quarters, is characterised by a summer and winter period as described in section 5.5. As the change of TV 2 happens in the middle of the winter period, the number of viewers from the fourth quarter of 2011 to the first quarter of 2012 is not expected to be marked significantly by seasonality.

Concluding, the change of TV 2 has caused TV 2|DANMARK to loose viewers. Furthermore, the change seems to have increased the number of viewers of the commercial broadcasters in the short run. Time will tell, if the effect on the commercial broadcasting competitors holds in the long run.

## 7.2 Predicting Advertising Revenue

In this section the developed regression models from section 6.4 will be used to predict the advertising revenue for the three broadcasters for the first quarter of 2012. Looking further ahead, the regression models will not sustain in predicting the advertising revenue, as they are only valid in the short run. Additionally, the three broadcasters have only published their first quarterly report for 2012, from which the actual advertising revenue is stated. In order to see if the change of TV 2 is permanent, the actual advertising revenues are needed to compare with the estimated advertising revenues computed by the developed regression models.

Even though, the change of TV 2 happened on the 11$^{th}$ January 2012, the first week of 2012 will not be excluded from the average number of viewers used in the regression models. The reason for this is that the actual advertising revenue stated by the three broadcasters is based on the full first quarter. In order to compare the estimated advertising revenue with the actual advertising revenue, the underlying basis, *number of viewers*, must be aligned.

The regression models of the three broadcasters will each be evaluated and compared in the following. Firstly, the regression models of TV 2 will be evaluated followed by the regression model of MTG and at last the regression models of SBS.

### 7.2.1 Predicting Advertising Revenue for TV 2

Two regression models fulfilling the CLRM's assumptions were developed to describe the relationship between advertising revenue and number of viewers for TV 2, namely MODEL A.1 and MODEL A.2, both corrected for autocorrelation. MODEL A.1 took its point of departure in the short run stationarity tests, whereas MODEL A.2 took its point of departure in the long run stationarity tests. Each model will be used to predict the advertising revenue for TV 2 for the first quarter of 2012.

The average number of viewers for the first quarter of 2012 for TV 2 is equal to 9.115. Plugging this into MODEL A.1, the result is as follows:

MODEL A.1

$$TV2advrev = \beta_1 + \beta_2(TV2viewers) \Leftrightarrow$$
$$TV2advrev = -134.7526 + 46.7741 * 9.115 = \mathbf{291.59} \quad (7.1)$$

MODEL A.2 represents the long run, where the two time series of the variables were not stationary to begin with. The first difference was taken in order to transform the time series into being stationary, so the variables of MODEL A.2 are in first difference. As the purpose of the model is to forecast the advertising revenue and not the first difference of the advertising revenue, MODEL A.2 is rewritten. The rewritten model requires data on number of viewers and advertising revenue in the fourth quarter of 2011. The required data is plugged into the equation, and the result is apparent in equation (7.2). The intermediary results are available in appendix 10.

MODEL A.2

$$\Delta TV2advrev = \beta_1 + \beta_2(\Delta TV2viewers) \Leftrightarrow$$
$$TV2advrev_{2012\,Q1} = 14.04442 + 21.94399(9.115 - 9.981) + 429.4 = \mathbf{424.44} \quad (7.2)$$

The short run model, MODEL A.1, estimates the advertising revenue to be DKK million 291.59, whereas the long run model, MODEL A.2, estimates the advertising revenue to be DKK million 424.44.

The actual advertising revenue stated by TV 2|DANMARK in their first quarterly report for 2012 is equal to DKK million 309.5. The actual advertising revenue exceeds the estimated value of MODEL A.1 and is lower than the estimated value of MODEL A.2. Hence, the predicted values from the two regression models underestimate and overestimate the earnings per viewer, respectively. As TV 2|DANMARK has lost viewers in relation to the change of TV 2, it was expected that the advertising revenue would be negatively affected. MODEL A.2 is expected to be more valid than MODEL A.1, as the stationarity tests are based on a larger sample than the first mentioned.

The regression models developed do not take the seasonality of number of viewers into account and thereby represent an average of the seasonality. The fourth quarter of 2011 and the first quarter of 2012 make up the peak season of number of viewers, which could explain, why the actual advertising revenue stated by TV 2|DANMARK is higher than the ones estimated using MODEL A.1. In the light of seasonality, MODEL A.2 could indicate that TV 2 has lost advertising revenue in relation to the change, as the estimated value is higher than the actual. The reason for this is that the model does not take the peak season into account meaning that the "true" estimated value would actually be even higher.

Though, as the difference between the actual and estimated advertising revenues is not that big and the interpretation is based on a small sample, it is difficult to draw any conclusions regarding advertising revenue related to the change of TV 2.

### 7.2.2 Predicting Advertising Revenue for MTG

Secondly, MODEL B.2 describing the relationship between advertising revenue and number of viewers for MTG will be used to forecast the estimated advertising revenue for MTG for the first quarter of 2012.

The average number of viewers for the first quarter of 2012 for MTG is equal to 2.340. The result from using MODEL B.2 to predict the advertising revenue for the first quarter of 2012 is stated below:

MODEL B.2

$$\begin{aligned} 2\Delta MTGadvrev &= \beta_1 + \beta_2(2\Delta MTGviewers) \Leftrightarrow MTGadvrev_{2012\,Q1} \\ &= 1.61144 + 76.33465(2.340 - 2 * 2.195 + 2.027) + 2 * 403.2 - 337.4 \\ &= \mathbf{468.75} \end{aligned} \tag{7.3}$$

The actual advertising revenue for MTG in the first quarter of 2012 is equal to SEK million 354.1.

The model overestimates the actual advertising revenue. The seasonality does not seem to explain the difference between the actual and estimated advertising revenue. Even though, the model developed may be good in describing the relationship between advertising revenue and number of viewers, the "true" model may include more explanatory variables. As MODEL B.2 is a gross simplification of the real world, the estimated value is expected not to be precise.

Like the regression models developed for TV 2, it is difficult to draw conclusions with respect to the outcome from MODEL B.2.

### 7.2.3 Predicting Advertising Revenue for SBS

Thirdly, the models describing the relationship between advertising revenue and number of viewers for SBS will be applied. The variables of MODEL C.1 are in first difference form, whereas the variables of MODEL C.2 are in second difference form. In order to estimate the advertising revenue, and not the first or second difference advertising revenue, the two models are rewritten, see (7.4) and (7.5) below. The intermediary results are stated in appendix 10.

The average number of viewers for the first quarter of 2012 plugged into the two models is equal to 1.881 as well as the other data needed to predict the advertising revenue. The predicted advertising revenues from using the two models developed are shown below:

MODEL C.1

$$\Delta SBSadvrev = \beta_1 + \beta_2(\Delta SBSviewers) \Leftrightarrow SBSadvrev_{2012\,Q1} = 5.07590 + 47.97436(1.881 - 1.773) + 127.84 = \mathbf{138.10} \quad (7.4)$$

MODEL C.2

$$2\Delta SBSadvrev = \beta_1 + \beta_2(2\Delta SBSviewers) \Leftrightarrow SBSadvrev_{2012\,Q1} = 0.25028 + 50.48639(1.881 - 2 * 1.773 + 1.469) + 2 * 127.84 - 86.99 \Leftrightarrow SBSadvrev_{2012\,Q1} = \mathbf{159.04} \quad (7.5)$$

The actual advertising revenue for SBS in the first quarter of 2012 is equal to 92.89. Both MODEL C.1 and MODEL C.2 overestimate the advertising revenue of SBS. As described previously, it is difficult to draw conclusions with respect to the estimated advertising revenue as the underlying basis is fragile.

Concluding, it is difficult to draw conclusions with respect to the estimated advertising revenues, as the underlying basis for the developed regression models is fragile. Furthermore, only one observation after the change of TV 2 is reported by the broadcaster making the basis for interpreting the change's effect on the broadcasters advertising revenue. As a result, the econometric analysis should not be used to draw conclusions outside the scope of this thesis.

# 8 Conclusion

This section will sum up the entire thesis. The overall purpose of the thesis was to figure out, how the change of TV 2 from a free-to-air channel to a pay-TV channel has affected TV 2|DANMARK and the two main commercial competitors, MTG and SBS.

The three sub-questions stated in section 1.1.1 will be reviewed and used in order to answer the main research question.

The Danish pay-TV market can be characterised as a two-sided market. An overall two-sided market and one embedded are apparent on the pay-TV market. On the overall market, the distributors act as a platform between the two sides of broadcasters and viewers, respectively. On the nested two-sided market the broadcaster enables the interaction between advertisers and viewers. Hence, the viewers are apparent on both markets, but are only charged by one of the platforms. Given that the pay-TV market is characterised as two-sided, some prerequisites must be in place, before the change of TV 2 would be significant to the commercial broadcasters.

One of the major prerequisites is that viewers must subscribe to a distributor. Boxer TV and TDC TV have incurred a large intake of subscribers in relation to the change of TV 2. The viewers can be delimited in their choice of distributor, as the accessibility is dependent on the geographical location of the household.

Having established a thorough understanding of the pay-TV market, the econometric analysis is conducted. Before developing the regression models, the time series *number of viewers* and *advertising revenue* are tested for stationarity. Stationarity in the time series is a prerequisite for the models to be used to predict future values. If the time series were not already stationary, they were transformed. Number of viewers is available for a longer period than advertising revenue, and thus the stationarity tests are based on a short and long run period in order to increase the validity of the econometric analysis.

Subsequently, the regression models for the three broadcasters are developed. The models are tested for the CLRM's assumptions regarding normality, autocorrelation and heteroscedasticity. If not fulfilled the model is changed using the GLS method. Valid for all the regression models, which fulfil the CLRM assumptions, is that number of viewers can explain changes in advertising revenue. Furthermore, the two variables are positively related. Thus, the models confirm the prior expectation.

Lastly, the regression models developed are used to predict the estimated advertising revenue for the first quarter of 2012. As the developed regression models are based on historical data, the change should be apparent, when the actual and estimated values are compared. It is difficult to draw conclusions based on the

estimated advertising revenue computed by the regression models, as the underlying basis is fragile. Furthermore, number of viewers is marked by seasonality, which is not included in the regression models making the estimated value doubtful. Considering the change in number of viewers it seems like the commercial broadcasters are gaining viewers, whereas TV 2 has lost viewers. Whether the change of TV 2 will have a permanent effect on the pay-TV market and the commercial broadcasters will not be apparent in the short run considered in the thesis, but in the long run it should be observable.

## 8.1 Suggestions for Further Investigation

As TV 2 changed from free-to-air to pay-TV channel in the beginning of 2012, only the first quarterly advertising revenue for 2012 stated by the broadcasters could be compared with the estimated advertising revenue predicted by the regression models. One observation is a fragile basis to determine, whether the change of TV 2 has had an effect on the advertising revenue of TV 2|DANMARK, MTG and SBS, though, it can give a hint to the long run changes. Thus, it is suggested that the regression models are used to predict the advertising revenue of the three broadcasters at a reasonable time after the change of TV 2. This will increase the number of observations and give the researcher a better idea of, how the change of TV 2 has affected the pay-TV market and the three broadcasters.

Furthermore, it could be interesting to investigate, if the regression models could be improved by adding additional variables, such that the estimated advertising revenue might be closer to the "true" value. An example of such a variable could be the GDP or the Danish advertising spending, as they could affect the advertising revenue. In the light of this, it could be interesting to figure out, how the regression models would change, if it was possible to incorporate the seasonality of number of viewers.

# 9 References

Andersen, I., 2004. *Guide til problemformulering – i projektarbejder inden for samfundsvidenskaberne*. First edition, second printing. Forlaget Samfundslitteratur.

Boxer, 2012. *Boxer runder 300.000 kunder*. Press release. Available at http://www.boxertv.dk/kundeservice/om-boxer/Presse/Pressemeddelelser/10februar2012/ [Accessed June 8, 2012]

Breinstrup, T., 2009. *TDCs guldæg slår revner*. Available at http://www.business.dk/digital/tdcs-guldaeg-slaar-revner [Accessed April 27, 2012]

Dansk Oplagskontrol, 2002-2011. *The Danish Advertising Expenditure Survey from 2002 to 2011*.

DR, 2012. Hvem skal betale licens? Available at http://www.dr.dk/OmDR/Licens/Privat/FAQ_Privat/Hvem%20skal%20betale%20licens.htm [Accessed March 3, 2012]

DR Medieforskning, 2011. *Medieudvikling 2011*. Available at http://www.dr.dk/NR/rdonlyres/D0F84992-F0E6-4107-A2B2-72B6F35B42D4/3471656/medieudv2011_download.pdf [Accessed April 23, 2012]

Europa-Kommissionen, 2008. *Kommissionen godkender redningslån til TV 2.* Press release. Available at http://ec.europa.eu/danmark/eu-politik/alle_emner/konkurrence/2008/080804_tv2-godkendt_da.htm [Accessed April 20, 2012]

Europa-Kommisionen, 2011. *Kommissionen godkender TV 2-støtte*. Press release. Available at http://ec.europa.eu/danmark/eu-politik/alle_emner/konkurrence/2011/110420_tv2_da.htm [Accessed April 20, 2012]

Gujarati D. N. & Porter, D. C., 2009. *Basic Econometrics*. Fifth edition. McGraw-Hill.

IT & Telestyrelsen, 2009. *Åbning for adgang til bredbånd via kabel-tv infrastrukturen på engrosmarkedet for bredbåndstilslutninger (marked 5).* Available at http://www.itst.dk/tele-og-internetregulering/smp-regulering/markedsundersogelser/filarkiv/marked-5/Gartner%20rapport%20-%20Engros%20bredband%20via%20kabel%20v1%200.pdf [Accessed April 20, 2012]

Konkurrencestyrelsen, 2003. *A Powerful Competition Policy – Report from the Nordic competition authorities*. Available at http://www.statensnet.dk/pligtarkiv/fremvis.pl?vaerkid=23084&reprid=0&filid=36&iarkiv=1 [Accessed June 10, 2012]

Konkurrence- og Forbrugerstyrelsen, 2011. *Distribution af tv-kanaler*. Konkurrence- og Forbrugeranalyse 07/2011.

Kulturministeriet, 2011. *Bred politisk aftale om ændret abonnementsbetaling for TV 2*. Press release. Available at http://kum.dk/nyheder-og-presse/pressemeddelelser/2011/marts/bred-politisk-aftale-om-andret-abonnementsbetaling-for-tv-2/ [Accessed April 3, 2012]

Kulturstyrelsen, 2011. *TV 2|DANMARK*. Available at http://www.bibliotekogmedier.dk/medieomraadet/tv/tv-2danmark-as/ [Accessed April 12, 2012]

La Cour, L., 2009-a. *Autocorrelation.* Teaching notes in Applied Econometrics.

La Cour, L., 2009-b. *Normality.* Teaching notes in Applied Econometrics.

MTG, 2000-2011. *Annual and quarterly reports from 2000 to 2011*. Available at http://www.mtg.se/en/investors/annual-reports/ and http://www.mtg.se/en/investors/quarterly-reports/ [Accessed June 8, 2012]

MTG, 2012. *Q1 2012 Report*. Available at http://www.mtg.se/documents/pdf/reports/en/1658625.pdf [Accessed June 8, 2012]

Pepall, L., Richards, D. & Norman, G., 2008. *Industrial Organization. Contemporary Theory and Empirical Applications*. Fourth edition. Blackwell Publishing Ltd.

Politiken, 2011. *YouSee får konkurrence på sit kabelnet*. Available at http://politiken.dk/tjek/digitalt/internet/ECE1257748/yousee-faar-konkurrence-paa-sit-kabelnet/ [Accessed March 26, 2012]

ProSiebenSat.1, 2000-2011. *Annual and quarterly reports from 2000 to 2011*. Available at http://en.prosiebensat1.com/en/media-lounge/downloads/publications/2010 [Accessed April 20, 2012]

ProSiebenSat.1, 2012. *Quarterly Report Q1 2012*. Available at http://en.prosiebensat1.com/media/3474744/e_q1_2012.pdf [Accessed June 8, 2012]

Rochet, J.C. & Tirole J., 2006. *Two-Sided Markets: A Progress Report*. The RAND Journal of Economics, Vol. 37, No. 3 (Autumn, 2006), pp. 645-667.

Saunders, M., Lewis, P. & Thornhill, A., 2009. *Research Methods for Business Students*. Fifth edition. Prentice Hall.

Seidenfaden, R.G, 2011. *De kommercielle TV-kanaler gør klar til at kæmpe om seere og annoncekroner, når TV 2 bliver betalingskanal efter nytår*. Available at http://www.business.dk/media/tv-kanaler-ruster-sig-til-kamp [Accessed April 27, 2012]

TD, 2012. *TV 2 forventer at tabe 123.000 husstande*. Available at http://mir.dk/spip.php?article7350 [Accessed May 6, 2012]

TDC, 2011. *Årsrapport 2011.* Available at http://investor.tdc.dk/annuals.cfm [Accessed June 8, 2012]

TDC, 2012-a1. *Delårsrapport januar-marts 2012.* Available at http://investor.tdc.dk/annuals.cfm [Accessed June 8, 2012]

TDC, 2012-a2. *TDC Dataark 1. Kvartal 2012*. Regnskabsmeddelelser. Available at http://investor.tdc.dk/annuals.cfm [Accessed June 8, 2012]

TDC, 2012-b. *Kundefremgang hos TDC.* Press release. Available at http://presse.tdc.dk/pressemeddelelser/kundefremgang-hos-tdc-759179 [Accessed June 8, 2012]

Teracom Group, 2009-2010. *Interim Reports from 2009 to 2010*. Available at http://www.teracom.se/Teracom_Group/Finansiellinformation/Rapportarkiv/ [Accessed June 8, 2012]

Teracom Group, 2011-a. *Interim Report January – September 2011*. Available at http://www.teracom.se/Teracom_Group/Finansiellinformation/Rapportarkiv/ [Accessed June 8, 2012]

Teracom Group, 2011-b. *Q4/Year-End Report 2011*. Available at http://www.teracom.se/Teracom_Group/Finansiellinformation/Rapportarkiv/ [Accessed June 8, 2012]

Teracom Group, 2012. *Interim Report January – March 2012.* Available at http://www.teracom.se/Teracom_Group/Finansiellinformation/Rapportarkiv/ [Accessed June 8, 2012]

TNS Gallup, 2012. *TV-Meter*. Available at http://tnsgallup.dk/vores-markedsfokus/medier/tv-meter.aspx [Accessed April 10, 2012]

TNS Gallup TV-Meter. *Seertal*. Press release. Available at http://tvm.gallup.dk/tvm/pm/default.htm [Accessed April 10, 2012]

TV 2|DANMARK, 2003-2011. Annual and quarterly reports from 2003 to 2011. Available at http://omtv2.tv2.dk/index.php?id=67 [Accessed April 20, 2012]

TV 2|DANMARK, 2001. *TV 2 Public Service-Beretning 2001*. Available at http://omtv2.tv2.dk/index.php?id=66 [Accessed April 20, 2012]

TV 2|DANMARK, 2002. *TV 2 Public Service-Beretning 2002*. Available at http://omtv2.tv2.dk/index.php?id=66 [Accessed April 20, 2012]

TV 2|DANMARK 2009. *Historie*. Available at http://omtv2.tv2.dk/index.php?id=68 [Accessed June 21, 2012]

TV 2|DANMARK, 2012-a. *Hvordan beholder jeg TV 2?* Available at http://behold.tv2.dk/tv-loesninger/ [Accessed April 20, 2012]

TV 2|DANMARK, 2012-b. *Priser & Betingelser 2012*. Available at http://tv2mediaforum.dk/artikel/priser-og-betingelser-2012 [Accessed April 20, 2012]

TV 2|DANMARK, 2012-c. *Kvartalsrapport for 1. kvartal 2012.* Available at http://omtv2.tv2.dk/index.php?id=67 [Accessed June 8, 2012]

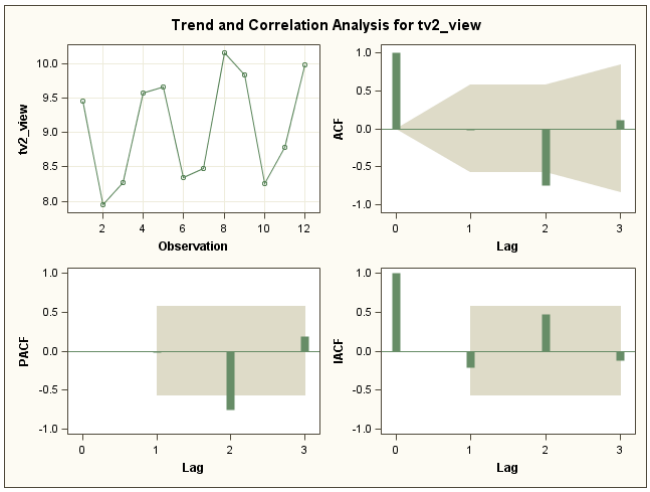
Wooldridge, J. M., 2009. *Introductory Econometrics, A modern approach*. Fourth edition. South Western Cengage Learning.

# Appendices

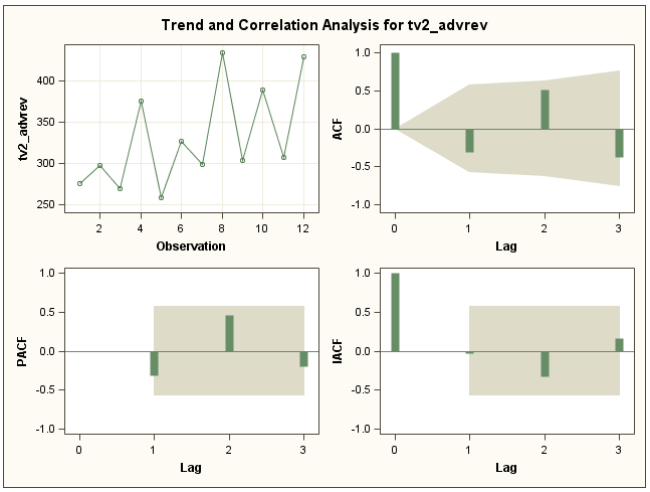
# Appendix 1 – Trend and Correlation Analysis for the Time Series of TV 2

**Short run**

Number of viewers for TV 2

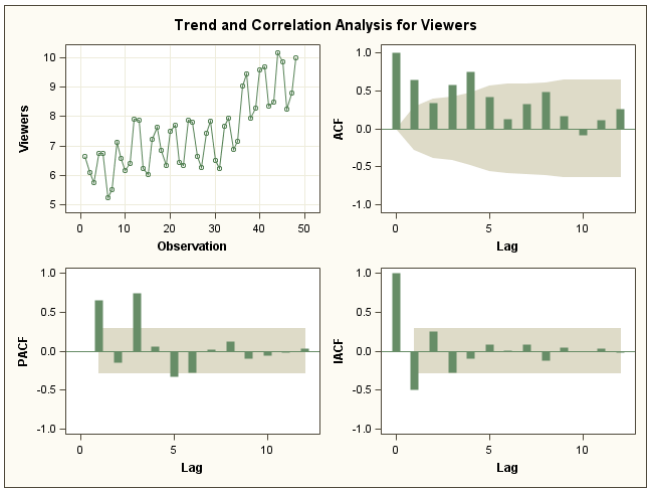



Advertising revenue of TV 2

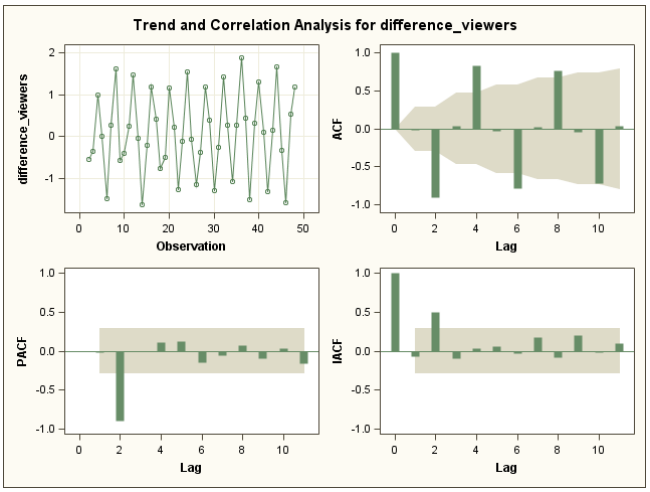



**Long run**

Number of viewers for TV 2



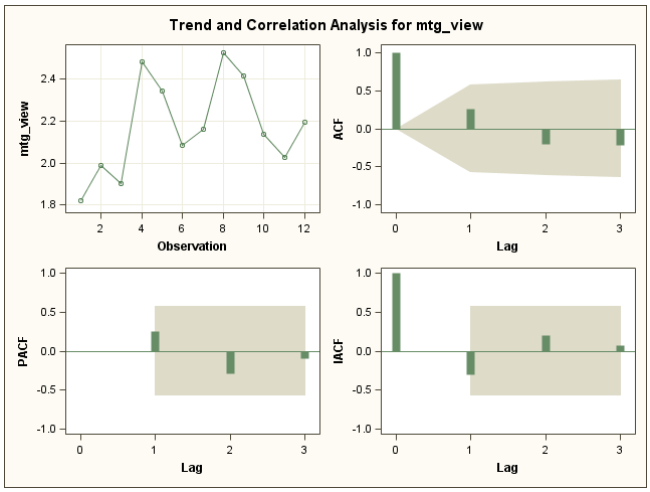

Number of viewers for TV 2 in first difference



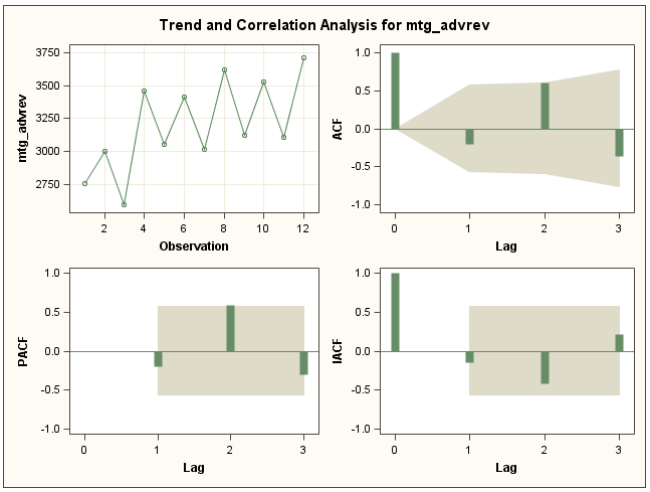
# Appendix 2 – Trend and Correlation Analysis for the Time Series of MTG

**Short run**

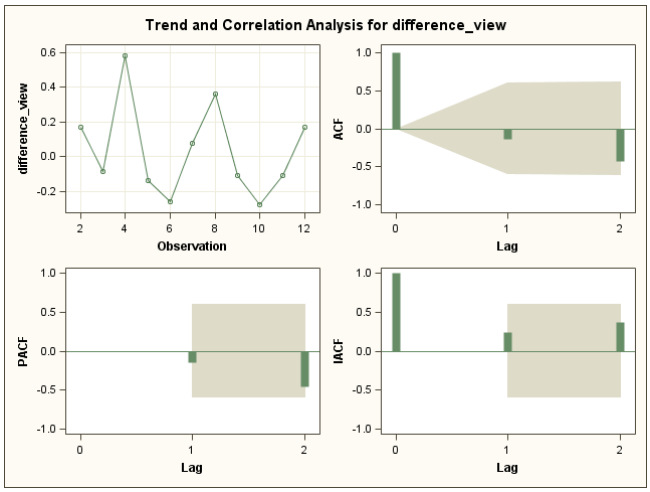
Number of viewers for MTG




Advertising revenue of MTG

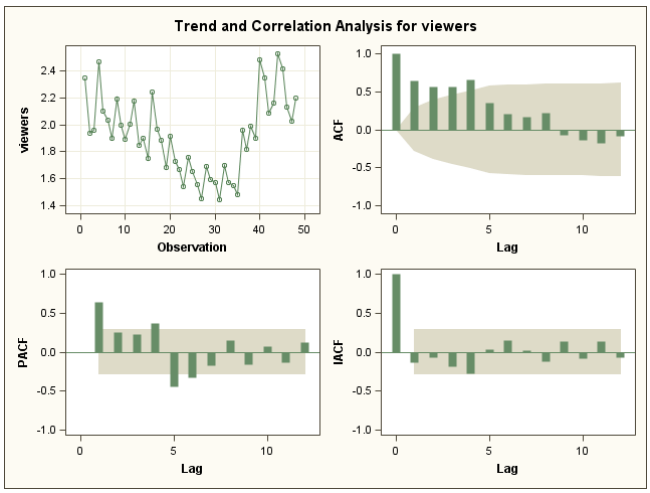



Number of viewers for MTG in first difference

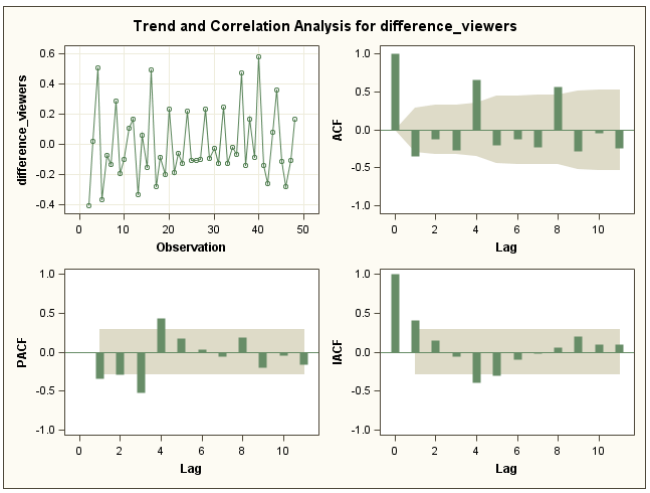


**Long run**

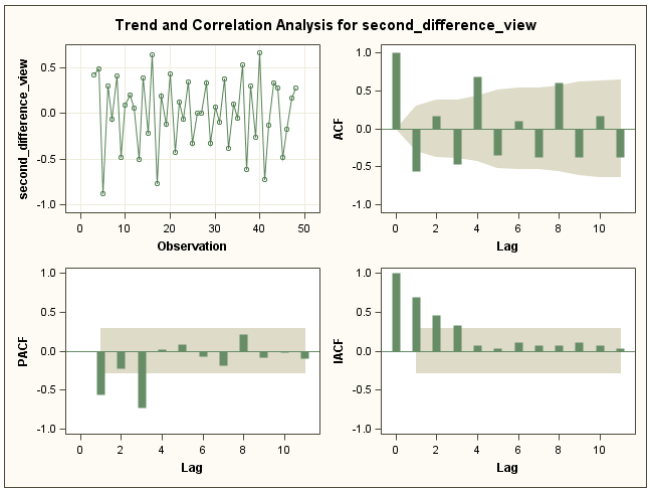
Number of viewers for MTG




Number of viewers for MTG in first difference



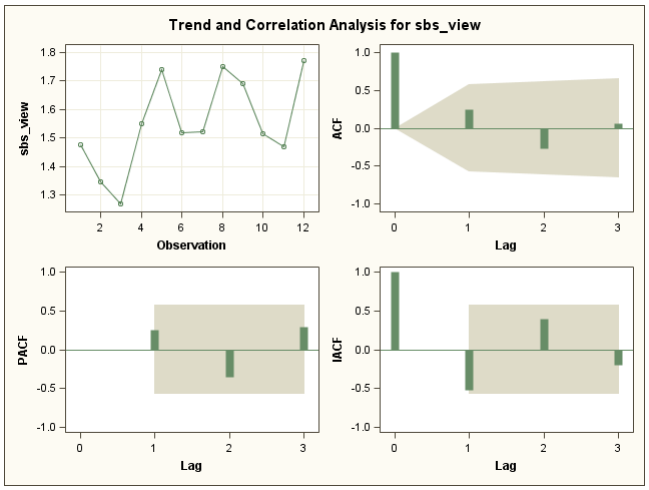

Number of viewers for MTG in second difference



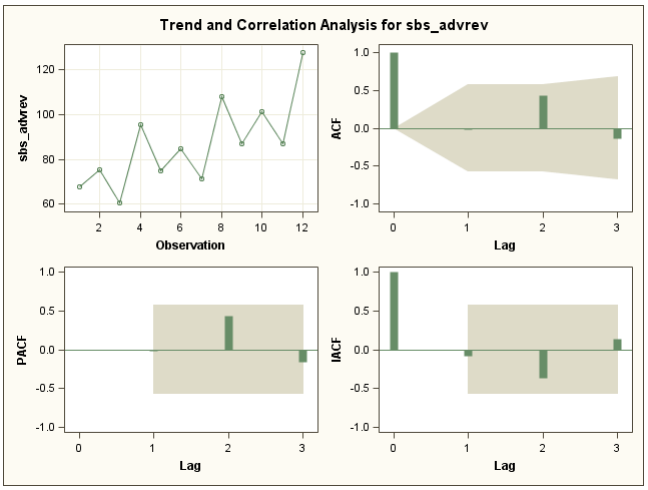
# Appendix 3 – Trend and Correlation Analysis for the Time Series of SBS

**Short run**

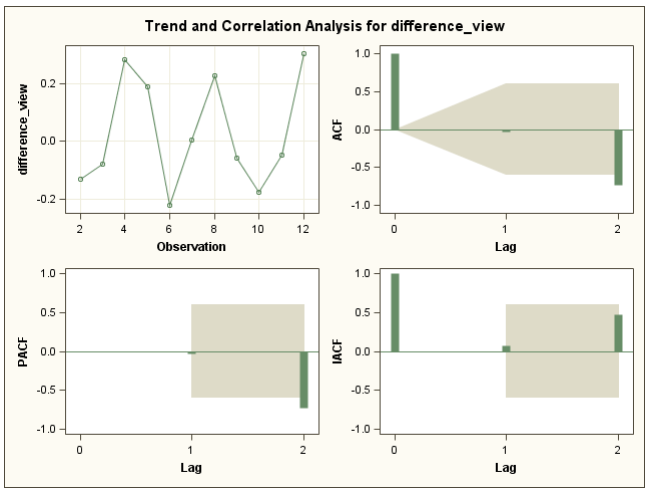
Number of viewers for SBS



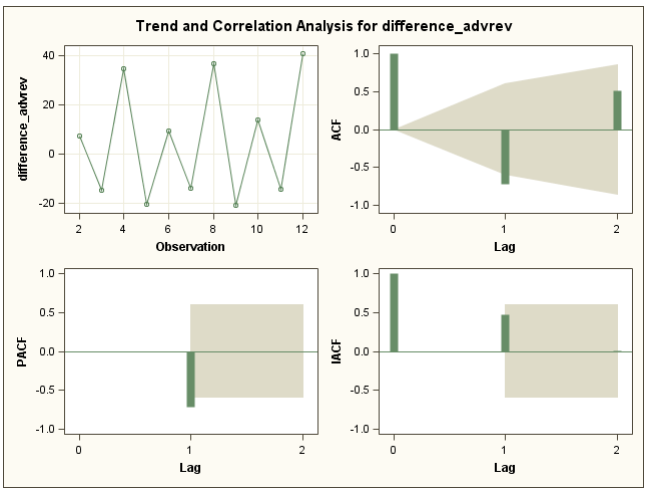

Advertising revenue of SBS




Number of viewers for SBS in first difference

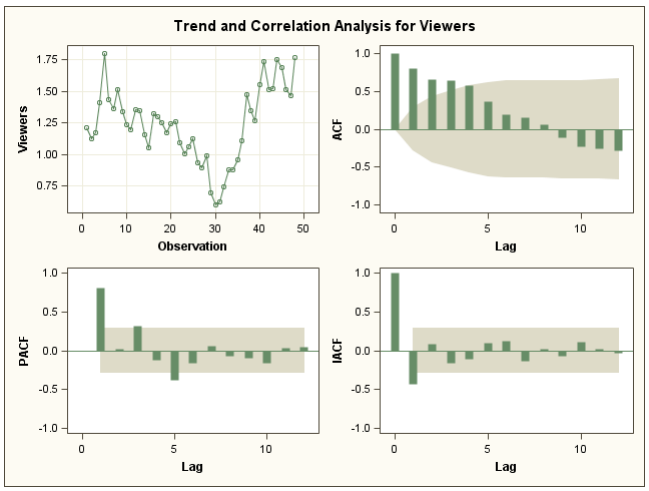



Advertising revenue of SBS in first difference

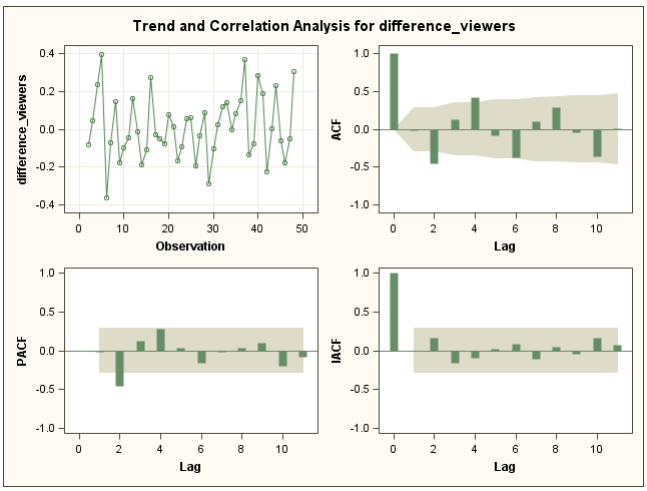


**Long run**

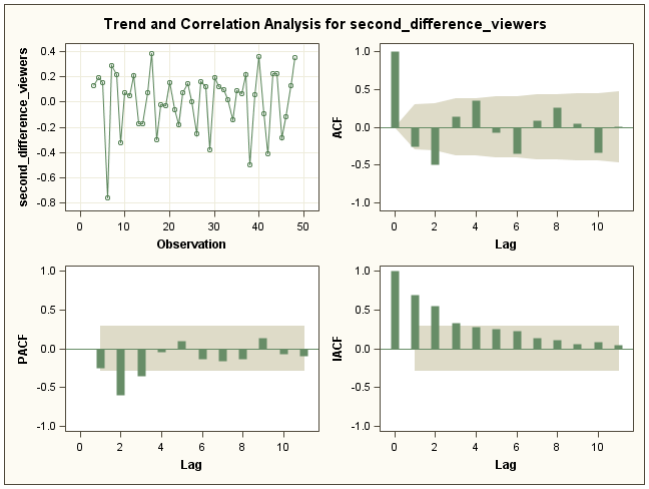
Number of viewers for SBS




Number of viewers for SBS in first difference



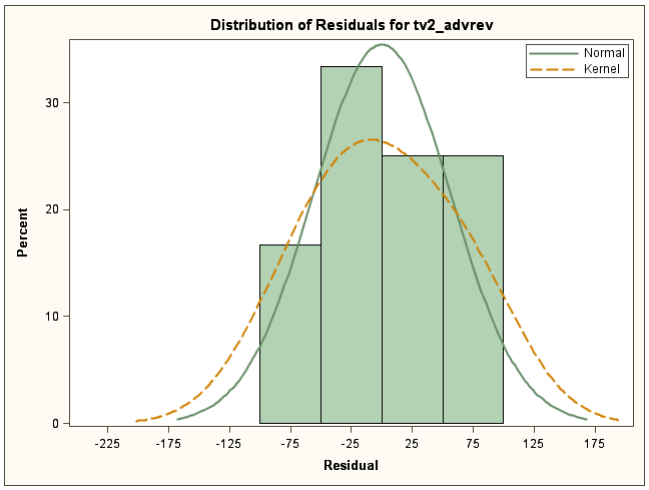

Number of viewers for SBS in second difference



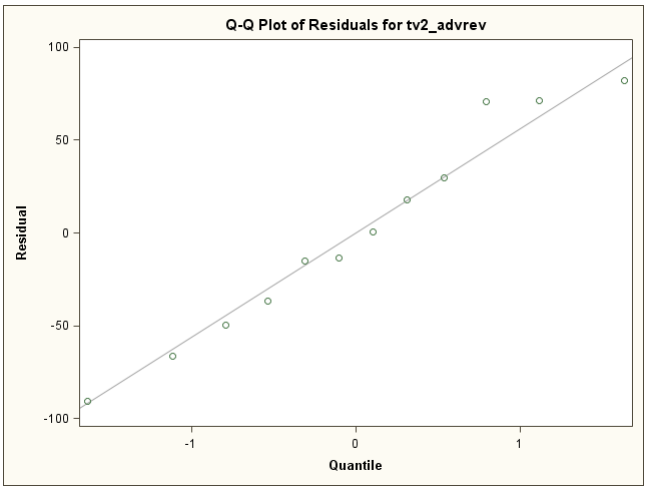
# Appendix 4 – Histogram and Q-Q plot for MODEL A.1

**MODEL A.1**

Histogram

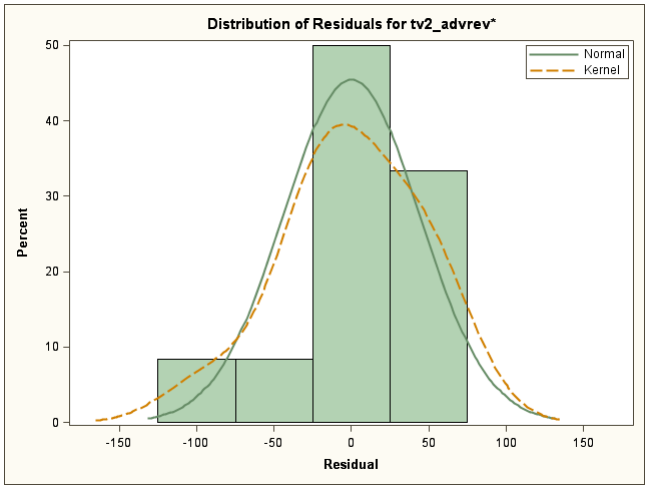



Q-Q plot

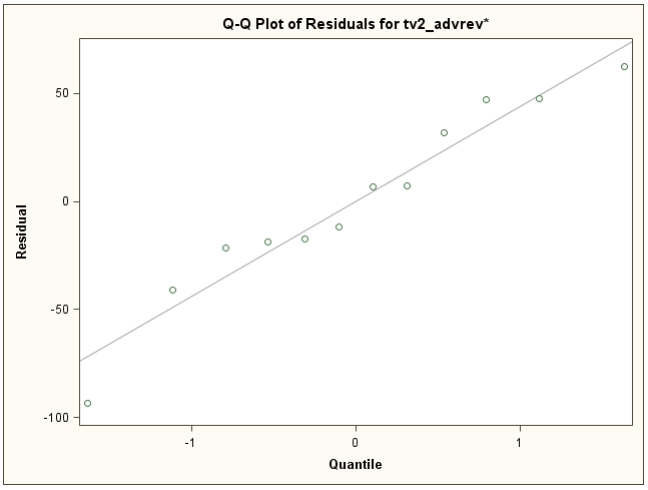



**MODEL A.1 corrected for autocorrelation**

Histogram



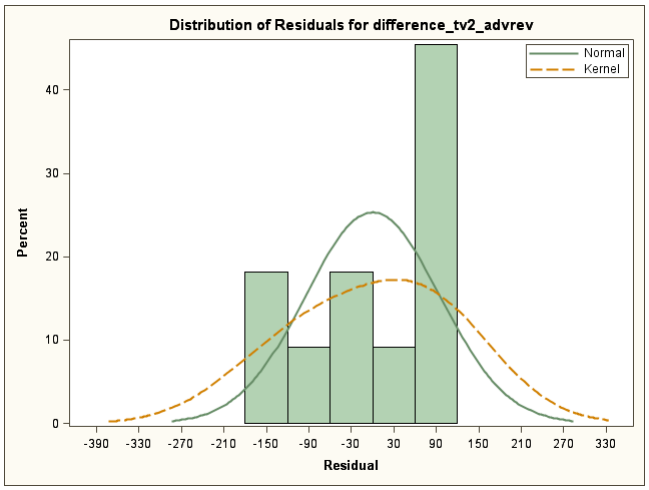

Q-Q plot



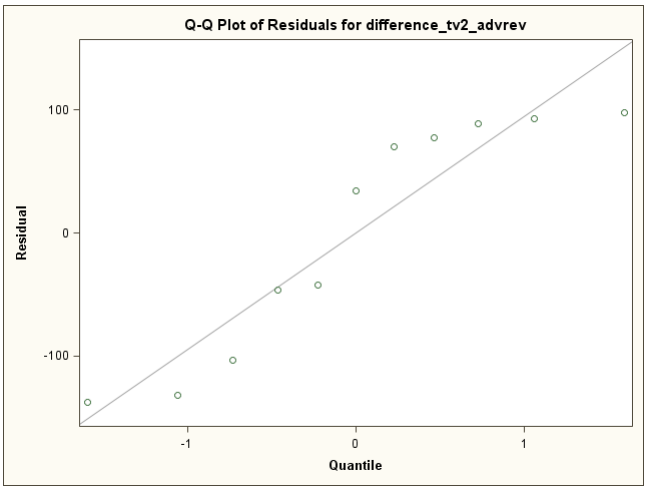
# Appendix 5 – Histogram and Q-Q plot for MODEL A.2

**MODEL A.2**

Histogram

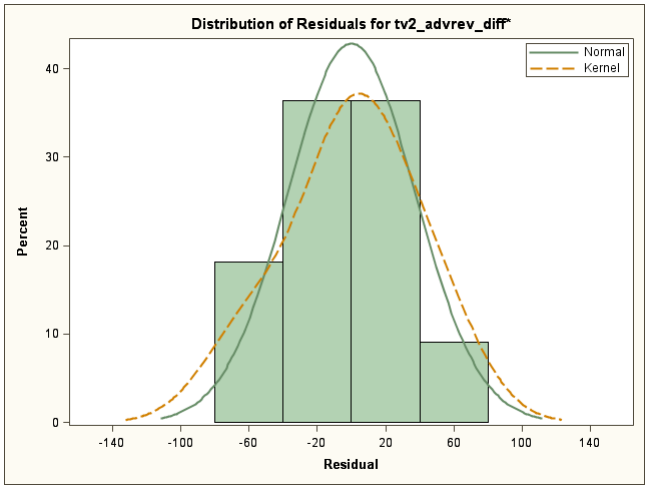



Q-Q plot

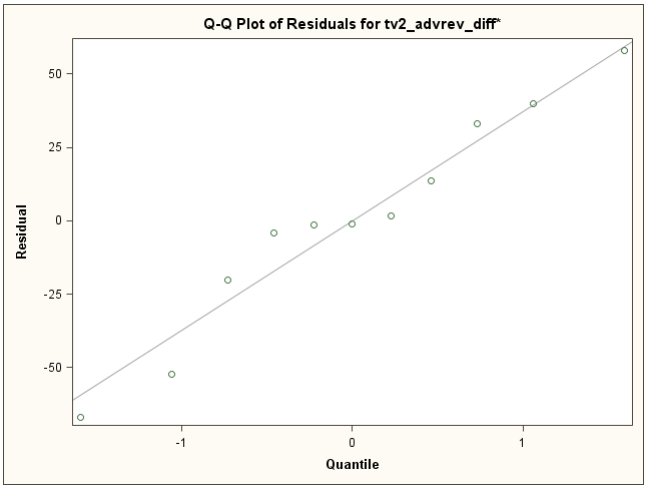



**MODEL A.2 corrected for autocorrelation**

Histogram



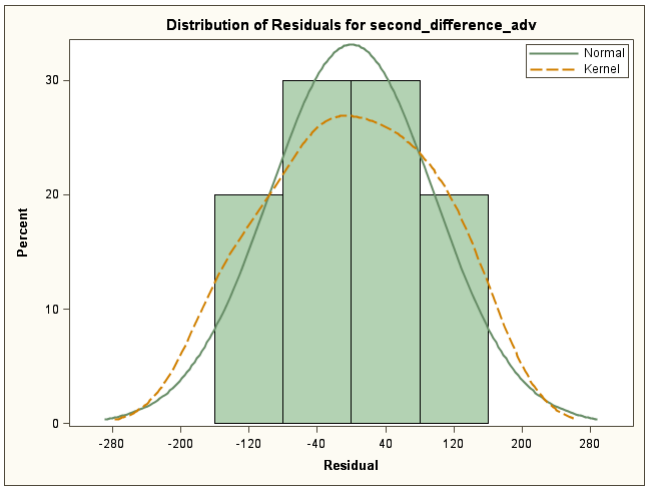

Q-Q plot



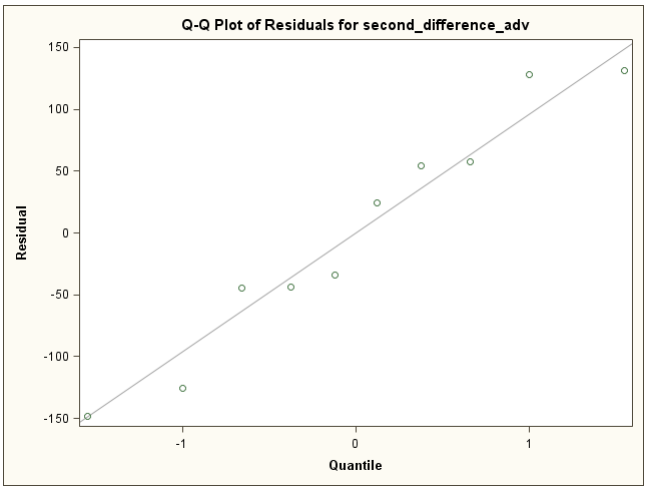
# Appendix 6 – Histogram and Q-Q plot for MODEL B.2

**MODEL B.2**

Histogram

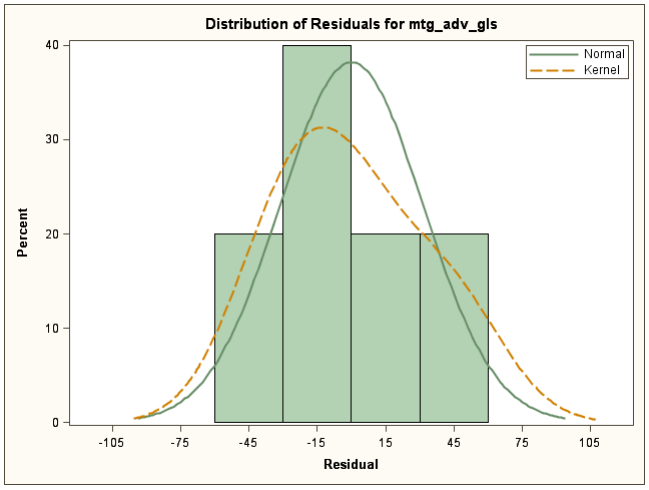



Q-Q plot

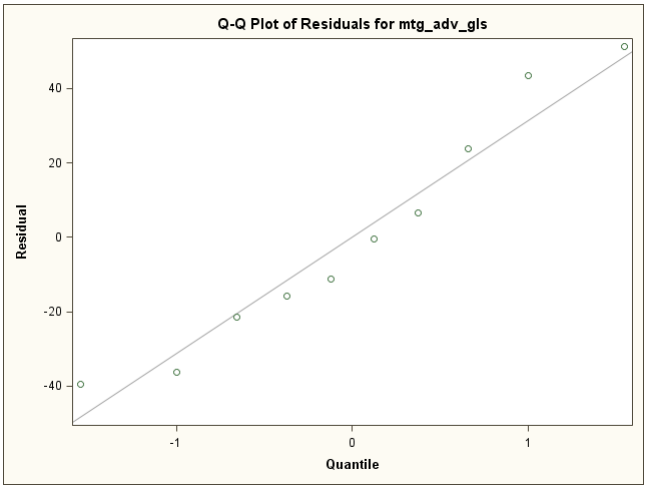



**MODEL B.2 corrected for autocorrelation**

Histogram



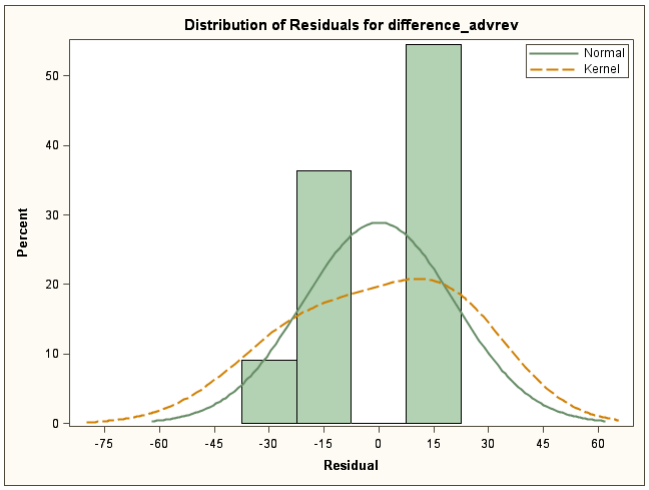

Q-Q plot



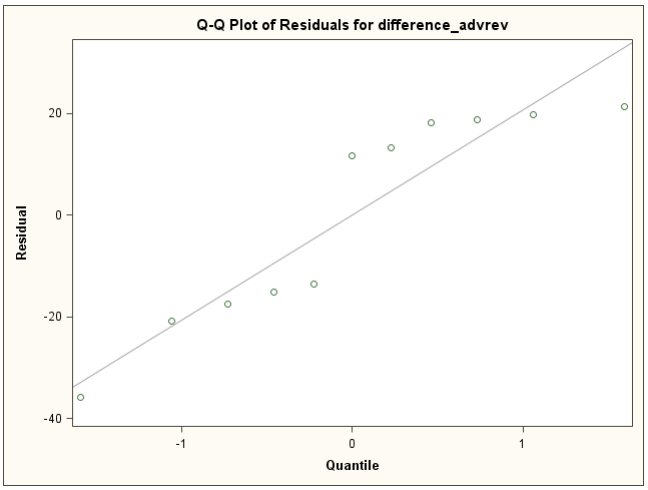
# Appendix 7 – Histogram and Q-Q plot for MODEL C.1

**MODEL C.1**

Histogram

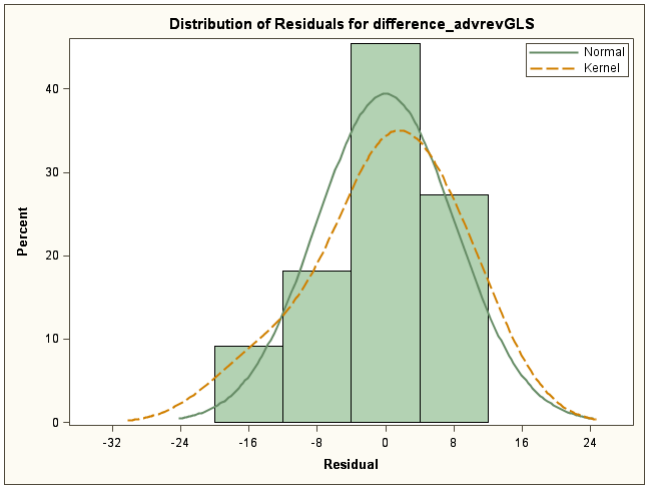



Q-Q plot

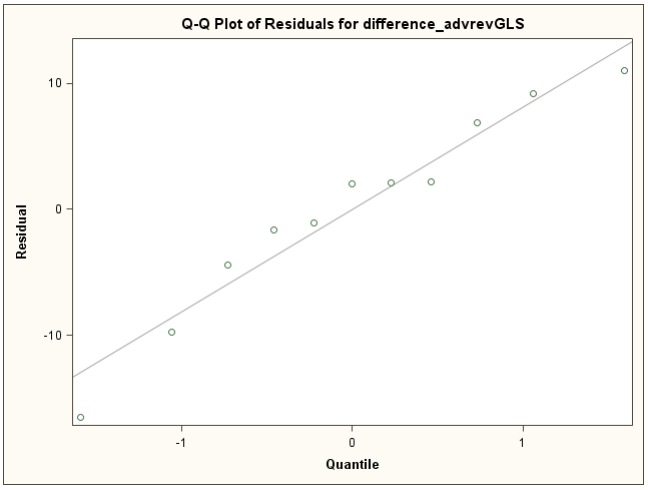



**MODEL C.1 corrected for autocorrelation**

Histogram



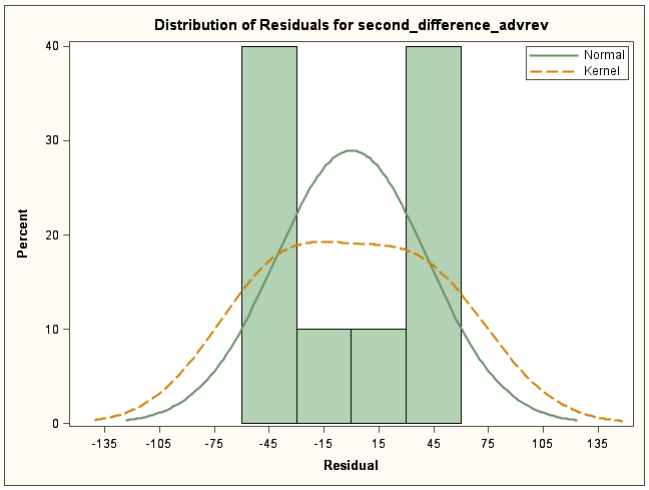

Q-Q plot



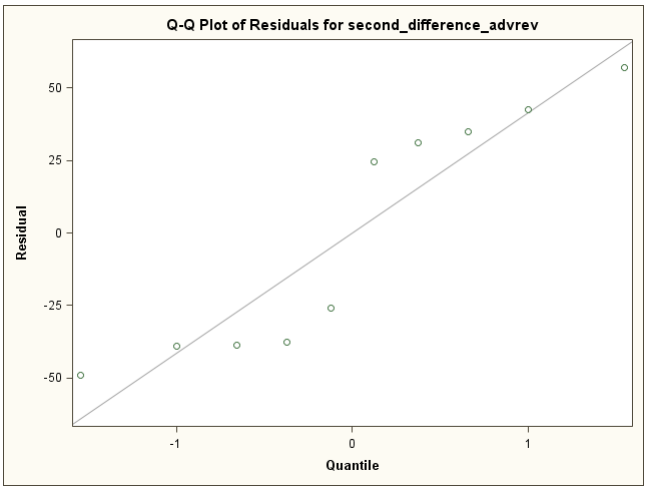
# Appendix 8 – Histogram and Q-Q plot for MODEL C.2

**MODEL C.2**

Histogram

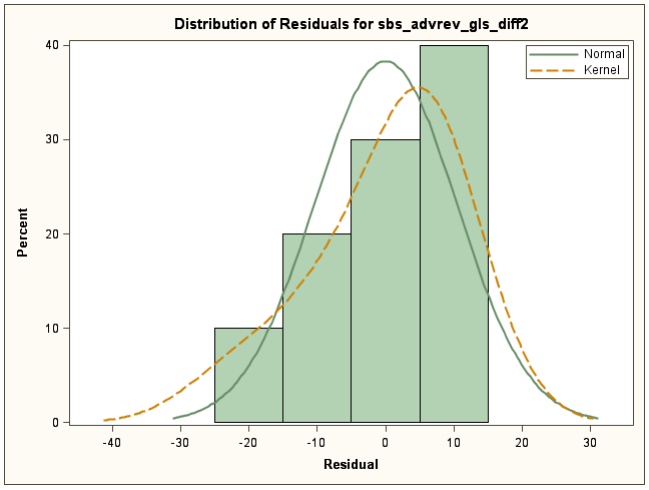



Q-Q plot

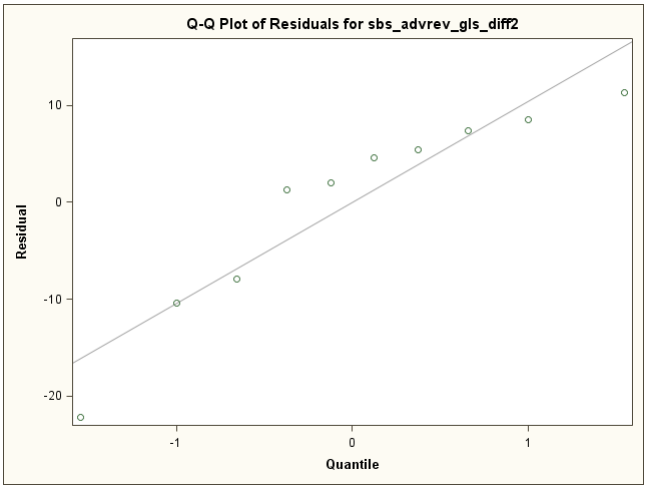



**MODEL C.2 corrected for autocorrelation**

Histogram




Q-Q plot



# Appendix 9 – Regression model, MODEL B.1, based on short run stationarity tests

The two variables *number of viewers* and *advertising revenue* for MTG will be evaluated together in the regression model called MODEL B.1 with the short run stationarity tests as point of departure. The relationship between the two is unchanged in relation to the general expectations stated in section 6.1. MODEL B.1 is different from MODEL A, as both variables were not stationary in their basic forms, specifically the first difference of *number of viewers* was taken in order to achieve stationarity. Normally, it is expected that both variables are either stationary or nonstationary, which is not the case here. This irregular situation could have an effect on the regression model. Furthermore, in the process of transforming *number of viewers* to become stationary, the first difference was taken, which induces a loss of the long run relationship between *number of viewers* and *advertising revenue*. The model is stated below together with the parameter estimates from running the regression in SAS.

MODEL B.1 $$MTGadvrev = \beta_1 + \beta_2(\Delta MTGviewers) \quad (9.1)$$

**Table 15: Parameter estimates for MODEL B**

| Variable | Estimate | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 359.32613 | 9.40992 | 38.19 | <.0001 |
| ΔMTGviewers | 65.60988 | 36.63785 | 1.79 | 0.1069 |

Source: Own creation based on output from SAS generated with data from (TNS Gallup TV-Meter) and (MTG, 2000-2011).

The estimated $\beta_2$ is positive as expected, thus a positive change of one unit in viewers of MTG increases advertising revenue of MTG by approximately 65.61. The explanatory variable is not significant, as the t-value is lower than the critical value of 1.833. The critical value is based on nine degrees of freedom and a significance level of five percent. If the significance level is changed to ten percent instead, the t-value becomes significant as the t-value exceeds the critical value of 1.383. Consequently *number of viewers* can to some extent explain the development of *advertising revenue* of MTG. The $R^2$ equals 0.2627 which suggests that *number of viewers* is a somewhat valid explanatory variable, thus confirming the significance of the variable.

The model is tested for the CLRM assumptions. If the model fails to fulfil the assumptions, it could explain the insignificant explanatory variable and the low $R^2$.

Firstly, the model is tested for normality in the error terms. The histogram and the Q-Q plot both imply normality, as the histogram is approximately bell-shaped, and the Q-Q plot shows a linear relationship. The JB test returns a value of 0.5923, which is lower than the critical value, thus the model fulfils the assumption regarding normality in the error terms.

Secondly and thirdly, the model is tested for autocorrelation and heteroscedasticity. Both the LM statistic and the $Q$ statistic are lower than the matching critical values, thus the assumptions regarding autocorrelation and heteroscedasticity in the error terms are fulfilled.

# Appendix 10 – Intermediary results

Intermediary results for MODEL A.2:

$\Delta TV2advrev = \beta_1 + \beta_2(\Delta TV2viewers) \Leftrightarrow$

$TV2advrev_{2012\ Q1} - TV2advrev_{2011\ Q4} = \beta_1 + \beta_2(TV2viewers_{2012\ Q1} - TV2viewers_{2011\ Q4}) \Leftrightarrow$

$TV2advrev_{2012\ Q1} = \beta_1 + \beta_2(TV2viewers_{2012\ Q1} - TV2viewers_{2011\ Q4}) + TV2advrev_{2011\ Q4} \Leftrightarrow$

$TV2advrev_{2012\ Q1} = 14.04442 + 21.94399(9.115 - 9.981) + 429.4 = \mathbf{424.44}$

Intermediary results for MODEL B.2:

$2\Delta MTGadvrev = \beta_1 + \beta_2(2\Delta MTGviewers)$
$\Leftrightarrow$

$(\Delta MTGadvrev_{2012\ Q1} - \Delta MTGadvrev_{2011\ Q4}) =$
$\beta_1 + \beta_2(\Delta MTGviewers_{2012\ Q1} - \Delta MTGviewers_{2011\ Q4}) \Leftrightarrow$
$\left((MTGadvrev_{2012\ Q1} - MTGadvrev_{2011\ Q4}) - (MTGadvrev_{2011\ Q4} - MTGadvrev_{2011\ Q3})\right) = \beta_1 +$
$\beta_2\left((MTGviewers_{2012\ Q1} - MTGviewers_{2011\ Q4}) - (MTGviewers_{2011\ Q4} - \Delta MTGviewers_{2011\ Q3})\right) \Leftrightarrow$
$MTGadvrev_{2012\ Q1} = \beta_1 + \beta_2(MTGviewers_{2012\ Q1} - 2 * MTGviewers_{2011\ Q4} + MTGviewers_{2011\ Q3}) +$
$2 * MTGadvrev_{2011\ Q4} - MTGadvrev_{2011\ Q3} \Leftrightarrow$

$MTGadvrev_{2012\ Q1} = 1.61144 + 76.33465(2.340 - 2 * 2.195 + 2.027) + 2 * 403.2 - 337.4 = \mathbf{468.75}$

Intermediary results for MODEL C.1:

$\Delta SBSadvrev = \beta_1 + \beta_2(\Delta SBSviewers) \Leftrightarrow$

$SBSadvrev_{2012\ Q1} - SBSadvrev_{2011\ Q4} = \beta_1 + \beta_2(SBSviewers_{2012\ Q1} - SBSviewers_{2011\ Q4}) \Leftrightarrow$

$SBSadvrev_{2012\ Q1} = \beta_1 + \beta_2(SBSviewers_{2012\ Q1} - SBSviewers_{2011\ Q4}) + SBSadvrev_{2011\ Q4} \Leftrightarrow$

$SBSadvrev_{2012\ Q1} = 5.07590 + 47.97436(1.881 - 1.773) + 127.84 = \mathbf{138.10}$

Intermediary results for MODEL C.2:

$2\Delta SBSadvrev = \beta_1 + \beta_2(2\Delta SBSviewers) \Leftrightarrow$

$(\Delta SBSadvrev_{2012\ Q1} - \Delta SBSadvrev_{2011\ Q4}) =$
$\beta_1 + \beta_2(\Delta SBSviewers_{2012\ Q1} - \Delta SBSviewers_{2011\ Q4}) \Leftrightarrow \big((SBSadvrev_{2012\ Q1} - SBSadvrev_{2011\ Q4}) -$
$(SBSadvrev_{2011\ Q4} - SBSadvrev_{2011\ Q3})\big) = \beta_1 + \beta_2\big((SBSviewers_{2012\ Q1} - SBSviewers_{2011\ Q4}) -$
$(SBSviewers_{2011\ Q4} - \Delta SBSviewers_{2011\ Q3})\big) \Leftrightarrow SBSadvrev_{2012\ Q1} = \beta_1 + \beta_2(SBSviewers_{2012\ Q1} -$
$2 * SBSviewers_{2011\ Q4} + SBSviewers_{2011\ Q3}) + 2 * SBSadvrev_{2011\ Q4} - SBSadvrev_{2011\ Q3} \Leftrightarrow$

$SBSadvrev_{2012\ Q1} = 0.25028 + 50.48639(1.881 - 2 * 1.773 + 1.469) + 2 * 127.84 - 86.99 = \mathbf{159.04}$