Re-regulation of the Swedish gambling market

An econometric and microeconomic analysis of AB Svenska Spel, competition and governmental tax revenues in the reformed gambling market

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Abstract

With the rise of foreign gambling entities establishing their presence through online platforms, the Swedish gambling market has faced intense competition in recent years. In order to reclaim control of the market, the Swedish Government re-regulated the market effective January 1st, 2019. As a result, all entities that wish to conduct business in Sweden require an approved gambling license and are subject to an excise tax of 18 percent on gross wins. The purpose of this study was to provide a deeper understanding on state-owned AB Svenska Spel and the effects of the re-regulation. The authors of this paper applied univariate time series analysis on AB Svenska Spel's three underlying categories to estimate the projected development if the re-regulation had not been implemented. Utilizing market intelligence provided by H2 Gambling Capital, this study has provided a forecasted gain in governmental tax revenue from the market reform in the sector of the gambling market previously controlled by AB Svenska Spel of SEKbn 1.5 and SEKbn 1.7 in 2019 and 2020, respectively. Furthermore, this study has also found that the re-regulated market has transitioned from a monopoly towards a competitive market structure exhibiting characteristics of a Bertrand oligopoly and monopolistic competition. This paper is the first of its kind to apply empirical forecasting methods on AB Svenska Spel and the findings can be utilized to further extend the research on AB Svenska Spel or the Swedish market post-regulation in general.

Definitions

- **AB Svenska Spel:** The Swedish state-owned entity which offers a wide array of gambling products
- **Casino Cosmopol incl. online poker (CC):** A wholly owned subsidiary of AB Svenska Spel with an exclusive license to operate land-based casinos in Sweden. The category also includes online poker games provided through AB Svenska Spel's online platforms.
- **Cannibalization ratio:** percentage of revenue obtained by one gambling entity from another gambling entity
- **Channelization ratio:** percentage of total gambling conducted within the regulated system
- **Foreign online gambling entities:** online gambling companies registered and located in countries other than Sweden
- **Folkhälsomyndigheten:** Public Health Agency of Sweden
- **Gross win:** Total gambling volumes, i.e. stakes/wager played by the consumer, minus paid out wins to consumers
- **Hold rate:** The price of gambling for consumers, defined as the percentage of the stake/wager retained by the firm from the gambler
- **Payout rate:** Percentage of the stake/wager that is retained by the consumer
- **Pre-regulation:** The Swedish regulated gambling market prior to January 1st, 2019
- **Post-regulation:** The re-regulated Swedish gambling market after January 1st, 2019, consisting of a licensing system and tax paid on gross win
- **Spelinspektionen:** The Swedish Gambling Authority (formerly known as Lotteriinspektionen)
- **Sports & Lottery (SL):** Sports betting and games of chance provided by AB Svenska Spel
- **Vegas gaming machines (VG):** Land-based gaming machines offered by AB Svenska Spel

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1. Introduction

In this chapter, an introduction of the study will be presented. The chapter starts with the preface of the topic, followed by purpose of study, research questions, delimitations as well as an overview of the paper in its entirety.

1.1 Preface

On January 1st, 2019, a new era began for the gambling market in Sweden as a new regulation became active. The regulation change was the culmination of a process which started more than a decade earlier where multiple investigations researched the need for a potential re-regulation of the gambling market and the monopoly held by the state-owned AB Svenska Spel. Sweden has a long history of state-owned enterprises in sectors which have the need for extra control in terms of public health. Pharmacies in Sweden were under state control from 1970 until the market was re-regulated and the monopoly was dismantled in late 2009 (Apoteket, n.d). Sales of stronger alcoholic beverages is still controlled under a monopoly operated by state-owned Systembolaget AB (Sveriges Riksdag, 2010).

With the rise of foreign online gambling sites in later years, the monopoly held by AB Svenska Spel was effectively lost, and the player security and protection mechanisms inherent to the monopoly were compromised as a result. The structural change of the market forced authorities to re-visit the question of how to tackle the challenges presented by the rise of foreign gambling sites. The result of the investigations led to the formation of a licensing system which meant dissolving the monopoly and instead requiring actors wishing to conduct business in Sweden to obtain an approval by the Swedish Gambling Authority (“Spelinspektionen”). The licensing system draws its inspiration from similar regulations in other European countries, such as the United Kingdom and Denmark. The fundamental logic behind the license-based regulation is that it allows governments to reclaim control of the market, increase tax revenues and introduce player protection mechanisms into the prerequisites to be granted a gambling license.

Uncertainty exists regarding how the new regulation might affect the industry. In terms of tax revenues and public finance, policy representatives assume the new license regulation should be successful. Regarding sociological factors, some researchers and analysts believe that the licensing system may lead to increased online gambling since new forms of legitimized gambling will be available, thus creating a potential risk of increased problem gambling (Eklund, 2018). Other representatives believe the opposite, that the regulation will not result in increased gambling, as increased control mechanisms and restrictions enhance the ability to capture gamblers which might be at risk of problem gambling tendencies (Eklund, 2018). Furthermore, given the liberalization of the market previously characterized as a monopoly, the question arises of what market structure will characterize the gambling market after the new gambling act.

1.2 Purpose of study

The purpose of the study is to analyze the re-regulation of the Swedish gambling market and to provide the reader with a deeper understanding of the reform in terms of (1) the expected impact on governmental income from the sector of the gambling industry previously controlled by AB Svenska Spel and (2) the structure of the reformed market which AB Svenska Spel will compete in post-regulation.

By applying economic forecasting techniques and utilizing previous literature on imperfect markets, this paper is intended to function as a foundation on which further research on the regulation change can build upon once enough post-regulation data is available to conduct a proper evaluation. Furthermore, the analysis is also intended to highlight the need for any potential regulatory amendments which may be required in the future, thus assisting in raising awareness to any potential issues at an early stage.

1.3 Research questions

With the purpose of the study taken into consideration, the authors of this paper have constructed two research questions:

RQ1: How will governmental tax revenues from the sector of the gambling market previously controlled by AB Svenska Spel develop post-regulation?

RQ2: What market structure will AB Svenska Spel compete in post-regulation?

1.4 Delimitations

As this paper focuses on AB Svenska Spel in connection to the re-regulation of the Swedish gambling market, the study consequently excludes other state-owned entities and foreign online gambling firms which do not operate in direct competition with AB Svenska Spel and its underlying games (see section 2.2 on different entities and games).

Moreover, the chosen variables for AB Svenska Spel provided higher frequency in terms of data points compared to other public- or private entities. More specifically, this paper utilizes data on gross wins from AB Svenska Spel from sports- and lottery, land-based Casino Cosmopol (incl. online poker) and land-based gaming machines (Vegas). The results from the univariate time series forecast will be used, combined with forecasted post-regulation gross win data provided by H2 Gambling Capital for the entire market, to estimate the impact on governmental tax revenues from the sector of the gambling market previously controlled by AB Svenska Spel. As such, data from public or private entities concerning games other than the three categories mentioned above will be not be considered in this paper, this includes e.g. horse racing and trotting, bingo and restaurant casino.

Moreover, the process of defining the relevant market structure post-regulation will be based on connecting observable characteristics with relevant theories of imperfect markets, competition and market power presented in the literature review.

Therefore, profit maximization solutions, estimating elasticities or calculating market concentration will not be included. Conservative and strong assumptions based on the theoretical models, such as profits equivalent to zero or that marginal cost is constant, are not always applicable in real-life. Nonetheless, this study should serve the purpose of providing the reader with a solid foundation in terms of theoretical perspectives on how firms behave given entry in the Swedish gambling market.

1.5 Overview of the paper

Chapter 2 – Background

The background chapter provides the reader with an understanding of the Swedish gambling market, its history, regulation, international competition and the re-regulation of the industry. The chapter also provides information on comparable countries with similar market reforms.

Chapter 3 – Literature review

The literature review presents relevant research on gambling from several aspects in order to provide the reader with a broad understanding of the mechanisms involved in gambling. This includes literature on the economics of gambling, competition, gambling taxes, effects of liberalized gambling, gambling motives as well as incentives from different stakeholder perspectives. The section intends to connect theories, definitions, concepts and frameworks within the given field of research.

Chapter 4 – Methodology

The chapter covers the methodologies chosen to answer the research questions of this paper. It will also present the motivation of the given research approach, a description of the chosen variables as well as a description of the empirical approach. A detailed presentation on the econometric forecasting model will also be presented. The chapter concludes with a methodological discussion including alternative methods and limitations.

Chapter 5 – Empirical results and analysis

The chapter presents the results from the empirical study. The econometric forecasting processes based on ARIMA/SARIMA are presented first and is followed by the forecasted post-regulation governmental tax revenue. Finally, the findings regarding the market structure post-regulation are presented.

Chapter 6 – Discussion

The chapter discusses the empirical findings laid out in chapter 5 and their implications in relation to the research questions stated in chapter 1.

Chapter 7 – Conclusions and future research

The paper concludes with a summary of the main findings based the empirical results presented in chapter 5 and the discussion in chapter 6. Furthermore, suggestions for future research are discussed.

2. Background

This chapter aims to provide the reader with a broad understanding of the regulated market in Sweden prior to the regulation change as well as the unregulated foreign online gambling market. Moreover, it also focuses on understanding state-owned AB Svenska Spel and its role in the Swedish gambling industry. Similar gambling market regulations found in Denmark and the U.K. will also be presented.

2.1 History of gambling regulation in Sweden

For several decades, the Swedish gambling market was controlled by the state as a monopoly. The roots trace back to the beginning of the 1930s, when inspectors were employed by the Swedish state. Shortly after, the government gained full control of Penninglotteriet, Tipstjänst and the National Lottery, which at the time were the only entities allowed in the market. During the 1970s and 1980s, the gambling market grew exponentially, which required the need for a central authority to be established in order to gain full supervision. Therefore, the Swedish Gambling Authority ("Spelinspektionen", formerly known as "Lotteriinspektionen"), was founded along with the new Lotteries Act as the foundation for its presence. In 1999, the government legislated land-based casinos with international rules. At the same time, Casino Cosmopol was founded, a subsidiary to AB Svenska Spel, with exclusive rights to operate land-based casinos. From the millennial shift up until 2018, no significant changes in the legislation were made. (Spelinspektionen, 2018)

The justifications for state control were manifold, such as preventing illegal gambling, placing restrictions on advertising as well as avoiding match-fixing. Furthermore, another important aspect is the sociological aspect, where a regulated system allows for better supervision of problem gambling and gambling addiction. By offering help with different tools and services, health problems connected to gambling can be minimized or even prevented before the damage has occurred (Spelinspektionen, 2016). During the last years, investigations into the current market situation have been conducted, both from governmental authorities and external analysts.

For instance, Potrafke (2010) and Küchler (2012) studied market competition and regulation. According to Potrafke (2010), a state-regulated market implies social advantages but highlights the barriers to entry as a disadvantage, whereas Küchler (2012) concludes that regulation and monopoly power can be beneficial in terms of protecting citizens from industries with potentially harmful products and services. Among regulators, politicians, consumers and businesses, it can be concluded that differences in opinions exist regarding whether a regulation is more beneficial than harmful or vice versa. A monopoly that acts in accordance with its societal responsibility is assumed to yield positive effects for consumers (Spelinspektionen, 2014). On the other hand, competition has indeed been restricted as the legislation creates an entry barrier for potential entrants, thus constraining market output (Motion 2014/15:1817, 2014).

2.2 The Swedish regulated gambling market pre-regulation reform

The Swedish gambling market was previously strictly regulated only allowing few organizations, mostly government-owned, to operate in the market (Spelinspektionen, 2016). State-owned AB Svenska Spel was the largest of these organizations in terms of the regulated market share, offering a wide variety of gambling products. It offers lotteries and jackpot (games of chance), online casinos- and gambling, sports betting, land-based gaming machines as well as land-based casinos in four cities in Sweden (Spelinspektionen, 2017). The organization's role is to contribute to a safe gambling environment, whilst providing different forms of gambling products to the market. Moreover, state-owned AB Trav och Galopp (ATG) held the rights to horse race betting and trotting whereas the rest of the market was mostly comprised of smaller non-governmental organizations with approved licenses offering different types of gambling for public purpose (Spelinspektionen, 2017). According to Spelinspektionen (2017), in recent years, changes in the market shares of the organizations within the regulated system was limited. Table 1 on the next page presents the regulated market in its entirety as of 2017:

SEKm		
Betting	**2017**	**Operator**
Sports betting	1,783	AB Svenska Spel
Horseracebetting	4,145	ATG
Total betting	**5,928**	
Gaming		
Bingo	220	Folkspel
Gaming machines	1,118	AB Svenska Spel
Casino Cosmopol	1,111	AB Svenska Spel
Resturant casinos	177	Private
Online poker	91	AB Svenska Spel
Total gaming	**2,716**	
Lotteries		
Games of chance	4,877	AB Svenska Spel
National/regional/local lotteries	3,461	NGOs
Total lotteries	**8,338**	
Total regulated gambling market	**16,982**	
Total AB Svenska Spel	**8,979**	
AB Svenska Spel %	*53%*	

Table 1: The Swedish regulated gambling market in 2017

Source: Spelinspektionen (2017)

2.3 The unregulated online gambling market

The development of online gambling emerged during the tech boom in the mid-1990s, when the first online platforms were launched. Ever since, technological improvement combined with easier access to the internet has allowed a rapid market expansion consisting of more than 2 500 online gambling sites owned by 600 different entities globally in 2009 according to Remote Gambling Association (2009). Studies by Zion Market Reseach (2018) (Zion Market Research, 2018) analyzed historical data and projected the market outlook in the upcoming years, found that the global turnover accounted for approximately USDbn 45.8 in 2017, and is expected to rise to USDbn 91.4 by 2024.

In terms of compounded annual growth rate (CAGR), the market for online gambling is assumed to grow by 10.9 percent annually between 2018 - 2024 (Zion Market Research, 2018). Narrowing the view to Swedish boundaries, gross wins (i.e. revenue less payout to consumers) of non-regulated entities accounted for approximately USDbn 6.1 in 2017, an increase by 15 percent compared to 2016 and over 50 percent compared to 2013 where gross wins amounted to USDbn 4.0 (Folkhälsomyndigheten, 2019). Spelinspektionen (2018) notes that non-regulated entities have been increasing their market share in recent years. As depicted in figure 1 below, non-regulated entities accounted for approximately one quarter of the total Swedish gambling market in 2017. By definition, non-regulated entities are organizations which were not part of the Swedish regulated system but mostly located and registered in countries such as Gibraltar, Channel Islands or Malta, where the respective gambling authorities provide licenses (Spelinspektionen, 2016).

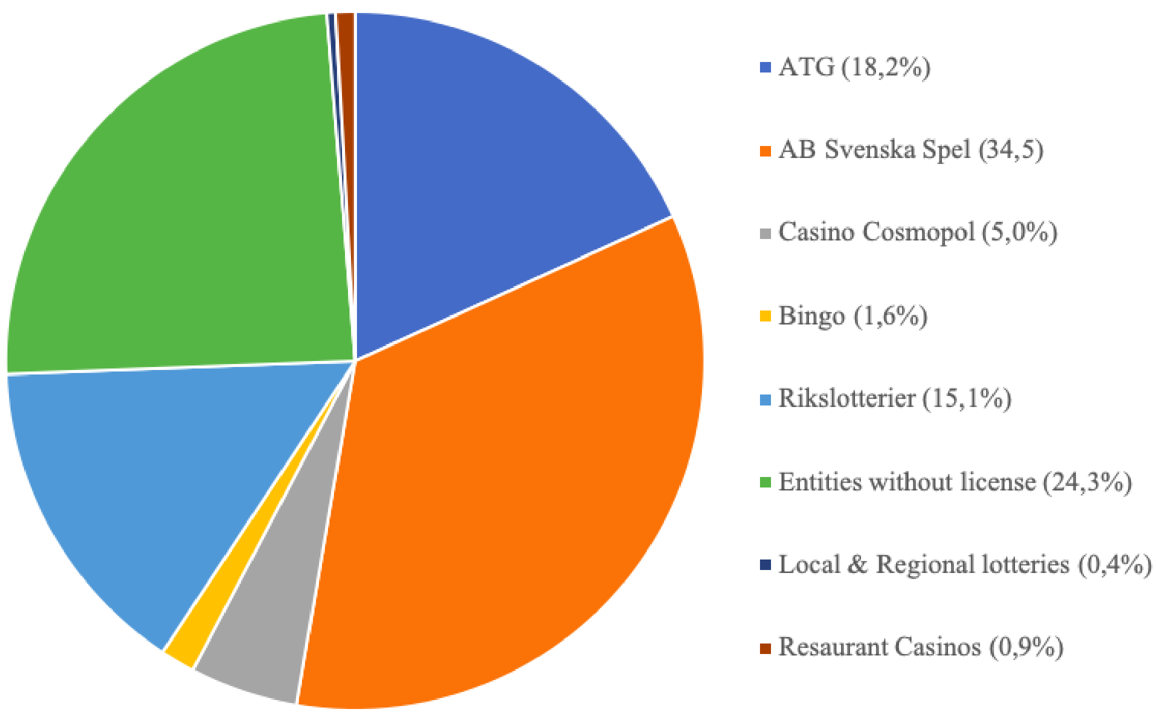

Figure 1: The Swedish gambling market in 2017 including non-regulated entities
Source: Spelinspektionen (2017)

2.4 Competition

Due to enhanced information technology and easier access to foreign registered internet platforms, the market for online gambling has increased exponentially, as stated in section 2.3. According to the Swedish National Audit Office (2012) (“Riksrevisionen”), the products offered by unregulated operators are similar to those offered by the Swedish regulated operators. However, the significant difference in the underlying business is that the payout rate to consumers is higher from unregulated operators, more bonuses are used as an incentive tool and the games in the product spectrum are riskier in general (Riksrevisionen, 2012). These attributes confirm that the unregulated products are undermining state policies. The increased competition is a result of a growing market with the ability to produce competitive and innovative solutions to consumers (Riksrevisionen, 2012).

Furthermore, it is concluded by both The Public Health Agency of Sweden (2018) (“Folkhälsomyndigheten”) and Spelinspektionen (2017) that a lack of supervision will cause more entry and higher concentration in the market. The primary reason is the freedom and liberalization of European movement on the internet that makes Swedish consumers a direct target for foreign online gambling entities, which in turn affects the Swedish monopoly. Competition is expected to increase following intense advertising through online channels, affiliates, social media and television commercials. According to statistics reported by Folkhälsomyndigheten (2019), advertising expenditure reached approximately USDbn 6.0 during 2017 in Sweden, an increase of USDbn 1.8 compared to 2016, with 75 percent of the marketing expenditure coming from non-regulated online gambling entities.

As the domestic gambling regulation was undermined by foreign unregulated private entities, the state monopoly was no longer considered a monopoly given the market circumstances (Regeringskansliet, 2018). Consequently, in 2018 the Swedish government proposed a regulation reform of the Swedish gambling market which became active on January 1st, 2019. The following section will present the new regulation.

2.5 Re-regulation of the Swedish gambling market

Since 2006, three thorough investigations analyzed whether a re-regulation of the market should be enforced and how it should be structured. The first investigation took place during 2006 and studied the market development with suggestions on potential regulatory changes regarding technological advancement, market structure as well as the sociological factors involved in gambling (SOU 2006:11, 2006). The proposition also included an abstract model for a potential licensing system which was left for further research. The second investigation during 2008 studied the licensing system in depth regarding the potential benefits and disadvantages and conducted a comparative analysis compared to the current regulation at the time, shown in table 2 (SOU 2008:124, 2008):

	Previous regulation	**Re-regulation**
Who?	Government	Entities and national organizations
How?	Exclusive rights	Licenses for certain gambling products
What?	In accordance to the Lottery Act	In accordance to new national legislation
Why?	A regulated market that allows gambling to be limited where surplus is directed for public purposes and utilities.	More gambling products gets controlled within the national legislation.

Table 2: Previous vs. proposed regulation in 2008 SOU investigation
Source: SOU (2008:124, 2008)

The third investigation focused on the proposal of the new licensing system. The new regulation changes the entire market spectrum by reforming the state monopoly. Furthermore, it also entails a division of AB Svenska Spel, where a part of the products is still only provided by AB Svenska Spel as a monopoly, and another part where it competes against other licensed firms. The reformed gambling market will include online and offline gambling as well as betting, whilst lotteries and bingo are still part of public purpose in the monopolistic structure. The government will also still control land-based casinos and land-based gaming machines. (SOU 2017:30, 2017)

The re-regulation secures tax revenues, protects public purpose products, regulates marketing, aims to minimize the negative effects of gambling as well as to prevent cheating. Consumer protection, as well as reliable security, are integral parts of the new system. (SOU 2017:30, 2017) Most importantly, the legislation change opens for controlled competition with sanctions available to oversee private entities. It also allows the ability to prosecute entities operating in the Swedish market outside the regulatory system. The aim is to achieve a channelization rate (i.e. rate at which gamblers stays within the regulated system) of 90 percent. (SOU 2017:30, 2017)

The new regulation is active as of January 1st, 2019 according to The Gambling Act (2018:1138). It consists of six different licenses; (1) gambling offered by the state, (2) lotteries and bingo for public purposes, (3) betting, (4) online gambling, (5) gambling on ships in international traffic and (6) land-based commercial gambling. As previously mentioned, consumer protection mechanisms are also central to the new regulation. Certain requirements need to be met by potential licensees to obtain a license in order to counteract excessive gambling behavior (Folkhälsomyndigheten, 2018):

- Consumers must be offered the option of shutting down their access from all licensed registered entities through a national registry, spelpaus.se.
- Consumers must be offered the option of setting limits on the time and money they want to allocate towards gambling.
- Gambling on credit is forbidden.
- Bonuses are only allowed to be given in conjunction with the first deposit.
- Consumers must be offered a “self-test” in order to evaluate if they are at risk of problematic gambling behavior.
- All licensed entities are required to educate employees regarding gambling monitoring, marketing, product development and customer support in terms of excessive gambling behavior and gambling addiction.
- Any form of direct marketing to consumers is prohibited if the consumer has shut themselves off from online gambling through spelpaus.se.

According to KPMG (2018), the license fee for commercial gambling entities is divided into two parts: (1) commercialized online gambling at SEK 400 000 and (2) betting at 400 000 SEK. Applying for both at the same time reduces the cost of a license application to SEK 700 000 annually.

According to The National Tax Authority ("Skatteverket") (2018), a gambling tax is introduced requiring licensed entities to pay 18 percent tax on gross win for each taxation period. A simple example by KPMG (2018) is illustrated in the table 3 below:

Revenue	**Payout**	**Gross Win**	**Tax Paid**
SEK 200	SEK 100	SEK 100	18 %
		[200 – 100 = 100]	[18% * 100 = 18]

Table 3: Tax on gambling gross wins in new regulation
Source: KPMG (2018)

Since AB Svenska Spel's business has also been divided in accordance with the new market structure, their operations in the new competitive environment will be on equal terms to private entities, with all licensed entities paying the same tax rate on gross wins. The only market that is tax exempted is the market for public purposes (Regeringskansliet, 2018).

The new legislation also makes it possible for the government to prevent and block transactions between consumers and unlicensed entities, consequently, offering a layer of protection from unlicensed entities bypassing the license requirements. Moreover, any marketing campaigns initialized by unlicensed entities are illegal according to the new regulation. (Regeringskansliet, 2018)

2.6 Similar regulations across Europe

Several countries in Europe have regulations in place similar to the new regulation in Sweden. This section will present two countries, Denmark and the U.K.

Denmark

Denmark has divided its market for gambling into two parts, (1) state monopoly and (2) a controlled market for free competition. According to research from Nordström et al. (2016), Denmark introduced a licensing system in 2012, which was the start of the country's liberalization of the market. Before 2012, the entire market was controlled by state-owned Danske Spil (PWC, 2016). Now, private entities can apply for a license with the Danish Gambling Authority ("Spillemyndigheden") in order to conduct business in the Danish market. The market consists of seven different licenses: (1) charity lotteries, (2) online gambling, (3) betting, (4) land-based poker, (5) land-based gaming machines, (6) land-based casinos and (7) lotteries. Private entities wanting to operate in terms of online gambling and betting (which includes both online and land-based) are required to have licenses for categories (2) and (3) for a total fee of DKK 391 300 (Spillemyndigheden, n.d.).

According to Nordström et al. (2016), the tax rate within the Danish licensing system is 20 percent of gross win (Spillemyndigheten, 2017). Despite the taxation on gross wins, the market has grown consistently since the regulation change. Statistics from Spillemyndigheden (2017) show that the betting market accounted for a gross win of DKKbn 2.3 in 2017, whilst the market for online casino accounted for a gross win of DKKbn 1.8, both increasing continuously since 2012, shown in table 4 on the next page:

	2011	2012	2013	2014	2015	2016	2017
Betting	750	1.175	1.371	1.791	1.999	2.168	2.329
Online Casinos		885	976	1.069	1.308	1.563	1.806

Table 4: Gross wins in Denmark for betting and online casinos (DKKm)
Source: Spillemyndigheden (2017)

Spillemyndigheten (2017) also found a higher growth in online gambling compared to land-based gambling, where online gambling includes casino, betting and lottery sales. Due to changes in consumer preferences, easier access to sites through smartphones and web browsers, the share of online gambling has steadily been increasing, up to approximately 52 percent in 2017, in contrast to 46 percent in the year before. The expansion is also a result of the market liberalization by Denmark (Spillemyndigheten, 2017).

In terms of bonuses, there are no restrictions on how many times a licensee can offer a bonus to the customer. However, the regulation requires licensees to be completely transparent on bonuses offered in conjunction with the terms and conditions. Furthermore, bonuses must be offered on equal terms to all consumers. This goes for both betting (land-based and online) as well as online casino (Spillemyndigheten, n.d.).

Another focus area within the regulated system in Denmark is regaining control of responsible gambling, where attention has been allocated towards young adults and problem gamblers. For instance, The Danish Gambling Authority administers the register of self-exclusion (“ROFUS”), which is a national register that makes it possible for gamblers to completely restrict their access to all sorts of gambling. As of the end of 2017, 12 877 people were included in the register, an increase of 46 percent compared to the prior year (Spillemyndigheden, 2017). According to Spillemyndigheden (2017), the increase is a result of its marketing focus on ROFUS. Moreover, activities and supervision to prevent match-fixing, money laundering and direct advertising to self-excluded customers are also important instruments used to minimize problem gambling (Spillemyndigheden, 2017).

For the regulation to work as intended, several tools have been implemented to stop unlicensed entities from operating in Denmark: (1) advertising restrictions, (2) DNS blocking and (3) transaction blocking. If Spillemyndigheden finds an entity that operates without a license, the normal procedure is to request that they immediately cease their operations towards the Danish market. Failure to comply entails further reprimands, such as contacting authorities for DNS blocking and transaction blocking. (Hansen, 2016)

The United Kingdom

The U.K. gambling market has been regulated since 2005 when the legislation of The Gambling Act 2005 was introduced, allowing The Gambling Commission to oversee the U.K. market. The reform was introduced as a result to the rapidly growing online gambling market. The objectives of the Gambling Act include controlling and preventing illegal gambling, protecting citizens from harmful behavior and ensuring that gambling products are offered in a fair and consistent manner among licensees. (Gambling Commission, n.d.)

The U.K. gambling market is divided into different sectors, which determine whether certain activities require a license or not. The sectors are organized as follows: (1) arcades, (2) betting (online and land-based), (3) bingo (online and land-based), (4) casino (online and land-based), (5) lotteries and (6) gaming machines. Casinos and all operators that offer betting in the U.K. require a license. Marketing towards U.K. consumers also requires a license. (Gambling Commission, n.d.)

Regarding taxation, the regulation was subject to changes in 2014. From 2005 to 2014, foreign-based entities with a license to operate in the U.K. had no requirements to pay taxes, since the law was constructed such that taxes were paid based on the legal residence of the entities, also known as “point of supply”. With the amended taxation scheme in 2014, foreign-based entities are now taxed at the “point of consumption” with a tax rate set to 15 percent of gross wins. (Gambling Commission, n.d.)

According to statistics from The Gambling Commission (2018), the total market of gambling in the U.K. amounted to approximately GBPbn 14.4 during the fiscal year of April 2017 - March 2018, an increase of 4.5 percent compared to the prior fiscal year.

The online gambling market, which includes both casino games and betting, amounted to GBPbn 5.4, an increase of 13.7 percent compared to the prior year. With a market share of 37 percent, the online gambling is the largest sector in the U.K. gambling market. (Gambling Commission, 2018)

As of March 2018, the total number of licensed entities amounted to 2 820 and is expected to keep growing (Wiggin, 2018). Therefore, according to the Gambling Commission (n.d.), it is important to have an established compliance function and tools that support responsible gambling. As a result, the government has implemented a self-exclusion program like those found in Denmark and Sweden. Consumers can, at any point in time, request to exclude themselves from being able to gamble with entities licensed in the U.K. for a minimum of six months. Licensed entities are required to close all accounts and transfer any money left back to the consumer during the exclusion period. Additionally, consumers can block themselves from gambling websites through GamCare, an entity that helps, support and treats problem gamblers. The Gambling Commission has also included and cooperated with financial institutions to block transactions to and from unlicensed firms. Barclays is the first bank to provide the service through its mobile banking platform, and more banks are expected to follow suit (Barclays, 2018).

Initially, bonuses offered by licensed operators were not limited under the regulation. However, The Government of the United Kingdom (2018) found in 2018 through The Competition and Markets Authority, that online gambling operators offered unfair bonus system to consumers. Consequently, restrictions on bonus offerings have been implemented as a reaction to the findings. More specifically, the changes include transparency requirements regarding terms and conditions, the ability for customers to withdraw money without any gambling turnover requirements as well as allowing consumers to withdraw bonuses without being obligated to participate in marketing activities (Government of the United Kingdom, 2018).

The regulation also covers advertising and marketing guidelines for licensed operators, where all forms of advertising must comply with the U.K. advertising code, be socially responsible, transparent and with no direct marketing permitted to individuals under the age of 18 (Gambling Commission, n.d.).

Comparison between countries

In summary, comparing the regulations in Sweden, Denmark and the U.K., it can be concluded that the countries have many similarities in terms of licensing system, taxation, and consumer protection mechanisms, summarized in table 5 below:

	Sweden	**Denmark**	**U.K.**
Licensing system for online gambling and betting	Yes	Yes	Yes
Tax-rate	18%	20%	15%
Tax-base	Gross win (i.e. revenue less payouts to consumers)	Gross win (i.e. revenue less payouts to consumers)	Gross win (i.e. revenue less payouts to consumers)
Bonus offering	Only on point of registration and first deposit	No restrictions	Yes – free consumer accessibility of bonus cash
Self-exclusion program	Yes	Yes	Yes
Marketing	Limited – only for licensed operators	Limited – only for licensed operators	Limited – only for licensed operators
Payment blocking	Yes	Yes	Yes – recently implemented
Age requirement and control system	Yes – 18	Yes – 18	Yes – 18
National self-assessment tool on gambling behavior	Yes	Yes	No

Table 5: Comparison of gambling regulations in Sweden, Denmark, U.K.

Source: Authors' elaboration

3. Literature review

The following section will present the literature review, which focuses on theories, definitions, frameworks and concepts that are relevant for the purpose of the paper and the posed research questions. The reader will get a broad understanding of the economics of gambling, competition, sociological factors, gambling motives as well as incentives from different stakeholder perspectives.

3.1 Gambling economics

For decades, several scholars have studied the phenomenon of gambling. For instance, Eadington (1999) examined the economics of casino gambling in the U.S. which expanded exponentially during the 1990s from large cities to suburban areas. According to the author, the market for gambling was constrained by the heavy regulation imposed by the U.S. government for approximately 40 years. The only state with exceptional gambling permissions was Nevada, although products such as bingo and horse betting were considered legal in other states (Ciaffone, 1991). As concluded by Eadington (1999), the subsequent market expansion was led through a liberalization reform with added monitoring authorities. Moreover, during the deregulation period, gambling gained public acceptance and became decreasingly associated with negative attributes. The acceptance allowed gambling to resemble more of a normal good, i.e. a good which increases with income, which gave rise to market entry of new private entities. Similar examples of market deregulations can also be found in the U.K. and Australia during the 1970s, in which both countries made regulatory changes which included decriminalizing gambling and controlling it under state-controlled supervision (Eadington, 1991; Kent-Lemon, 1984).

Eadington (1999) also discusses the relationship between profitability and controversial goods. As suggested, the notion of gambling as a product differs considerably compared to other goods, where gambling is considered as immoral or as a bad habit. Similar goods with comparable characteristics are drugs, alcohol, cigarettes and sexual services, which are all controversial industries, causing social issues and are subject to moral debates (Lindorff, Jonson & McGuire, 2012; Palazzo & Richter, 2005).

Previous studies laid out above concluded that the industry has been subject to controls by restricting where, how and to whom gambling can be provided to. Despite these restrictions, according to Eadington (1999), demand does not diminish. Gambling entities will seize the opportunity to achieve positive economic returns, with the risk that entities try to bypass the restrictions, causing social costs that cannot be observed from regulators. In conclusion, on the one hand, the author suggests that restrictions prevent competitive market equilibrium but mitigates social issues. On the other hand, restrictions reduce aggregated market supply given entry barriers and taxes that limit overall profits (Eadington, 1999).

Eadington (1999) conducts a cost-benefit analysis and defines three distinctive areas of potential gains from a liberalized gambling market. First, the majority of consumers gamble in moderation. Liberalizing the market in a controlled form would potentially yield higher consumer surplus in terms of competition based on product quality and price. Second, liberalization brings economic benefits in terms of job opportunities, tourism, investments and urbanization, proven through previous research such as Walker and Jackson (1998). Third, liberalization increases revenue income to the public sector through taxation on gambling profits. Despite the economic gains, gambling and online gambling in particular, faced further regulation in the U.S. in 2006, criminalizing transactions from financial providers to online gambling sites, suggesting concerns of increasing social costs in terms of problem gambling being the motivation behind the increased regulation (Smith, Hodgins & Williams, 2007). Gambling was still legal, but since transferring money to online gambling providers was criminalized, the perceptions and attitudes towards online gambling were impacted, decreasing aggregate demand and causing foreign operators to exit the market (Rose, 2010).

3.2 Competition and elasticities

Several scholars have researched the economic relationship between online and land-based gambling. Philander (2012) estimates the relationship between the two different market segments in the U.S. of land-based gambling venues and foreign online gambling entities, the so-called grey market.

Online gambling was loosely regulated before the Unlawful Internet Gambling Enforcement (UIGEA) established during 2006 and was considered a substitute to land-based games, with a revenue cannibalization rate (i.e. the percentage of revenue taken from offline gambling venues) of approximately 30 percent. However, regulating and liberalizing the market also meant increased governmental revenues through license fees along with taxes paid on gross wins. Given these market circumstances, Philander (2012) studied whether these industries are complements or substitutes to one another using gambling revenues. If the two are to be considered as complements, legislators should seek to leverage both industries in order to further increase tax revenues. However, if they should be considered as substitutes, it might cause operators to cannibalize their own business (Philander, 2012). As concluded by Philander's (2012) research using econometrical models (2SLS and ARIMA), online gambling had a negative relationship to land-based gambling venues, implying that the two are considered as substitutes. The result implied that a USD 1 increase in online gambling revenue decreases land-based casino revenue by USD 0.28. Moreover, using real GDP as a proxy for income, Philander (2012) found that gambling was considered a normal good.

Previous research prior to Philander (2012) also studied cross-effects as well as various elasticity measures. For instance, according to Landers (2008a), price elasticity ranged between -0.19 for lotteries up to -2.81 for betting and casino gambling, whilst Thalheimer and Ali (2003) found a price elasticity value of -1.5 during 1991 and -0.9 during 1998. Including both long and short-run income elasticities, Nichols and Tosun (2008) found a range between -0.22 to -2.29, whilst Landers (2008b) found a range between -1.43 to -1.91. Similar results were found by Leal et al. (2014), who studied the Spanish online versus offline gambling market and found a negative relationship between betting and casino gambling. Additionally, using real GDP as a proxy for income elasticity, the results proved to be positive, a short-run estimate of +0.74 and a long-run estimate of +1.41, suggesting that online gambling is considered a normal good, increasing with increased income.

Applying the same framework as Philander (2012), a study by Arvidsson et al. (2017) looked at the Swedish gambling market and estimated the relation between AB Svenska Spel and foreign online gambling entities.

According to the authors, long-run income elasticity yielded +0.54, implying that a one percent increase in income increases revenue of foreign online gambling entities by 0.54 percent. Moreover, the authors found a negative relationship between the revenues of AB Svenska Spel and foreign online gambling entities, suggesting that AB Svenska Spel and foreign online gambling entities are substitutes (Arvidsson et al., 2017). As concluded by both Philander (2012) and Arvidsson et al. (2017), loose regulation with easy access to online gambling sites increases the risk of cannibalization of the regulated market. In both cases, where the first study was made between online- and offline gambling, and the second study between state-owned monopoly (including online- and offline) and foreign unregulated online gambling entities, yielded similar results. However, Arvidsson et al. (2017) found that the substitutability was relatively limited, either suggesting that gamblers within the regulated market continue to remain within that segment and that online unregulated entities have a different consumer base compared to that of the Swedish state-owned monopoly. Thus, according to the authors, legislators, industry incumbents and entrants should carefully evaluate how potential regulations could impact the market dynamics.

Moreover, Philander et al. (2015) continue the research on the effects of online gambling development, e.g. the relative impact on offline gambling and on consumer behavior. The study aims to understand demand in the U.K. market since the market for online gambling has been regulated for a relatively long period through the Gambling Act 2005. The U.K. market is considered a robust foundation for online gambling analysis as it offers a wide variety of gambling products and its relatively long period of regulation along with heterogeneous consumers (Williams & Wood, 2012). By applying OLS, 2SLS and two-part model practice, the results differ from that of previous research, where Philander et al. (2015) found that online- and offline gambling activity in the U.K. showed no indication of cannibalization risks. The contradicting results, according to the authors, might be attributed to the fact that previous research in the U.S. and Sweden stemmed from grey market data, whilst the research period in Spain was not subject to taxation for online gambling activities (Philander, 2012; Arvidsson et al., 2017; Leal et al., 2014).

Nonetheless, the results imply that a regulated online gambling market may affect offline and state-owned monopoly positively, which suggests that legislators should consider potential leverage opportunities, increasing returns to scale and synergy effects in terms of economic prosperity while mitigating the risks of extensive gambling (Philander et al., 2015).

Navin and Sullivan (2007) study casinos in the U.S. and how firms behave in response to entry of new firms. The authors suggest a gambling market based on price competition and that price, which is equivalent to the hold rate (i.e. the percentage of the stake/wager retained by the firm from the gambler), decreases with increased entries, consequently increasing the payout rate for the consumer. In contrast, firms may act in accordance with collusive agreements by price-fixing, hence constraining the payout rate at a constant level. In such a case, further entries will not cause a decrease in firms hold rates and, as a result, the tax income will remain unaffected given an unchanged tax base. Conversely, if firms compete with prices, a decrease in the hold rate yields a lower tax base for governmental tax revenue. It may also be the case that new entries attract new consumers therefore increasing overall gambling volumes, despite a decrease in the hold rate, leaving governmental tax revenues relatively unaffected. Navin and Sullivan (2007) apply Cournot competition with assumptions based on “overlapping sales territories”, heterogeneous products as well as constant marginal cost. Their research suggests that shorter distances between casino venues as well as increased competition through market entry yields lower prices (i.e. lower hold rate and higher payout rate). The authors further conclude that state legislators should approve more licenses to gambling operators under the assumption that more consumers enter the market, which offset the decrease in hold rate and tax base. However, entrance of new firms resulting in higher payout rate may cause increased problem gambling (Navin & Sullivan, 2017).

In contrast to Navin and Sullivan (2017), research by Hurley and McDonough (2007) assumes the gambling market to be a Bertrand oligopoly with the theoretical implication that firms set prices such that profits are equivalent to zero. However, according to the authors, real-world application suggests a gambling market that lies between pure monopoly and Bertrand oligopoly given the assumption that any firm or consumer bias creates imperfection that lies between the two market structures (Hurley & McDonough, 2007).

3.3 Effects of legalized gambling

Kearney (2005) studies institutional winners and losers when it comes to legalized gambling. A regulated gambling market differs to a market with free competition as the government decides both on the size and form of the given market. As concluded by the author, the state benefits from the legalization through tax revenues whilst private entities gain from the legitimization of their business granted by a license, which by extension can generate increased revenues. Consumers in a regulated gambling market benefit from added protection mechanisms which are commonly included in a regulated system. However, the author raises the question of whether regulation in the gambling industry is considered an effective tool in terms of mitigating problem gambling; whether the economic profits are larger than the social cost and how to determine the optimal level of regulation.

Considering the above-mentioned queries, Beem and Mikler (2011) study regulatory actions for online gambling, a market characterized with national statutes in a borderless industry using the U.S. and the U.K as examples. The two countries differ in their regulation, where the U.S. have a conservative approach through The Unlawful Internet Gambling Enforcement Act (UIGEA). On the contrary, the U.K. has liberalized the industry, through a national license system. Regulatory histories in the respective countries is attributed as the primary reason behind their current market regulations.

Beem and Mikler (2011) argue that globalization has allowed foreign online gambling entities to operate with a regulatory arbitrage strategy, having legal residences in countries with low entry barriers and favorable taxation schemes while still being able to operate internationally. Balestra (2007) suggests that firms wish to be a part of an industry with state laws for reputational purposes in order to legitimize and expand its business. As concluded by Beem and Mikler (2011), the regulatory history of the U.S. has led to the current state by allowing individual states to self-regulate online gambling, thus allowing the possibility for monopolistic market power of land-based gambling.

In contrast, the U.K. with its liberal attitude, considers online gambling as an extension of the ordinary form of land-based gambling, thus legitimizing the online gambling industry. Therefore, foreign online gambling entities can legally profit from U.K. citizens, while the British government receives tax revenues, which is not the case in the U.S. (Beem & Mikler, 2011).

3.4 Gambling taxes, interest groups and channelization

Paton et al. (2004) studied the U.K. market by applying data from before and after the regulatory changes to the taxation scheme. The re-regulation consisted of a change from the previous form of General Betting Duty (GBD), i.e. tax on gambling turnover of 6.75 percent, to Gross Profit Tax (GPT), i.e. tax on gross win of 15 percent, effective October 2001. Paton et al. (2004) states that GBD is considered a commodity tax (tax based on unit), whilst GPT is an ad valorem tax (tax based on value). According to economic theory (see e.g. Benar & Jenkins, 2008), GPT, which is taxed on price (i.e. price paid to participate in a bet), is assumed to be more effective than GBD, which is taxed on quantity, defined as the sum of all bets placed. Paton et al. (2004) discuss that GPT incentivizes entities to focus on margins, concentrating on delivering revenues through low prices. Hence, all things held equal, the shift from GBD to GPT lowers the tax burden on low-margin and highly competitive industries such as online gambling, but also constructs a market where domestic entities can compete on equal terms with foreign online gambling entities.

According to Paton et al. (2004), in the long run, GPT yields higher tax revenues than GBD, as it reduces the overall tax burden on entities which promotes market competition through entry, thus making it more less costly for foreign online gambling entities to operate within the regulated system. Using econometrical models, the authors found a statistically significant relationship between demand and tax levies. Specifically, in the event of a tax reduction, the demand elasticity of a tax varied between -0.50 and -0.55, suggesting that domestic gambling demand would increase by 10 percent given a 20 percent decrease in tax rate. A statistically significant negative relationship was also found between market demand and unemployment and a positive relationship between market demand and wages (Paton et al., 2004). However, the authors include a disclaimer that their research was solely based on domestic gambling, not including foreign online gambling sites which should affect the domestic gambling demand.

Another study which focuses on gambling regulation and political economics, is Sauer (2001), who uses a model based on two types of interest groups. The model sheds light on political competition between the group which maximizes welfare in an unregulated gambling market and the group which maximizes welfare in a heavily restricted market. One group views gambling as a good with increasing utility and thus considers it to be harmless, whilst the other contrarily considers it as harmful. The model explains that the *deadweight cost of taxation*, i.e. market inefficiencies stemming from taxation, is affected by the political influence of the two interest groups. The political influence of the two interests group also determines the equilibrium level of market restrictions. According to Sauer (2001), all things held equal, the marginal welfare cost for the group which desires an unregulated gambling market is equal to the marginal benefit for the group which desires a regulated market. Sauer (2001) derives the model through previous empirical results, e.g. using lotteries as an economic tool for governments with relatively high tax burdens. The author concludes that one explanation for the increasing liberalization of the market, is that the liberalized systems allow governments to impose tax schemes, thus funding governmental spending or to cover deficits. Gambling markets may therefore be an alternative source of tax revenues if the deadweight cost of taxation increases, which further implies that the alternative cost of finding alternative sources decreases. According to the model suggested by Sauer (2001), for the gambling market to decease, a decline in government spending and optimal adjustment in the deadweight cost of taxation is required.

A more recent research by Nordström et al. (2016) studies the connection between tax rates, channelization rates and gambling volumes which maximizes tax revenues for Sweden’s new licensing system. The authors point out the conflicting paradigm in terms of a regulated system. For the channelization rate to be maximized, thus ensuring that all foreign online gambling entities acquire a license to operate within the regulated system, the tax rate should be set at zero percent. A tax rate above zero percent implies higher operational costs, thus increasing the risk that foreign online gambling entities would not acquire a license, impacting the tax base. Therefore, the authors conclude that there exists a negative relationship between the tax rate and channelization rate and a negative relationship between the tax rate and gambling volumes.

As such, legislators need to consider both channelization rate in conjunction with governmental tax revenues when setting the tax rate. Through a comparative analysis between European countries with licensing systems and with demographical similarities to Sweden, Nordström et al. (2016) conclude that a tax rate on gross win of 15 – 20 percent is expected to yield a channelization rate between 85 – 90 percent. By comparing the U.K. and Danish regulatory licensing- and taxation schemes, the authors further conclude that a tax rate below 15 percent will only marginally increase the channelization rate, but substantially lower tax revenues. Furthermore, empirical estimates show that a tax rate above 20 percent will result in channelization rate lower than 80 percent. Nordström et al. (2016) also show that there exists a substitutional effect with a tax rate above 20 percent, firms might not join the regulatory system due to higher costs and reduced margins and try to attract consumers outside the system.

The results are supported by evidence in Europe, where U.K. has a tax rate of 15 percent and 95 percent channelization, Denmark has a 20 percent tax rate and 88 percent channelization, Spain has a 25 percent tax rate and 70 percent channelization, Portugal and France have 41 percent and 45 percent tax rate respectively, both yielding a channelization rate of 52 percent.

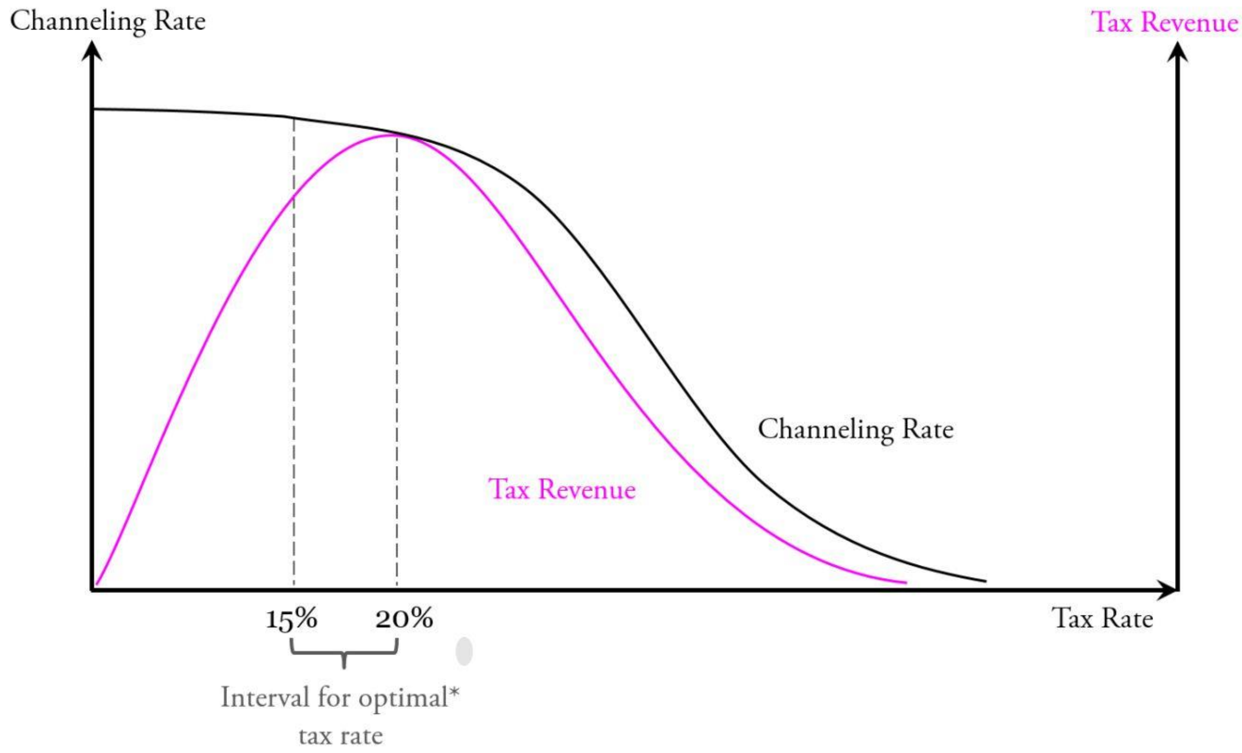

Figure 2: Optimal tax rate on gambling with high channelization and tax revenues
Source: Nordström et al. (2016)

3.5 Imperfect markets theory

In terms of market power, there are several established models available which can be applied to explain and analyze the characteristics of imperfect market structures. The fundamental attributes of market structure analysis are based on competition, quantity and price. Monopolistic competition is an imperfect market as there are several consumers and firms, where the firms serve the market with differentiated products and services, with no barriers to entry and/or exit (Baye, 2013). The assumption of differentiated goods with close but not perfect substitutes allow firms to take some control of the price variable, such that a price increase will still retain some customers while others change firm in favor of lower prices.

According to Baye (2013), firms allocate significant amounts of investments towards advertising in order to differentiate themselves from competitors. Short-run economic profits attract new entrants and lead to increased competition. In the long-run, the price is above marginal cost but economic profits equivalent to zero.

Oligopolistic market structures are also common in many industries. Like monopolistic competition, a set of assumptions as well as strategic variables are established, which differ between the models. The main characteristics of oligopolistic market structures include few firms producing differentiated or homogenous goods, serving many consumers. Four different oligopolies with their respective market assumptions will be presented. The kinked-demand curve is a model based on the assumption that (1) firms produce differentiated goods to many consumers in markets with entry barriers, and (2) every firm assumes that the other firms will decrease their prices given a price reduction from another firm, but will not react the same to a price increase. The implication of the kinked-demand curve model is that firms do not have any incentives to change their prices if the marginal cost is at a certain interval which does not affect the profit maximizing level. However, the model does not answer how the industry determines the price level, rather it demonstrates how sticky prices might affect the market. (Baye, 2013)

In contrast to the kinked-demand curve model, another model with imperfect market characteristics is the Cournot oligopoly. According to Baye (2013), quantity is the strategic variable in a Cournot oligopoly where firms decide on their output level. The underlying assumption can be summarized as follows; (1) firms produce either homogenous or differentiated products in a market with entry barriers to many consumers and (2) each firm independently assumes that its competitors will hold its output level constant given changes in its own output level. Baye (2013) states that firm behavior is associated with the production level based on their best reaction function, in which the profit-maximizing output level depends on the output level of the other firms in the market.

In the two models presented above, the assumptions were based on either symmetric situations where firms follow price reductions or that firms are independent of each other based on output levels. In a Stackelberg oligopoly, the model assumes that one firm in the market is considered the leader and decides on its output before the other following firms. (Baye, 2013)

Given the leader's output level that maximizes profits, the followers decide on its profit-maximizing output based on the leader's output. According to Baye (2013), the followers behavioral output decision is equivalent to the best reaction function in the Cournot model. The underlying assumptions of Stackelberg oligopoly can be summarized as follows; (1) few firms produce either homogenous or differentiated products to many consumers in a market with the existence of entry barriers; (2) one firm is the leader whilst the others are the followers assuming; (3) the followers choose their profit-maximizing output level given the leader's choice of output level (Baye, 2013).

The final model presented in this paper is the Bertrand oligopoly. The underlying characteristics of the model can be summarized as follows; (1) few firms produce homogenous products to many consumers in a market with entry barriers; (2) price is the strategic variable firms use to compete with; (3) absence of transactions cost and consumers have perfect information; (4) firms have constant marginal cost. Given the assumptions of perfect information, homogenous products and constant marginal costs, the market outcome will be the same as in the case of perfect competition. Thus, economic profits are zero since price is equivalent to marginal cost, leading to an economically efficient output level. The situation is otherwise known as the Bertrand trap, which can be mitigated by producing differentiated products and advertising given changes in consumer preferences. (Baye, 2013)

3.6 Gambling behavior and advertising

As for economic consumer behavior, several theories have been established throughout the years. For instance, Grinols and Omorov (1996) state that gambling is “socially unproductive seeking”, since participating and spending time on a certain game is to seek short-run economic profits but ends up with economic losses in the long-run.

Eadington (1999) refers to previous theory that gambling makes people and society stupid on the grounds that they attempt to utilize causality into events based on pure chance. The author assumes that the more people gamble, the less efficient the industry becomes, since gambling undermines rational thinking and the knowledge of cause-effect relationship.

Furthermore, Eadington (1999) also states that previous literature argue that gamblers are assumed to be beings with rational behavior, who consumes entertainment with anticipation to increase its future wealth by giving up monetary value at present.

Folkhälsomyndigheten (2017) published a report based on data from a longitudinal study running between 2008 - 2015. The report stated that gambling advertising has increased significantly since the dawn of the millennia, amounting to SEKbn 3.7 in 2014, which was seven times that of advertising in 1999 (inflation adjusted). According to Folkhälsomyndigheten (2017), advertising is a way to attract consumers to participate in different forms of gambling. Thus, entities can distribute consumer's interests in gambling to different games it offers. Advertising is also, according to Folkhälsomyndigheten (2017) a way for firms to increase the overall gambling. Despite the increase in advertising, 88 percent of the study population did not believe they had been negatively impacted by the advertisement, 10 percent had believed they had been negatively impacted by advertisement and two percent felt they were continuously impacted in a negative manner by the commercials. The report concluded by remarking that gambling advertisement appears not to be a problem among the general public as the number of problem gamblers has not increased during the period 2008 - 2015 despite large increases in advertisement.

However, it was noted that the effect should not be neglected, especially as gambling problems relating to online casinos has been increasing, which are also responsible for a clear majority of the advertisement investments. Similar evidence is found in an Australian study from 2014 which concludes that there is limited available evidence that gambling advertisement increases overall gambling volumes or if it simply functions as a means of competing for market share (Hing et al., 2014). The results found by Hing et al. (2014) is similar to the findings found by Binde (2009b); advertising activities is used as a tool to attract existing customers from competitors in the market, suggesting that advertising is a way of means to increase market share. Recent statistics from Spelinspektionen (2019) shows that advertising expenditure reached SEKbn 7.4 during 2018, an increase by 35 percent the year before and 95 percent increase compared to 2016, where over two-thirds of the expenditure came from foreign online gambling entities.

However, the study also found preliminary evidence of internet gambling advertisement increased overall gambling volumes among some subgroups of consumers. It appears that gambling advertisement is impacting individuals with already existing gamblers and gamblers with problematic gambling behavior. Specifically, advertising campaigns that were connected to deposit offers and free bets increased overall gambling. In the report from Folkhälsomyndigheten (2017), among the two percent which noted they had been negatively impacted on several occasions, more than 20 percent had gambling issues. Advertising makes them play for more money than what was initially intended, mainly because of the quick impulse reaction that advertising gives in terms of bonuses and jackpots. Similarly, among the 88 percent who did not consider they had been negatively affected, few players had similar problems. Out of 25 problem gamblers, approximately 75 percent of the individuals reported advertisement having a marginal or tangible negative effect by triggering urges to gamble (Binde, 2009b).

In terms of banning advertisement, as concluded by Friend and Ladd (2009), restricting gambling advertisement surely violates the freedom of speech. It also creates problems when government interferes in controversial industries, such as gambling, to restrict advertising exposure, but still sees tax revenue from the industry as acceptable. The authors conclude that, if however, any governmental interventions such as anti-gambling campaigns are to be made in order to minimize and mitigate problem gambling, both financial and political resources are required with a high degree of duration, exposure and evaluation.

4. Methodology

The following chapter will present the chosen methodology in order to answer the research questions posed in section 1.3. Furthermore, a description of the chosen data will be introduced, the selected variables as well as the model specifications. The chapter concludes by discussing quality standards, delimitations as well as potential problems with the method chosen.

4.1 Research purpose

Farrell (2012) reviews data sources as well as different types of research methods available with respect to gambling. According to the author, time series data on activity, such as gambling volumes, turnover or tax revenue, is logical to use if one wants to study competition or analyze policy changes. Previous research has been focusing on the cost-benefit of deregulation from different perspectives. However, Farrell (2012) states that several of these studies have limitations when it comes to data, as most of the research only uses cost variables that can be quantified easily. Thus, the author argues that researchers within this field omit sociological costs, which, in some cases, are more important to address rather than direct monetary costs. Moreover, Farrell (2012) also highlights that using time series processes to analyze pre- and post-effects of deregulation is fundamentally incorrect. Such studies, according to Farrell (2012), does not capture the important essence of the counterfactual; that is, assuming the absence of the given event (i.e. no policy changes), what would have happened? Moreover, Farrell (2012) addresses that current time series data on gambling cannot perform accurate cost-benefit and/or before-and-after analysis and should, therefore, be used for analyzing trends. This motivates the authors of this paper to use time series data for trend analysis and forecasting estimations. It furthermore motivates the authors of this paper to provide an estimate of the counterfactual, although it should not be considered in a true difference in difference estimation.

4.2 Research approach

Yin (2014) describes three types of research approaches that can be conducted scientifically; descriptive, exploratory and explanatory. This paper applies the descriptive research approach, as the study aims to describe the nature of the phenomenon, with no direct intent to understand *"why"* it occurs. As concluded by Dulock (1993), *"something"* in descriptive research can include an event or phenomena consisting of a variable of interest, where one aims to describe the phenomena, accurately and systematically, to discover new meaning and/or describe what exists. In this case, the authors of this paper analyze three variables independently. In addition to descriptive approach, this paper aims to understand and define a market structure based on observations to see whether it can be explained using existing theories presented in the literature review. As such, the authors define the study as descriptive with exploratory elements.

Moreover, this paper will follow Dulock's (1993) underlying characteristics of descriptive research approach: (1) no independent variables since there is no manipulation or control, (2) applying historical data in order to describe and document the nature of the phenomenon, (3) the goal is not to explain causal relationship and thus internal validity is of no concern, (4) a hypothesis is not stated since the empirical results will serve as a foundation for future research within the field of study and (5) narrowing the study down to a relatively unexplored phenomena, either by geographic location or demographic segment.

Further, this paper uses real world data of the given phenomenon, which is applied using well established econometrical models. The applied models will be thoroughly presented in section 4.6. Therefore, external validity condition put forward by Dulock (1993), i.e. gathering the right *data* from the right *subject* in the right *setting,* is considered as fulfilled.

According to Jacobsen (2002), the purpose and research questions should be the sole foundation when deciding the methodological approach of a study. Considering that the research questions posed for this study are characterized by "*how*" and *"what"*, the designed research approach will be both quantitative in terms of econometric forecasting processes as well as qualitative in terms of defining market structure using existing theories.

As suggested by Dulock (1993), applying quantitative methods using econometrical procedures in a descriptive study, has three purposes, (1) describing the variable, (2), describing relationships between two or more variables and (3) describing the distributions using graphs in order to illustratively interpret the results. This paper will also use an inductive approach of reasoning since the study ought to quantitatively, empirically and objectively measure the given phenomenon using structural equation modelling and, to some extent, generalize the results beyond the population studied. Moreover, according to Saunders et al. (2009), an inductive research approach is considered when researchers ought to explore the chosen data and afterward develop potential theories that can be related to previous literature, which will be the case of this paper.

According to Saunders et al. (2009), within exploratory, explanatory and descriptive research approach, there exist seven different types of research strategies; case study, action research, grounded theory, survey, experiment, ethnography and archival research. The research strategy chosen for a study should be dependent on to what extent the authors of the paper can control behavioral events, the posed research questions posed and whether the study focuses on contemporary events, in contrast to historical events. In terms of the posed research questions, "*why*" and "*how*" questions may be the result of applying case study with descriptive approach and quantitative method. (Saunders et al., 2009). Furthermore, this paper uses, as suggested by the author, *"empirical investigation of a particular contemporary phenomenon within its real-life context".*

4.3 Case selection

According to Yin (2014), when conducting a case study, one of four different case study types should be considered; single, multiple, embedded or holistic case studies. In terms of case selection, this paper focuses on gross win for three different types of gambling categories operated by AB Svenska Spel. Thus, the study is a single mixed method case study since it applies quantitative methods to forecast three variables as well as to qualitatively define the market structure AB Svenska Spel will compete in post-regulation. A multiple case study would be preferred for variation purposes, comparisons and dynamic effects.

However, this is not possible due to limited and inadequate number of observations from other countries with similar regulation to Sweden, which will be further discussed in section 4.8. Moreover, given the fact that this study applies forecasting estimations on three different types of gross win gambling variables, i.e. more than one unit of analysis within the case selection chosen, an embedded case study is conducted. In conclusion, given the case selection of state-owned AB Svenska Spel, this research uses a single, embedded and mixed method case study approach.

4.4 Data collection

The data used in this study has been gathered from AB Svenska Spel through H2 Gambling Capital, a market data provider focusing on the global gambling market primarily collecting data from regulatory authorities in the respective countries. The organization has over 20 years of experience in the industry and has provided data to legislators, institutions and gambling operators for analysis and decision making (H2 Gambling Capital, n.d.). According to AB Svenska Spel, H2 Gambling Capital updates the data on a continuous basis and is one of the primary sources of data inputs for AB Svenska Spel. Thus, the authors of this paper believe that the data provided from the source is reliable for the intended study.

As suggested by Saunders et al. (2009), there are advantages in using secondary data. First, the authors mention that, in general, secondary data provides the availability for public scrutiny which increases transparency, lowering concerns of data quality. Second, using secondary data that is accessible for others will enable future research within the field of study to control whether the findings could be used for comparative analysis. Third, Saunders et al. (2009) discuss that the availability of secondary data allows for future studies which may lead to unforeseen discoveries when re-analyzing the data.

4.5 Selected variables

As described in section 4.3, this paper adopts a single embedded mixed method case study approach, using gross win (SEKm) on three different types of gambling categories offered by AB Svenska Spel, sports- and lottery, Casino Cosmopol (incl. online poker) and land-based gaming machines. Quarterly data is provided by H2 Gambling Capital, starting from Q1-2006 until Q4-2018. The first variable, sports- and lottery (SL), concerns games that consist of betting on a sporting event and lotteries, i.e. games of chance. H2 Gambling Capital aggregates sports and lottery to one variable, which is possible due to the structural similarities of the games, i.e. randomness and luck. This is also concluded by Forrest and Pérez (2015) who studied the similarities between lotteries and football betting and found that the cognitive effects between the two types of games are closely related.

The second variable, Casino Cosmopol incl. online poker (CC), includes games within land-based Casino Cosmopol that are operated in four different cities in Sweden. Casino Cosmopol is a wholly owned subsidiary to AB Svenska Spel and has exclusive rights to offer casino games, such as blackjack, baccarat, roulette, poker, Texas hold'em and classic slot machines (Casino Cosmopol, n.d.). Online Poker is a game which is a part of AB Svenska Spel (2017) and is aggregated together with Casino Cosmopol as one variable by H2 Gambling Capital.

The third and last variable consists of land-based gaming machines (VG), named Vegas in Sweden. According to AB Svenska Spel (2017), land-based Vegas gaming machines offer multiple games with similar gambling characteristics to casino games. AB Svenska Spel has exclusive rights to offer Vegas in Sweden. Vegas are located all over the country through selected bingo halls with bingo permits and restaurants with an approved license. By the end of 2017, 5,015 Vegas were available in Sweden, which is distributed by AB Svenska Spel's business partners (AB Svenska Spel, 2017).

In conclusion, 156 data points have been collected from Q1-2006 to Q4-2018, distributed between three gambling categories offered by AB Svenska Spel; sports- and lottery (SL), Casino Cosmopol incl. online poker (CC) and Vegas (VG).

4.6 Econometric framework

In this section, the econometric framework will be presented. This section will include the process for ARIMA modeling, automatic procedures and other tests, forecasting accuracy, dealing with long and short times series as well as alternative econometric methods.

4.6.1 ARIMA process

The authors of this paper have chosen an econometric approach in order to answer the first research question. More specifically, in order to build predictive models on AB Svenska Spel's gross wins on sports and lottery, Casino Cosmopol (incl. online poker) and gaming machines (Vegas), this study utilizes ARIMA modeling for univariate time series analysis and forecasting. Gujarati (2003, p. 837) describes ARIMA processing as "*...analyzing the probabilistic, or stochastic, properties of economic time series on their own under the philosophy let data speak for itself*". According to Stock and Watson (2015), ARIMA uses autoregressive (AR), integrated (I), moving average (MA) order, which is an econometrical method applied using the given variable itself for trend forecasting.

The practical application of the ARIMA modeling will follow the Box-Jenkins (1976) methodology for times series forecasting. The Box-Jenkins (1976) iterative and methodological framework is based on a three-step process which entails (1) model specification, (2) parameter estimation and (3) model checking. First, an identification process is applied by estimating the given variable's potential non-stationarity and identifying the order of differentiation (d) required to achieve a stationary time series. According to Gujarati (2003), stationarity is defined as a time series process where its autocorrelation, mean and variance is time-invariant, i.e. the properties do not change over time. Moreover, the author states that stationarity is required when applying time series forecasting due to the assumption that the properties are constant across time, especially when predicting future values of the given variable.

Estimating (d) is completed by visually analyzing the variable of the interest and by applying unit root testing through the Augmented Dickey-Fuller (ADF) test. The ADF test is an extended version of the unit root test by Dickey-Fuller, which augments the original model by adding lagged changes, Δy_{t-h}.

The generalized version of the test with *(p)* lags of Δy_t is illustrated below where the test is conducted by running the following regression: Δy_t on $y_{t-1}, \Delta y_{t-1}, \dots, y_{t-p}$ and conducting a t-test on $\hat{\theta}$, which is the coefficient of Δy_{t-1}. (Wooldridge, 2008)

The null hypothesis is formulated as: $H_0: \hat{\theta} = 0$ under the alternative that $H_1: \hat{\theta} < 0$. More intuitively, the tested null hypothesis is that there is a unit root in the time series, implying non-stationarity. Thus, a significant t-test implies that the hypothesis of unit root can be rejected at given level of significance. (Wooldridge, 2008)

Once a stationary time series has been achieved, the next step is to specify the autoregressive, AR(p) and moving average MA(q) components of the model. The components are estimated by analyzing the pattern in the autocorrelation function (ACF) and the partial autocorrelation function (PACF) of the time series. In general, the final significant lag of the PACF is indicative of the value of (p) while the final significant lag of the PACF is indicative of the value of (q). However, the ACF and PACF cannot be analyzed in isolation and the combined pattern must govern the model selection. When model candidates have been identified using the ACF and PACF, the relative quality of the model fits are evaluated using the Akaike Information Criterion (AIC) and Bayes Information Criterion (BIC):

$$AIC = T\,log\left(\frac{SSE}{T}\right) + 2(k+2)$$

$$BIC = T\,log\left(\frac{SSE}{T}\right) + log(T)(k+2)$$

Where *T* = number of observations, *SSE* = sum of squared errors, *k* = number of predictors in the model. The information criterion formulas trade off the fit of the model as estimated by the sum of squared errors with penalty terms for adding extra values, as such adding another parameter is useful if it allows a better fit than the penalty the extra term entails. According to Hyndman and Athanasopoulos (2018), the model with the minimum AIC is typically the best model for forecasting. The BIC puts a heavier penalty on the number of parameters included in the model and will consequently return either the same model as chosen by the AIC or one with fewer parameters.

With small sample sizes, there is a risk of the AIC overfitting the parameters. The Corrected Akaike Information Criterion (AICc) is an extension of the AIC which, according to Hyndman and Athanasopoulos (2018), is useful for time-series with small values of *T*, i.e low number of observations. The AICc is useful when *T* is small as it is used as a proxy for forecasting out-of-sample mean squared errors (MSE) and accounts for the amount of noise to be included. Thus, according to the authors, one should consider choosing the lowest AICc value when determining the model, specified as follows:

$$AIC_c = AIC + \frac{2(k+2)(k+3)}{T-k-3}$$

After deciding on a model specification using the information criterion, the autocorrelations of the residuals will be plotted to verify that they are a white noise process, i.e. no spikes shall exist outside the confidence interval (Stock & Watson, 2015). The visual residual analysis of the ACF is complemented by a portmanteau test, which tests whether a group of autocorrelations are significantly different from a white noise process. The chosen portmanteau test applied in this paper is the Ljung-Box test which tests Q* under the null hypothesis that the residuals are independently distributed, thus if the p-value of the Ljung-Box test is above a given significance level, the residuals are not significantly different from a white noise process.

$$Q^* = T(T+2)\sum_{k=1}^{h}(T-k)^{-1}r_k^2$$

Where h = the maximum lag being considered, T = number of observations, k = number of parameters, r_k is the autocorrelation for lag k. If the residuals are not a white noise process, it is an indication that the fit of the model can be improved as there is still information to be captured in the data. According to Hyndman and Athanasopoulos (2018), the ARIMA process can be summarized as per figure 3 on the next page:

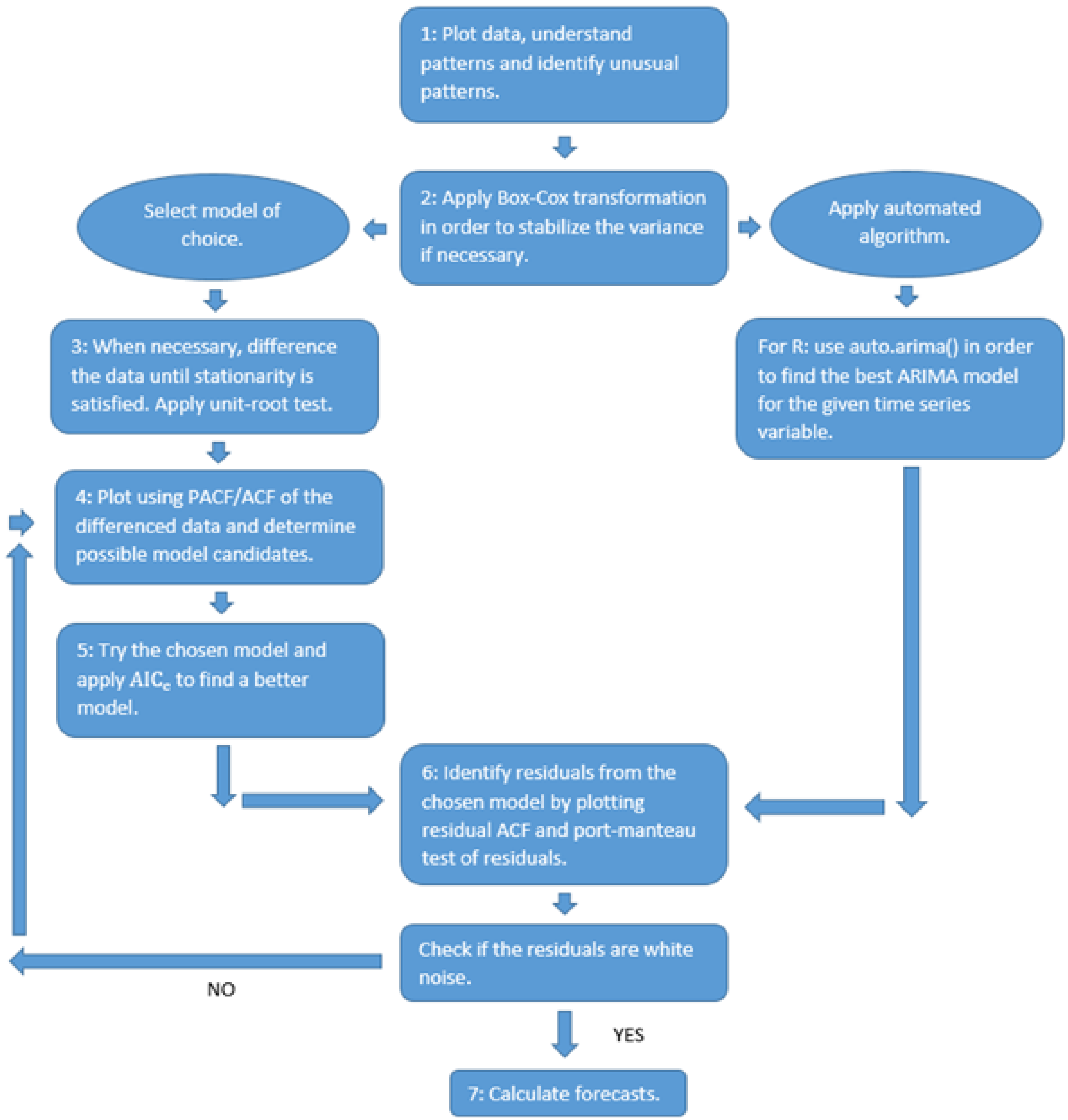

Figure 3: General process for ARIMA forecasting
Source: Hyndman and Athanasopoulos (2018)

4.6.2 Seasonal time series

The process outlined above is applicable for both non-seasonal data as well as seasonal time series. According to Hyndman and Athanasopoulos (2018), the general process and structure for SARIMA (seasonal autoregressive integrated moving average) models are the same as for non-seasonal models, but with added seasonal terms as follows:

$$ARIMA \underbrace{(p,d,q)}_{non-sesonal} \underbrace{(P,D,Q)_m}_{seasonal}$$

Where the lowercase letters indicate the non-seasonal part of the model, whilst the uppercase letters indicate the seasonal part of the model. The lower letter *m* corresponds to the frequency of the data, e.g. for quarterly data, *m* = 4. A general rule is that when potential seasonality in the data has been identified, the first step is to analyze whether a seasonal difference is required or not by studying the PACF and ACF plots. If there exists a stable and strong seasonal effect, one can assume that seasonal difference is appropriate to properly model the seasonal effects. In that case, a maximum of one seasonal differencing, or a total differencing of two (i.e. non-seasonal plus seasonal) should be applied (Hyndman & Athanasopoulos, 2018).

Another general rule is; given that there exists a positive autocorrelation in the seasonal period at lag *m*, one should suggest on adding a seasonal autoregressive term (*P*) in the given model. In contrast, if there exists a negative autocorrelation in the seasonal period, one should suggest adding a seasonal moving average term (*Q*) (Hyndman & Athanasopoulos, 2018).

In terms of an MA(*Q*) or an AR(*P*) model, the seasonal part can be shown graphically by the seasonal lags of the ACF and PACF. For instance, Hyndman and Athanasopoulos (2018) exemplify, assuming a model of ARIMA (0,0,0)(0,0,1)[4], a spike at the fourth lag will be shown when plotting the ACF, and no other significant spikes elsewhere. Furthermore, the seasonal lags in terms of the PACF will show an exponential decay at lags 8, 12, 16, 20 etc.

4.6.3 Automatic procedures and other tests

The auto.arima() function is applied as a complement to the model specification process outlined above, which uses both the ndiffs() in order to estimate the number of first differencing (d) as well as nsdiffs() for determining the required seasonal differences (D), both functions are further described below. Estimating the autoregressive term AR(p), moving average MA(q), seasonal autoregressive AR(P) and the seasonal moving average term MA(Q) is achieved by testing combinations and chooses the fit with the lowest AICc described in section 4.6.1. In general, the automatic ARIMA procedure will return the fit with lowest information criteria score. However, to accelerate the process, certain assumptions and approximations are made which implies that the auto.arima() function does not necessarily always return the model with the lowest AICc. Consequently, in some cases, estimating a model manually instead may lead to a better fit. (Hyndman & Athanasopoulos, 2018)

According to Hyndman and Athanasopoulos (2018), the ndiffs() function is a unit root test that estimates the required number of first differences in order for the time series to be stationary. Ndiffs() applies the ADF test described in section 4.6.1, where $H_0: \hat{\theta} = 0$, i.e. non-stationarity. The ndiffs() function returns the number of first differences required to fail the ADF test at the given significance level. Moreover, ndiffs() also applies the KPSS test where $H_0: \hat{\theta} < 0$, i.e. stationarity. The function then returns the number of first differences required to pass the test at the given significance level (Hyndman & Athanasopoulos, 2018).

Similarly, if there exist a seasonal trend in the given time series, the nsdiffs() function is applied in order to test for seasonal unit roots (D). The nsdiffs() test applies the Wang, Smith and Hyndman (2006), Canova-Hansen (1995), Hylleberg, Engle, Granger and Yoo (1990) as well as Osborn-Chui-Smith-Birchenhall (1988) tests to determine the number of seasonal differences required to achieve stationary time series. (Hyndman & Athanasopoulos, 2018)

Other functionalities which will be applied throughout the fitting process include utilizing the tsoutliers(), tsclean() and QLR functionalities in R. The tsoutliers() function is an automatic procedure for detecting outliers which fits a loess (locally estimated scatterplot smoothing) curve to the data and labels the residuals as outliers if they lie outside the range of $\pm 2(q_{0.9} - q_{0.1})$ where q_p is the p-quantile of the residuals Hyndman (2014). The tsclean() function cleans the data from outliers by replacing the outliers with values determined by applying Friedman's SuperSmoother Friedman (1984). Friedman's SuperSmoother calculates a predicted value based on linear interpolation from the best of three different spans decided determined by the sample size of the data.

The Quandt Likelihood Ratio (QLR) statistic Quandt (1960), is used to test for a structural break at an unknown date in the time series and is accomplished by computing the test laid out by Chow (1960) for each period and returning the point with the highest F statistic, thus making it the most likely point for the break. (Stock and Watson, 2015)

4.6.4 Forecasting accuracy

The time series consist of quarterly observations from 2006-2018 for a total of 52 observations per gaming category. The total set of observations is split into a training set for determining the model specification and a test set for evaluating the pseudo out of sample forecasting accuracy. The size of the test set is in accordance with Hyndman and Athanasopoulos (2018) who state that the size of the test set should ideally be approximately 20 percent of the total set, or at least match the length of the intended forecast period. As such, the training set includes the first 44 observations from 2006 - 2016, while the remaining 8 observations from 2017 - 2018 will be allocated to the test set.

By using the training set to specify a model and generate forecasts for the same period as the test set, it allows for calculating the forecast errors against the actual observations. By extension, it also allows the models to be evaluated based on their pseudo out of sample forecast.

In particular, the following measurements will be applied for analysis in accordance with Hyndman and Athanasopoulos (2018): root mean squared errors ($RMSE = \sqrt{mean(e_t^2}$)), mean absolute error ($MAE = mean(|e_t|)$), mean absolute scaled error ($MASE = mean(|q_j|)$) and mean absolute percentage error ($MAPE = mean(|p_t|)$). In short, MAE and RMSE are both scale dependent errors: minimizing MAE yields forecast based on the median whilst minimizing RMSE yields forecast based on the mean. MASE is a scale independent error measurement and minimizing its values yields a forecast based on the absolute value of the mean. Lastly, MAPE is percentage based and is commonly used when there are no extreme values. (Hyndman and Athanasopoulos, 2018)

4.6.5 Long and short time series

An issue to address in terms of forecasting is how many data points are required to fit in a time series process. As discussed by Hyndman and Athanasopoulos (2018), there is no universal law that answers this question, as it depends on the randomness of the given data as well as the number of parameters that needs to be considered. The authors state that the required data observations increase in conjunction with the amount of white noise as well as the number of parameters. Hyndman and Athanasopoulos (2018) argue that the general rule of minimum 30 observations for ARIMA forecasts is false and instead argue that the theoretical limit is that there need to more observations than the number of parameters. In contrast to short times series, there also exist issues when forecasting very long time series. Hyndman and Athanasopoulos (2018) address that when there are too many observations, parameter optimization for ARIMA forecasting becomes problematic and time-consuming. However, issues with regards to very long time series should not be a problem for this paper. On the contrary, the authors of this paper need to inspect whether the number of observations is too low and, if so, take it into consideration when it comes to model specification for ARIMA forecasting, which will be addressed in the empirical analysis.

4.6.6 Alternative econometric methods

As concluded by the methodology chapter, this paper uses ARIMA modelling for univariate times series forecasting, which is one of the most widely used methods in terms of forecasting time series. The advantage of applying a univariate model is that it only depends on the target variable as well as the autocorrelations of the data. Moreover, ARIMA tends to be robust when it comes to short-run forecasting (Wooldridge, 2008). This study could also have used different approaches for forecasting sports- and lottery, Casino Cosmopol (incl. online poker) and gaming machines (Vegas). One alternative forecasting method is to introduce external regressors, using either ex-ante or ex-post methodology. Instead of only using past values of the target variable, adding other predictors in order to forecast future values of the dependent variable, such as employment, GDP, consumer preferences towards a certain gambling, tax burdens and volumes from foreign online gambling entities, may or may not forecast gross wins for the respective games better. However, in order to conduct an ex-ante regression forecast, all predictors must be forecasted, which is time-consuming and challenging to generate. In contrast, ex-post regression forecast does not require forecasting of the predictors, but the model itself is mostly used for evaluation purposes (Hyndman & Athanasopoulos, 2018).

Another advanced and one of the most widely used forecasting methods is exponential smoothing (Gujarati, 2003). There are several varieties of the method, such as Holt's linear method as well as Holt-Winter's method. Essentially, applying exponential smoothing yields past observations weighted averages of the forecasting variable. The weighted average of past observations decreases exponentially, which implies that the most recent data observations get the highest weighted average. However, forecasting using exponential smoothing will not be accurate if there exist seasonal or cyclical variations in the data. As such, exponential smoothing is excluded as a potential alternative method.

Further, extending univariate processing, one might consider using multivariate time series, which, by definition, has more than one variable. According to Gujarati (2003), forecasting using multivariate time series corresponds to simultaneous-equation modeling on the basis that each variable is dependent on its previous values as well as the previous values of other variables. In other words, it requires a model that accounts for “feedback relation”. For this reason, one can apply vector autoregression forecasting (VAR), given the assumption that all variables in the model are treated with endogeneity. VAR has been widely applied for macroeconomic economic research, such as real business cycle theory. However, according to Hyndman and Athanasopoulos (2018), VAR requires extensive analysis on how many variables should be included in the system as well as the number of lags for each variable, which is both difficult and time-consuming. Therefore, the authors of this paper will, due to time constraints, not apply VAR forecasting, but welcomes it as a method for future research within the field of study.

Hyndman and Athanasopoulos (2018) also discuss that to improve forecasting accuracy, one can combine different forecasting methods for the same time series data. The output of the models is then averaged either by weight or by simple averaging. The authors exemplify this by applying exponential smoothing, ARIMA as well as okneural network autoregression modeling on monthly expenditures data.

Although this might be an interesting approach to conduct in terms of econometric forecasting, it requires extensive knowledge for each model applied as well as a longer time period for the research. Hence, given the circumstances of this research, combining forecasting methods will not applicable for the intended study. The authors of this paper, however, encourage other researchers when possible to apply the methods for the same variables as a robustness check.

4.7 Market structure framework

In order to define a relevant market structure post-regulation in which AB Svenska Spel competes in, the theories of imperfect markets, market power and competition will be utilized from the literature review. Observable characteristics of the Swedish gambling market primarily presented in the background chapter in section 2 will be connected to the given theories. The models are widely used by economists, policymakers as well as industrialists and will serve as a solid foundation for market definition.

Moreover, beyond imperfect market, market power and competition, this paper has extensively presented previous research on the gambling industry from different perspectives. Thus, given the observations of the Swedish gambling market, the authors of this paper will utilize previous research on the gambling industry and connect it to the Swedish market post-regulation.

4.8 Limitations

There are several limitations and alternative methods to the research that needs to be addressed. The new gambling regulation has been put into effect as of January 1st, 2019. As this research is being conducted shortly after the regulation and must be finished before mid-May 2019, limited data in terms of post-regulation is available. Clearly, post-regulation results of 2019 for AB Svenska Spel would have been of interest to evaluate the actual impact of the policy change.

Like all forms of research, another limiting factor which should be taken into consideration is that it is impossible to capture all aspects of the real world, which therefore requires assumptions in order to simplify yet yield valid and robust results for academics, governments and businesses to use. As presented above, this research uses a mixed method case study approach, focusing on AB Svenska Spel and three of its underlying games as well as identifying the market structure post-regulation.

At this point in time, there exist differences in opinions from government, operators and researchers how re-regulation versus no re-regulation affect AB Svenska Spel and its underlying business, which cause for motivation to apply time series and forecasting analysis on AB Svenska Spel assuming no re-regulation. Further, there are no econometric forecasting studies on AB Svenska Spel, nor a definition of market structure in Sweden post-regulation on the basis of the theories of imperfect markets, which cause for motivation to focus the study on these particular perspectives. Once post-regulation data or higher frequency of data points from similar jurisdiction is available, the result of this paper can be used as a foundation for future research within the field, with suggestions of possible topics presented in chapter 7. Moreover, this paper does not intend to address or depict any potential conclusion whether a re-regulation of the gambling industry in Sweden is for the better or worse in general, as it requires an extensive analysis on cost-benefit on several different aspects. The authors of this paper want to objectively, using econometrical forecasting methods as well as theoretical models of market structure, present how AB Svenska Spel's underlying games would have evolved, the projected impact on governmental tax revenues and what kind of market it will compete in post-regulation.

5. Empirical results and analysis

The following chapter will present the empirical results and analysis of the paper. Specifically, the ARIMA processes and forecasting modeling for sports- and lottery, Casino Cosmopol (incl. online poker) as well as Vegas gaming machines will be presented respectively in decreasing order in terms of percentage of total gross win for AB Svenska Spel in 2018 (full details and output can be found in the Appendix). Furthermore, an estimation of the impact on government tax revenue post-regulation will be calculated. The chapter concludes by identifying the relevant market structure of the Swedish gambling market post-regulation.

5.1 Sports & Lottery (SL)

The sports- and lottery category is the largest of the three revenue streams for state-owned AB Svenska Spel, amounting to a total gross win of SEKbn 6.7 in 2018, 76 percent of the total gross wins of SEKbn 8.8. Figure 4 on the next page illustrates the sports and lottery time series, which is where the identification process starts for the given time series in order to find the order of differencing required to meet the stationarity condition.

Identifying the order of integration

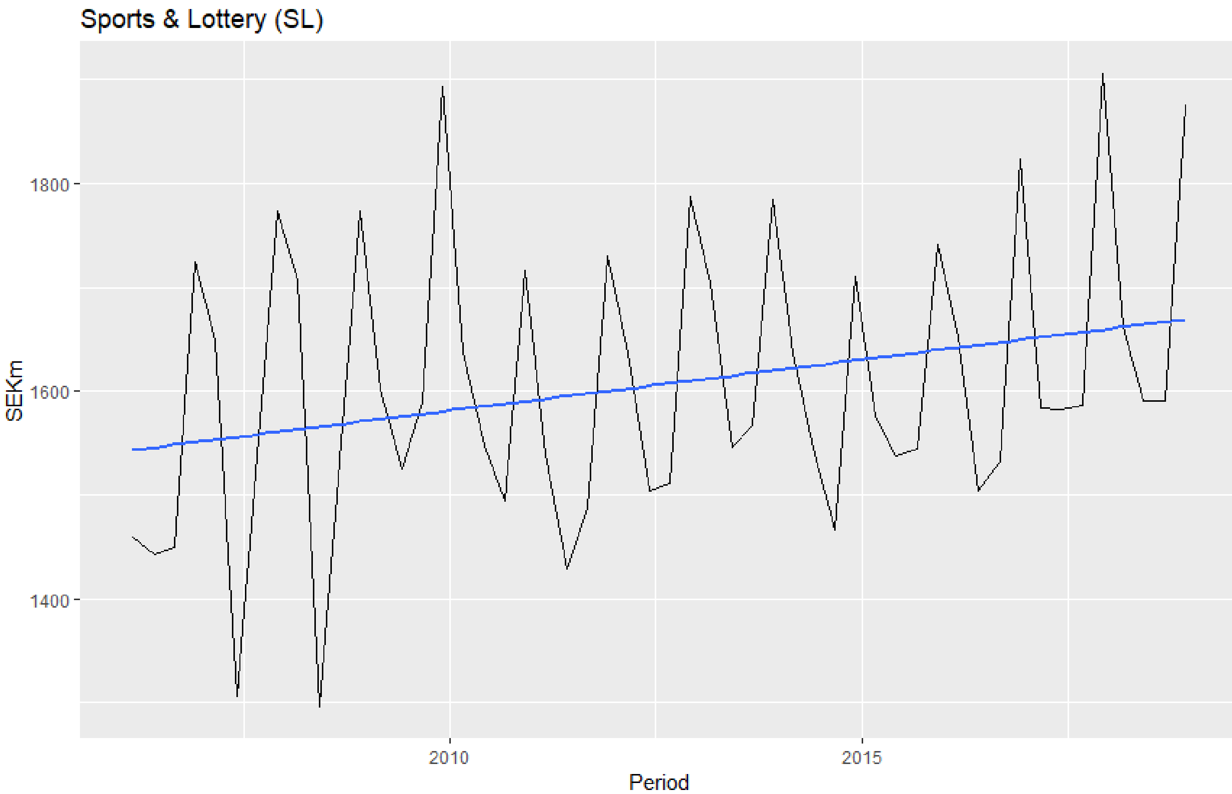

Figure 4: Sports and Lottery 2006-2018
Source: Authors' elaboration on the basis of Spelinspektionen (2019)

Analyzing the data, the series appears to exhibit seasonal tendencies along with a positive trend. As we are dealing with positive amounts and to try and stabilize the variance, we will compute the logarithm of the series and divide the time series into a test set and a training set as described in section 4.6.4. The logged training set is illustrated in figure 5 on the next page:

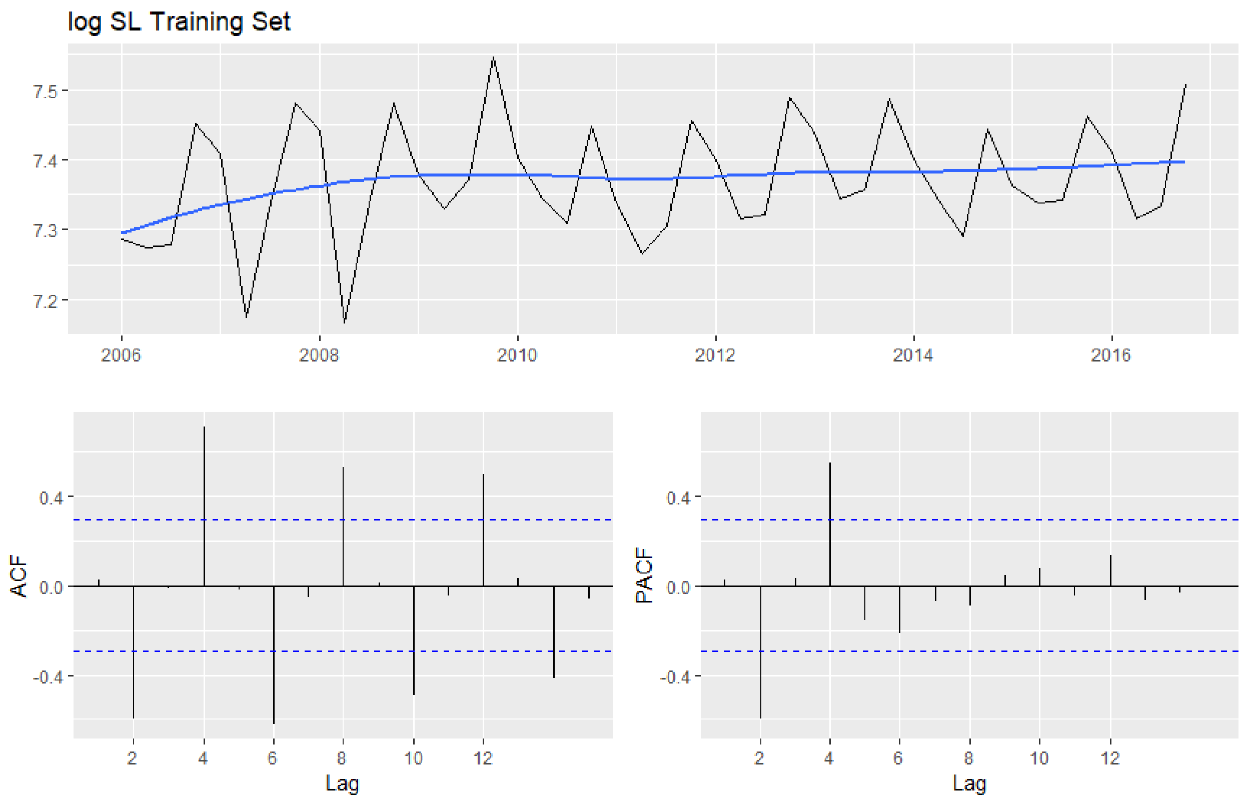

Figure 5: SL training set
Source: Authors' elaboration

Testing for seasonality in the data is conducted by applying a set of seasonality tests through the nsdiffs() function. The seasonality is visualized in figure 5 above and in the polar plot found in the Appendix, see figure A2. The nsdiffs() test confirms that a seasonal difference is appropriate to apply to the time series. After taking a seasonal difference, the data is plotted in figure 6 on the next page, which appears to fulfill the stationarity requirement.

Running the Augmented Dickey Fuller test (ADF) to check for a unit root confirms that the series is stationary after one order of seasonal differencing with a test statistic of -3.6134 and a critical value of -2.93 at the five percent significance level. However, as the coefficient in the ADF test is close to -1 (-0.8782), it is an indication of potential over differencing. The ADF test on the original non-seasonally difference series also returns a significant coefficient of -3.7594 with the same critical value of -2.93 at the five percent significance level. However, as the seasonality in the data is apparent, it seems likely that a seasonal difference is appropriate.

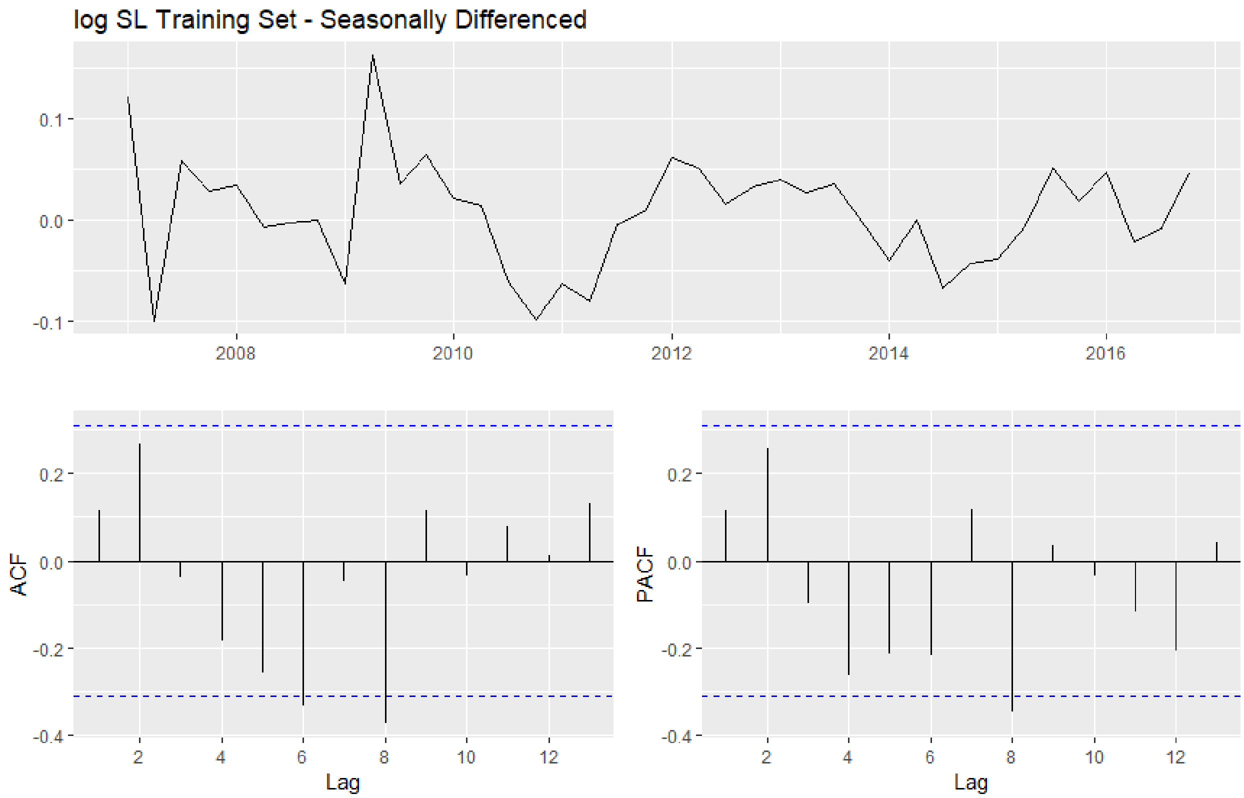

Figure 6: SL training set – seasonally differenced
Source: Authors' elaboration

Identifying model specification

The combined pattern in the ACF and the PACF of the seasonally differenced data shown in figure 6 above is not sufficiently clear to draw any conclusions on. The decreasing pattern in the semi-annual lags of the ACF in the non-differenced data, see figure 5, along with the spikes in lags two and four in the PACF, suggest either an AR(2) or AR(4) on non-differenced data might be appropriate fit for the time series. Furthermore, the negative coefficient at lag four of the ACF in the seasonally differenced data in figure 6 suggest that it could be worthwhile to also test a seasonal MA (1), i.e. SMA (1), component as well. Applying the auto.arima() function using the AICc information criterion, the automatic ARIMA process suggests an ARIMA(0,0,0)(0,1,1)[4] with a drift term. Along with the model suggested by auto.arima(), an AR(2) and an AR(4) is also fitted on non-seasonally differenced data. The three tested model specifications and their respective scores according to the AIC, BIC and AICc are summarized on the next page in table 6:

Fit	Specification	AIC	BIC	AICc
1	(0,0,0)(0,1,1)[4] with drift	-124.47	-119.40	-123.80
2	(2,0,0) with drift	-111.81	-102.89	-110.23
3	(4,0,0) with drift	-125.15	-112.66	-122.04

Table 6: SL information criterion comparison
Source: Authors' elaboration

Fit 1 returns the lowest AICc and BIC scores while the AIC chooses Fit 3. The scores of Fit 1 and Fit 3 are not significantly different, consequently these two models seem to best fit the data thus far.

The next step in the process implies generating forecasts for the period 2017 - 2018 using the three model specifications summarized in table 6 above, which will be tested against the actual observations in the test set for the same period. The forecast errors against the actual observations in the test set are summarized below in table 7:

Fit	Specification	RMSE	MAE	MAPE	MASE
1	(0,0,0)(0,1,1)[4] with drift	0.0346	0.0311	0.4179	0.7377
2	(2,0,0) with drift	0.0608	0.0442	0.5909	1.0487
3	(4,0,0) with drift	0.0431	0.0375	0.5040	0.8912

Table 7: SL forecast accuracy comparison
Source: Authors' elaboration

Fit 1 returns the lowest forecasting errors according to all measurement techniques. Plotting the forecasts generated by the model, see figure 7 on the next page, it is evident that the model captures the movements of the last available actual observations rather well. Fit 3 is also able to capture the movements of the latest actuals, shown in figure A9 in the Appendix, however given the combined results of the information criteria and forecast accuracy measurements, the findings are in favor of Fit 1, i.e. ARIMA (0,0,0)(0,1,1)[4] with a drift term as the best available fit for the sports and lottery time series.

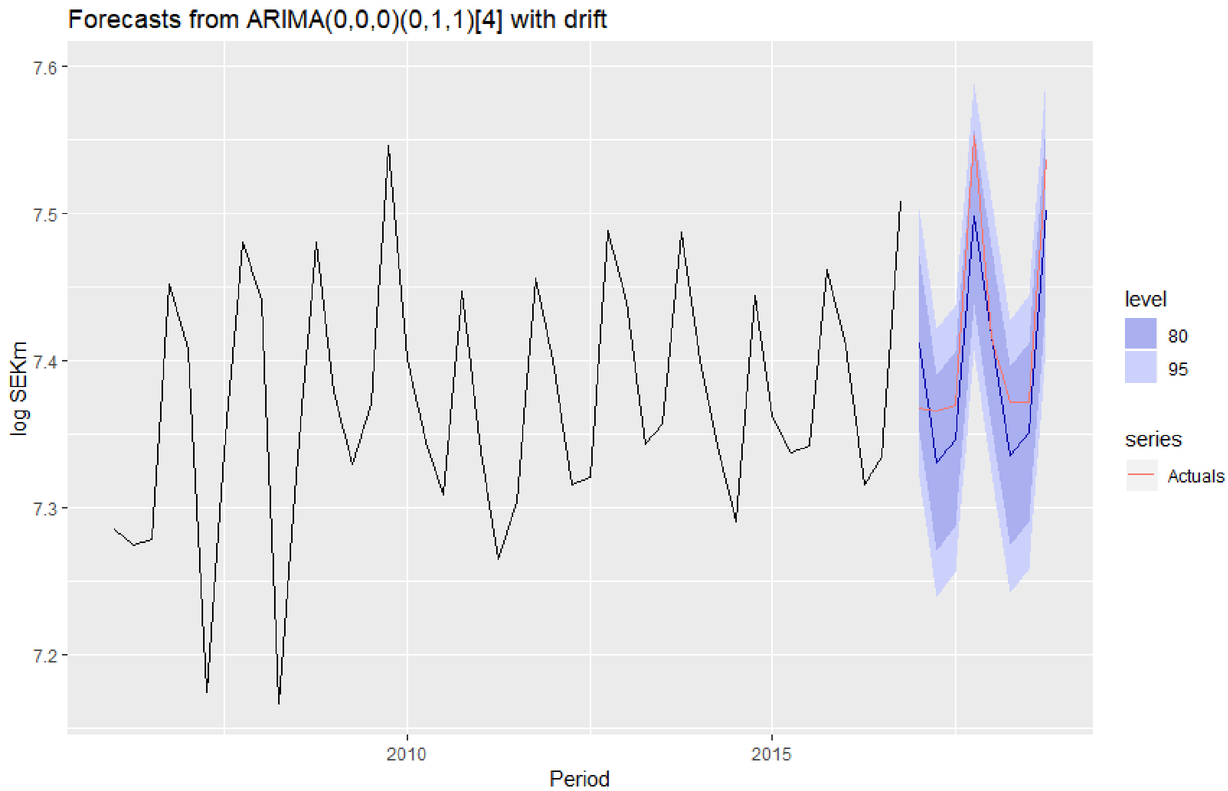

Figure 7: SL ARIMA forecast vs actual observations
Source: Authors' elaboration

The residuals of Fit 1 are plotted in figure 8 on the next page where all spikes are within the bounds. As such, it seems the model specification captures the available information in the data. The Ljung-Box test also confirms that the residuals are white noise as the p-value of 0.06352 is above 0.05, although borderline. The coefficients of the estimated model are presented in table 8 below:

Coefficients ARIMA(0,0,0)(0,1,1)[4] with drift

	Estimate	Std. Error	z-value	Pr(>|z|)	
sma1	-0.794109	0.165374	-4.801900	0.000002	***
drift	0.001159	0.000637	1.818200	0.069040	.

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 8: SL ARIMA coefficients
Source: Authors' elaboration

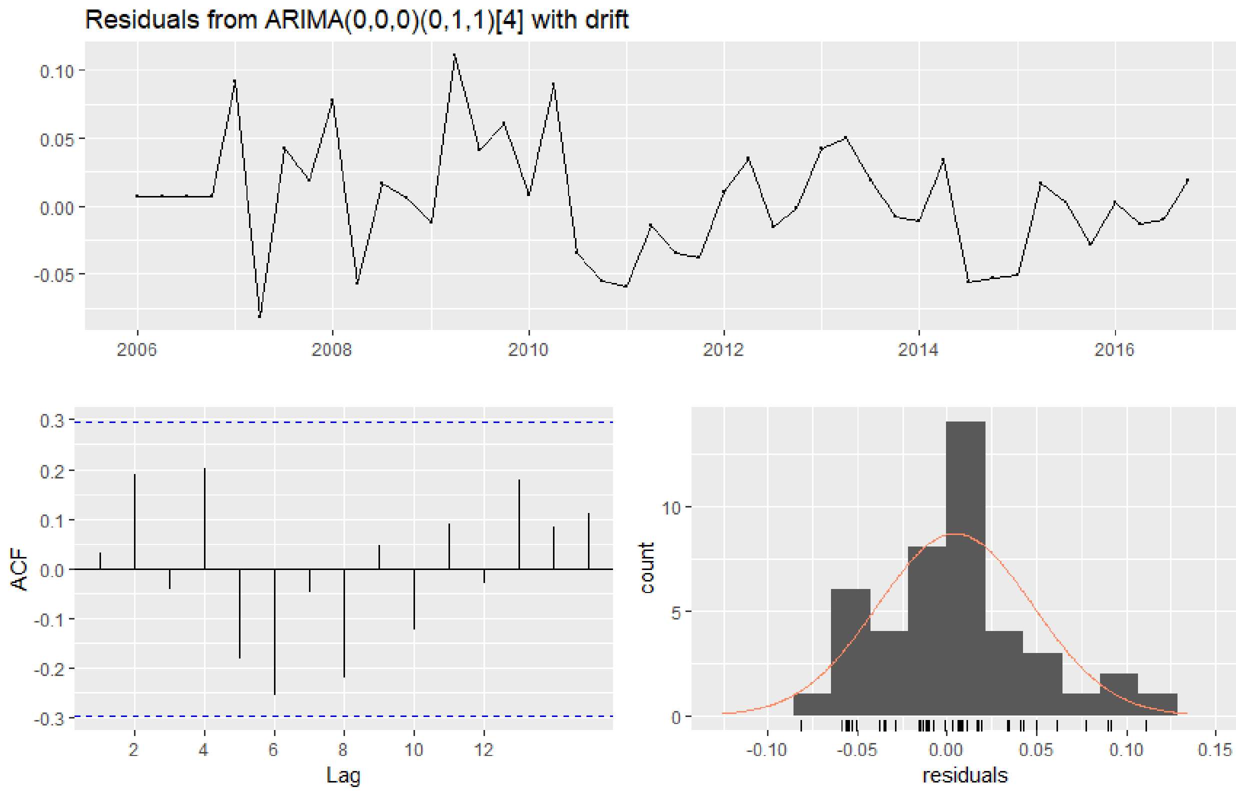

Figure 8: SL ARIMA residuals
Source: Authors' elaboration

Forecasting using final model

The final model for the sports and lottery time series is consequently an ARIMA(0,0,0)(0,1,1)[4] with a drift term. Using this model specification on the full data sets, the forecasts for 2019 and 2020 are plotted in figure 9 below and summarized in table 9 on the next page:

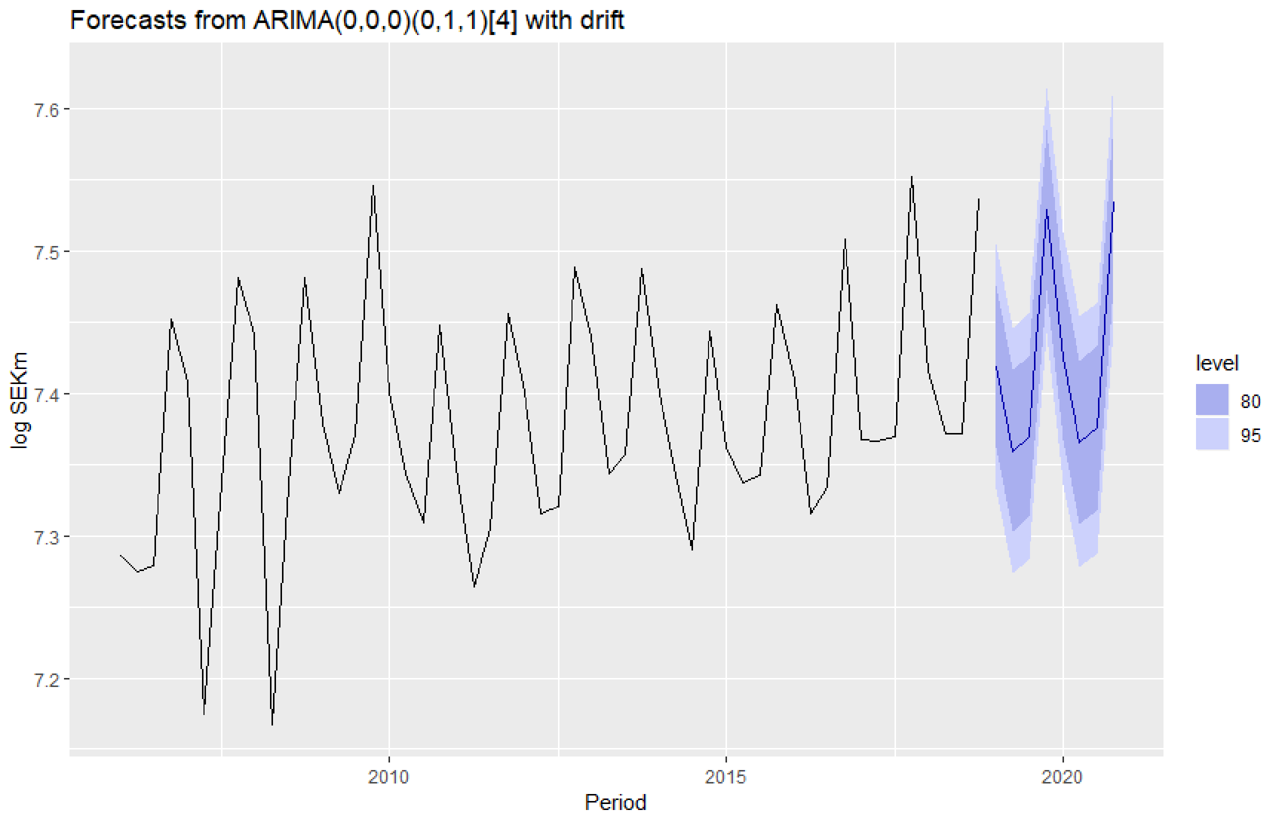

Figure 9: SL forecast from final ARIMA model (graph)
Source: Authors' elaboration

Forecasts from ARIMA(0,0,0)(0,1,1)[4] with drift

Year	Quarter	log SEKm	SEKm
2019	Q1	7.4192	1,668
2019	Q2	7.3597	1,571
2019	Q3	7.3696	1,587
2019	Q4	7.5291	1,861
2020	Q1	7.4251	1,678
2020	Q2	7.3657	1,581
2020	Q3	7.3756	1,596
2020	Q4	7.5350	1,873

Table 9: SL forecast from final ARIMA model (output)
Source: Authors' elaboration

5.2 Casino Cosmopol incl. online poker (CC)

Casino Cosmopol incl. online poker is the second largest revenue stream representing gross wins of SEKbn 1.2 in 2018, i.e. 13 percent of the total SEKbn 8.8.

Identifying the order of integration

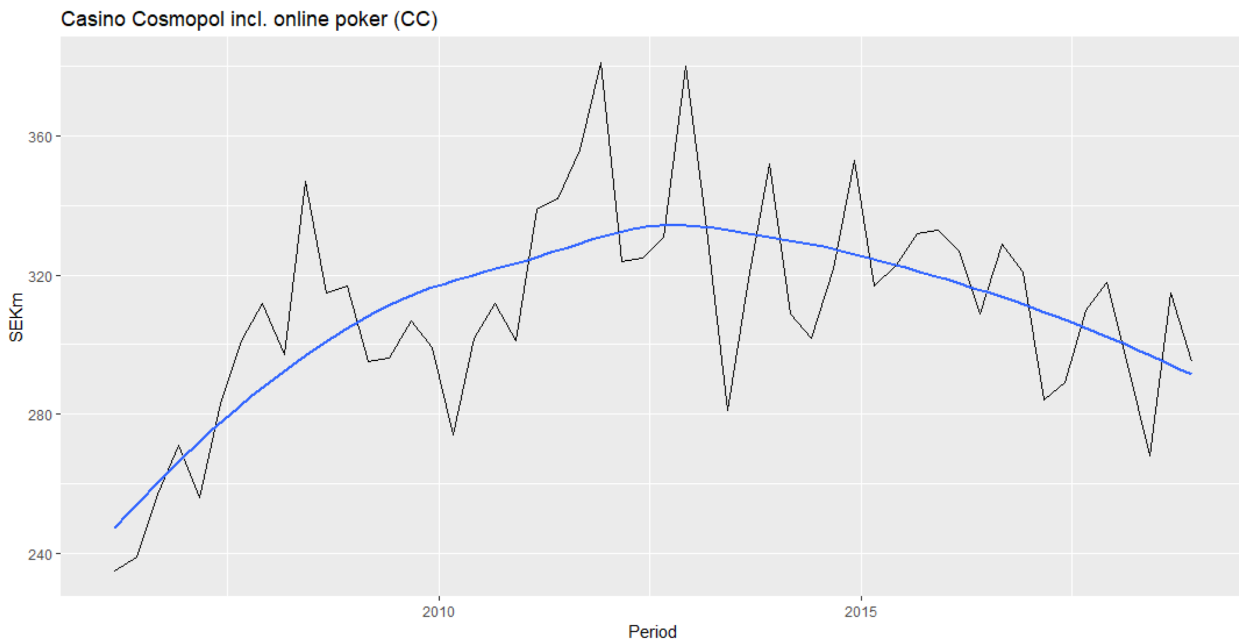

Figure 10: Casino Cosmopol incl. online poker 2006-2018
Source: Authors' elaboration on the basis of Spelinspektionen (2019)

Like the SL category, some seasonal tendencies are observable in the data although it is not as clear. Shown in figure 10 above, there appears to be a decreasing trend in the data, especially in the last few years. As in the SL series, the authors of this paper will apply a logarithm transformation and split the set into a training set and a test set. The logged training set is plotted on the next page in figure 11:

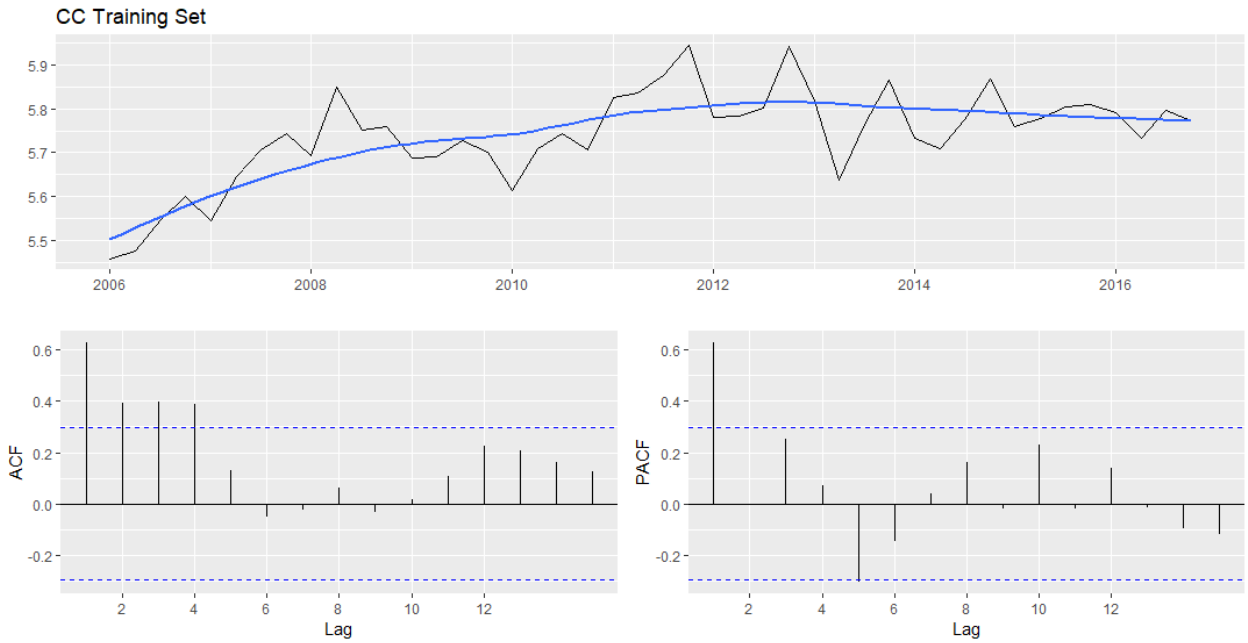

Figure 11: CC training set
Source: Authors' elaboration

Visualizing the seasonality plot shown in figure A11 in the Appendix, the seasonality pattern is not as clear as in the SL time series although some tendencies are observable. The nsdiffs() test does not advise applying a seasonal difference to the data. Nevertheless, the time series does not seem to meet the stationarity requirement. The suspicion is confirmed by an ADF test, returning a test statistic of -2.8062 which is not significant at the five percent significance level with a critical value of -2.93. The first differenced data is plotted in figure 12 on the next page and now resembles a stationary time series. The ADF test on the differenced data returns a test statistic of -6.1016 against a critical value of -2.93, hence rejecting the null hypothesis of a unit root in the time series.

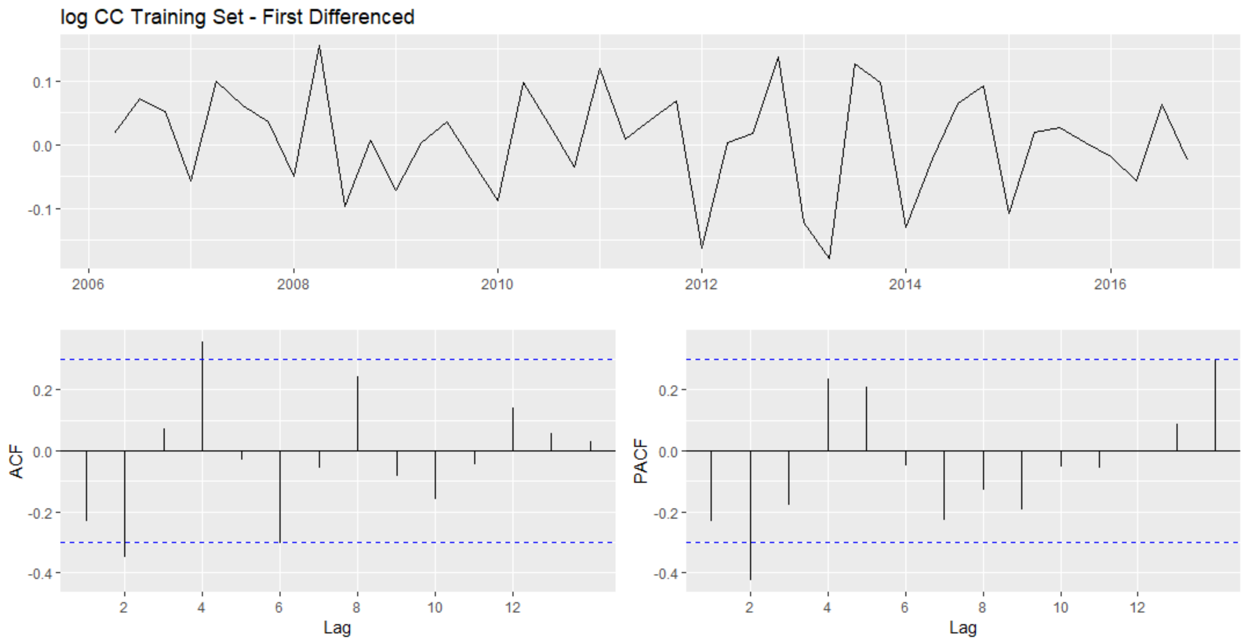

Figure 12: CC training set – first differenced
Source: Authors' elaboration

Identifying model specification

Analyzing the ACF and PACF plotted in figure 12 above, there seems to be some sort of semi-annual seasonality shown in the decreasing spikes at lag 2, 4, 6, 8 etc. The pattern in the ACF along with the significant spike at lag 2 suggests that the pattern may be captured by modelling with an AR(2) component. The pattern may also potentially be captured by including a seasonal diff as well despite the result of the nsdiffs() test. The auto.arima function using the AICc on the non-differenced data suggests an ARIMA(0,1,1)(0,0,1)[4]. Alongside the specification suggested by the automatic process, the authors of this paper will try modelling the AR(2) component and to extend the model suggested by auto.arima with a seasonal difference along with the first difference. The models and their information criterion scores are summarized in table 10 on the next page:

Fit	Specification	AIC	BIC	AICc
1	(0,1,1)(0,0,1)[4]	-100.17	-94.89	-99.56
2	(0,1,1)(0,1,1)[4]	-85.45	-80.46	-84.76
3	(2,1,0)	-98.43	-93.14	-97.81

Table 10: CC information criterion comparison
Source: Authors' elaboration

Fit 1 is chosen by all information criteria although Fit 3 is close behind while the scores for Fit 2 are unable to match the same level. Using the models to test their forecasting accuracy against the test set, the findings are summarized in table 11 below:

Fit	Specification	RMSE	MAE	MAPE	MASE
1	(0,1,1)(0,0,1)[4]	0.0942	0.0774	1.3689	1.0399
2	(0,1,1)(0,1,1)[4]	0.0603	0.0492	0.8688	0.6607
3	(2,1,0)	0.0917	0.0747	1.3210	1.0034

Table 11: CC forecast accuracy comparison
Source: Authors' elaboration

Contrary to the indications in the information criterion overview, Fit 2 has the lowest forecast errors as measured by all four of the forecast accuracy measurements. In other words, including the seasonal difference has allowed the model to better capture the seasonal tendencies previously discussed. Plotting the forecast generated by Fit 2 against actual observations during 2017-2018 in figure 13 on the next page, the overall trend of the data fits rather well, albeit with quite large uncertainty intervals. For comparison, see figures A17 and A18 in the Appendix of the forecasts generated by Fit 1 and 3 respectively which are not able to capture the fluctuations in the data at all. The results from the information criteria and the forecasting accuracy results are suggesting different models. While pseudo out of sample forecasting accuracy is not a guarantee of true out of sample accuracy, the final model selected for the CC time series is Fit 2, ARIMA (0,1,1)(0,1,1)[4] as including the seasonal difference has improved the ability to capture the seasonal tendencies in the data.

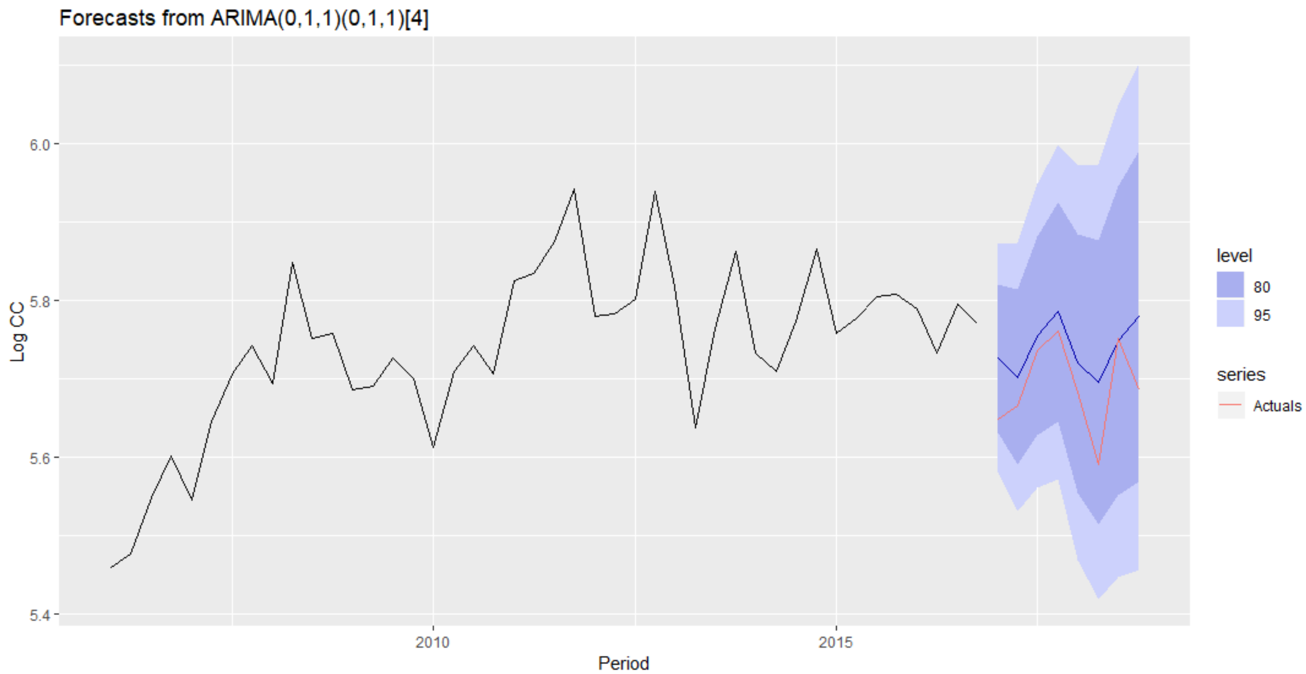

Figure 13: CC ARIMA forecast vs actual observations
Source: Authors' elaboration

Checking the residuals of Fit 2, see figure 14 on the next page, the residuals are all within the significance bounds and the Ljung-Box test returns a p-value of 0.1813, maintaining the null hypothesis that the residuals are independently distributed. The coefficients of the estimated model are summarized in table 12 below:

Coefficients ARIMA(0,1,1)(0,1,1)[4]

	Estimate	Std. Error	z-value	Pr(>|z|)	
ma1	-0.374770	0.150270	-2.494000	0.012630	*
sma1	-0.713530	0.174020	-4.100200	0.000041	***

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 12: CC ARIMA coefficients
Source: Authors' elaboration

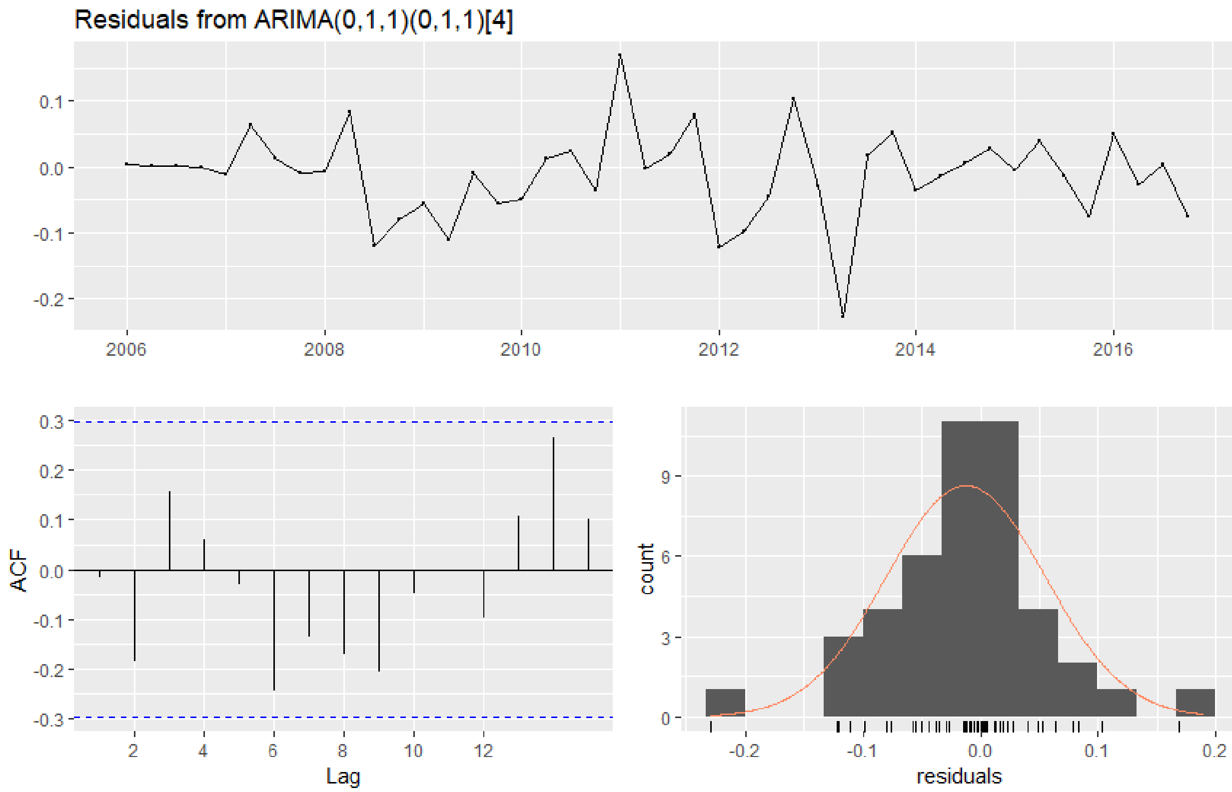

Figure 14: CC ARIMA residuals
Source: Authors' elaboration

Forecasting using final model

The final model for the CC time series is consequently an ARIMA(0,1,1)(0,1,1)[4]. Using this model specification on the full data sets, the forecasts for 2019 and 2020 are plotted in figure 15 and summarized in table 13 on the next page:

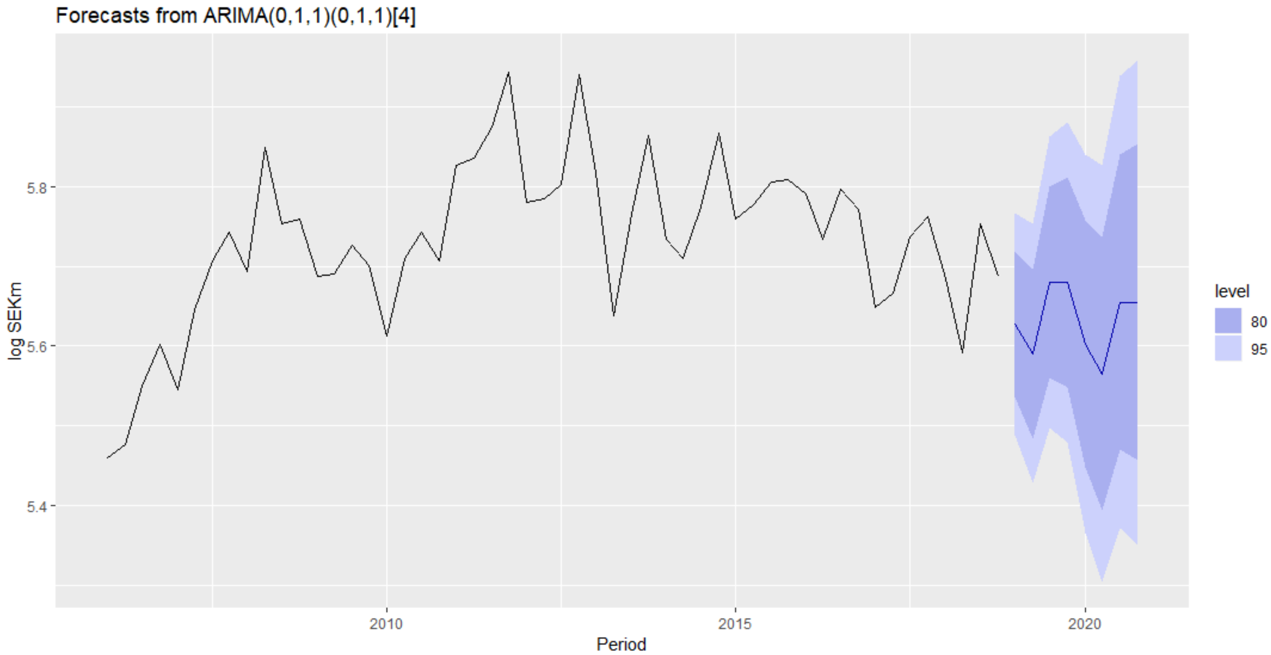

Figure 15: CC forecast from final ARIMA model (graph)
Source: Authors' elaboration

Forecasts from ARIMA(0,1,1)(0,1,1)[4]

Year	Quarter	log SEKm	SEKm
2019	Q1	5.6274	278
2019	Q2	5.5904	268
2019	Q3	5.6800	293
2019	Q4	5.6798	293
2020	Q1	5.6023	271
2020	Q2	5.5653	261
2020	Q3	5.6549	286
2020	Q4	5.6547	286

Table 13: CC forecast from final ARIMA model (output)
Source: Authors' elaboration

5.3 Vegas gaming machines (VG)

The final time series consists of gross wins from Vegas gaming machines which represents the smallest source of gross wins in 2018, amounting to SEKbn 0.9 representing approximately 10 percent of the total gross wins.

Identifying the order of integration

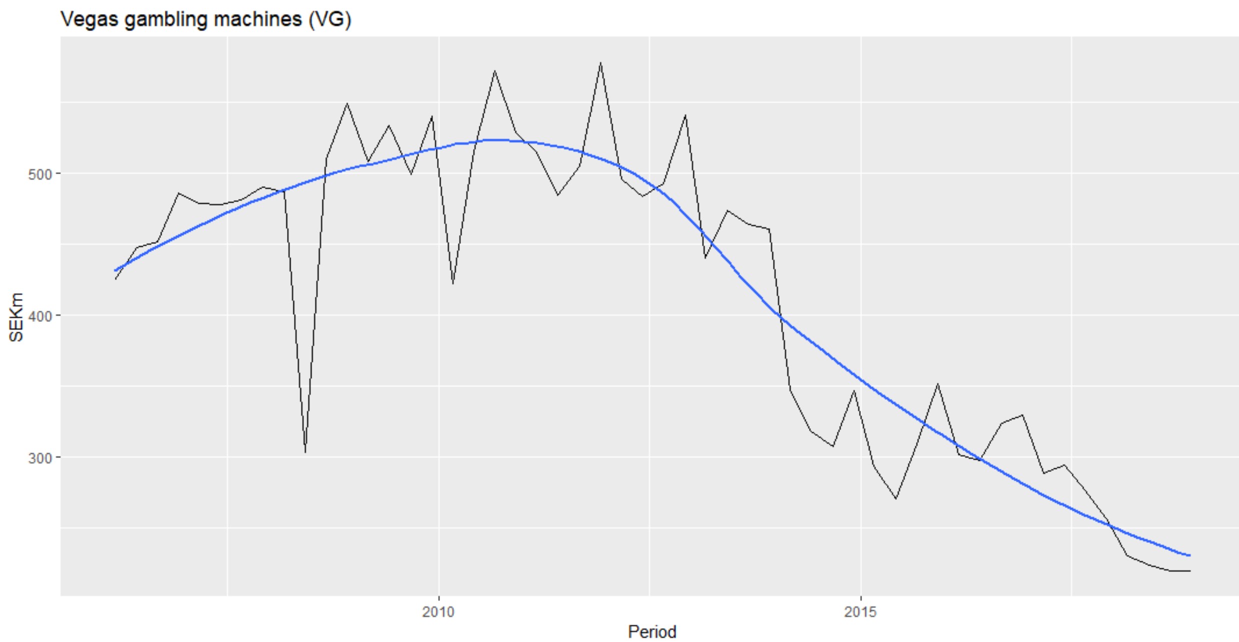

Figure 16: Vegas gaming machines (VG) 2006-2018
Source: Authors' elaboration on the basis of Spelinspektionen (2019)

Analyzing the graph from figure 16 above, two potential issues with the time series are observable: (1) a significant drop around 2008 and then an immediate return to the trend level in the quarters which follow. (2) In 2013, the series appears to be facing a potential structural break where it not only decreases to a new level but also shifts to settle on a new trend after the break. Applying the tsoutliers() function will return the period of the outlier and a QLR test with 15 percent trimming on each side we can also retrieve the period of the structural change. The QLR test is plotted in A19 in the Appendix. A tsoutliers() test informs that the outlier is located in Q2 2018 while the QLR test informs that the structural break is found in Q3 2013.

At first glance, as the significant drop in 2008 is coinciding with the financial crisis during the same period, it would be reasonable to assume that the financial disturbances during this period might have caused individuals to tighten their expenditures thus causing the significant drop. However, the volumes revert towards the trend in the quarters which follow. Furthermore, if the financial crises were the main reason behind the drop, the same pattern should be visible in the SL and CC time series as well. Any potential effects from the global macro environment during the period cannot be excluded, however, according to Svenska Spel's annual report (2008), the significant drop in volumes is best attributed towards the introduction of an age verification requirement which was rolled out during the first and second quarters of 2008. With regards to the events in 2013, according to the annual report of AB Svenska Spel (2013), gambling volumes on Vegas decreased due to the implementation of a responsible gambling tool as well as increased competition from foreign online gambling entities.

The outlier, structural break and new trend present a challenge with regards to modeling the data. Given the limited number of observations available in the data set, any disturbances to individual observations will be magnified compared to that of a larger set. To combat the difficulties which follow the two above mentioned factors in the data, the authors of this paper will include dummy variables to serve the following purposes:

- **Outlier in Q2 2018** – a dummy variable which takes the value of one for the outlier and zero otherwise
- **Structural break in Q3 2013** – a dummy variable with the value of zero for the period prior to the break, and one for the consequent periods after the break
- **Change in trend after the structural break** – a variable set which is zero up to the break point and starts a sequence at one after the break and which increases with one in each subsequent period, i.e. after Q3 2013 the following sequence is implemented (1, 2, 3, 4, 5, …, 22)

For a complete overview of the dummy variables in their original and first differenced forms, please see table A20 in the Appendix.

An important note when including a deterministic trend is that it requires considering certain aspects when forecasting. A deterministic trend is implicitly assumed to maintain the slope of the trend over time while stochastic trends can change. The increased uncertainty which comes with a stochastic trend will consequently yield greater forecast uncertainty. Therefore, forecasts using a stochastic trend are safer in the sense that the greater uncertainty intervals allow for more fluctuation within the bounds compared to forecasts with deterministic trends Hyndman and Athanasopoulos (2018).

With the dummy variable for the structural break in place, the different trends can be visualized in figure 17 below:

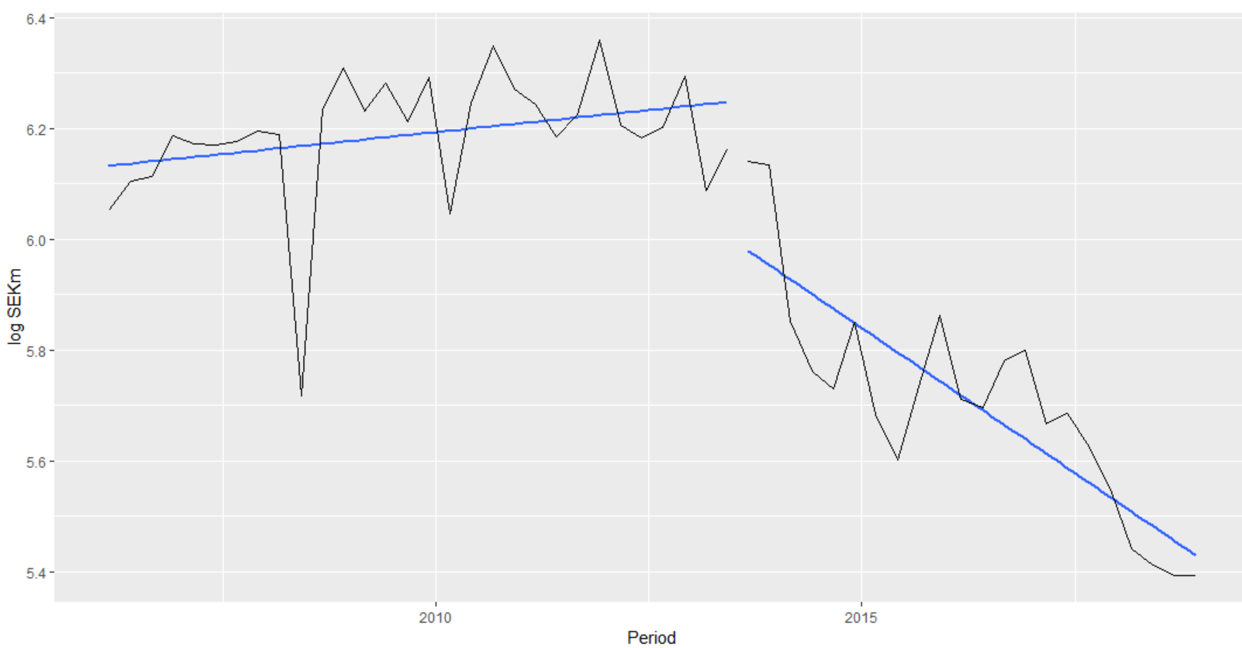

Figure 17: VG trend shift
Source: Authors' elaboration

The VG set is also transformed to logarithms and divided into a training- and test set following the same methodology as the SL and CC series. Seasonality testing using the nsdifffs() test returns different results depending on whether the outlier is included or replaced with a value using the tsclean() function. With the outlier included, the seasonality pattern appears to be distorted causing the test to return zero suggested seasonal differences.

However, when the outlier is replaced, the seasonality pattern appears to be more apparent as the test suggests applying a seasonal difference in the data. The seasonality polar chart illustrated in figure A22 in the Appendix suggests a slight seasonality towards increasing values in the fourth quarter of the year, although the pattern is not distinctly observable. Therefore, it may be needed to test a seasonal difference further along in the process. However, as the seasonality pattern is not evident, it will be proceeded without.

The series clearly does not meet the stationarity requirements and after taking a first difference, the ADF test rejects the null hypothesis of a non-stationary time series with a test statistic of –5.4162 and critical value of -2.93 at the five percent significance level. The first differenced training set is plotted in figure 18 below:

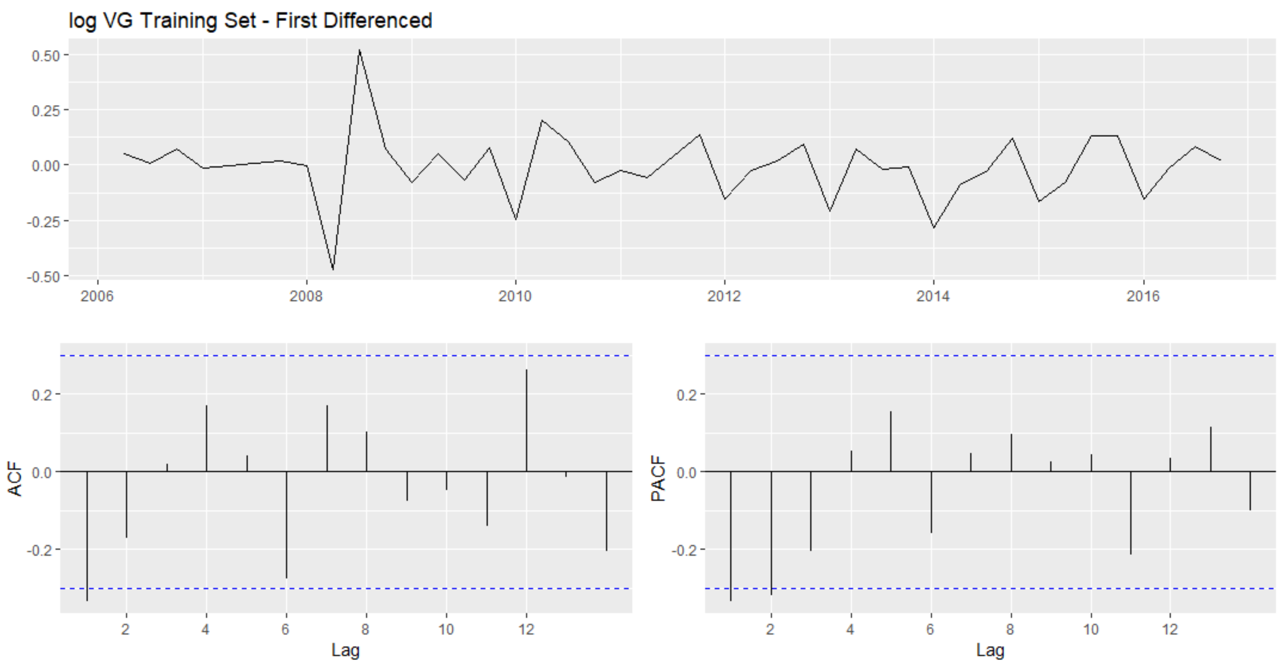

Figure 18: VG training set – first differenced
Source: Authors' elaboration

Identifying model specification

To model the outlier, structural break and allow for a new trend, three different combinations will be tested using the auto.arima() function. The model specifications and their corresponding information criterion scores are summarized in table 14 below:

Fit	Specification	External regressors	AIC	BIC	AICc
1	(0,1,0)(1,0,1)[4]	Outlier	-80.31	-71.50	-78.69
2	(1,0,0)(1,0,1)[4]	Outlier and break	-80.39	-67.90	-77.28
3	(0,0,1)(0,1,1)[4]	Outlier, break and new trend	-79.54	-69.41	-77.00

Table 14: VG information criterion comparison
Source: Authors' elaboration

Fit 2 has the lowest score according to the AIC while Fit 1 is chosen by the AICc and BIC. The structural break coefficient (see Appendix A25-27 for coefficients) is not significant when added on its own in fit 2. However, when combined with the new trend, both the structural break and the trend variables are significant in Fit 3. The scores in all three of the tested models do not vary greatly. Using the models to test their forecasting accuracy against the test set, the findings are summarized in table 15 below:

Fit	Specification		RMSE	MAE	MAPE	MASE
1	(0,1,0)(1,0,1)[4]	Outlier	0.1682	0.1423	2.6105	1.1886
2	(1,0,0)(1,0,1)[4]	Outlier and break	0.2881	0.2429	4.4590	2.0288
3	(0,0,1)(0,1,1)[4]	Outlier, break and new trend	0.0928	0.0826	1.4966	0.6900

Table 15: VG forecast accuracy comparison
Source: Authors' elaboration

Fit 3 produces the lowest forecasting errors against actual observation in 2017 and 2018. The difference is quite significant compared to Fit 1 and 2. Like the CC series, adding a seasonal difference allows model to capture the seasonality tendencies in the data. The forecasts provided by Fit 3 are plotted against actual observations in figure 19 on the next page:

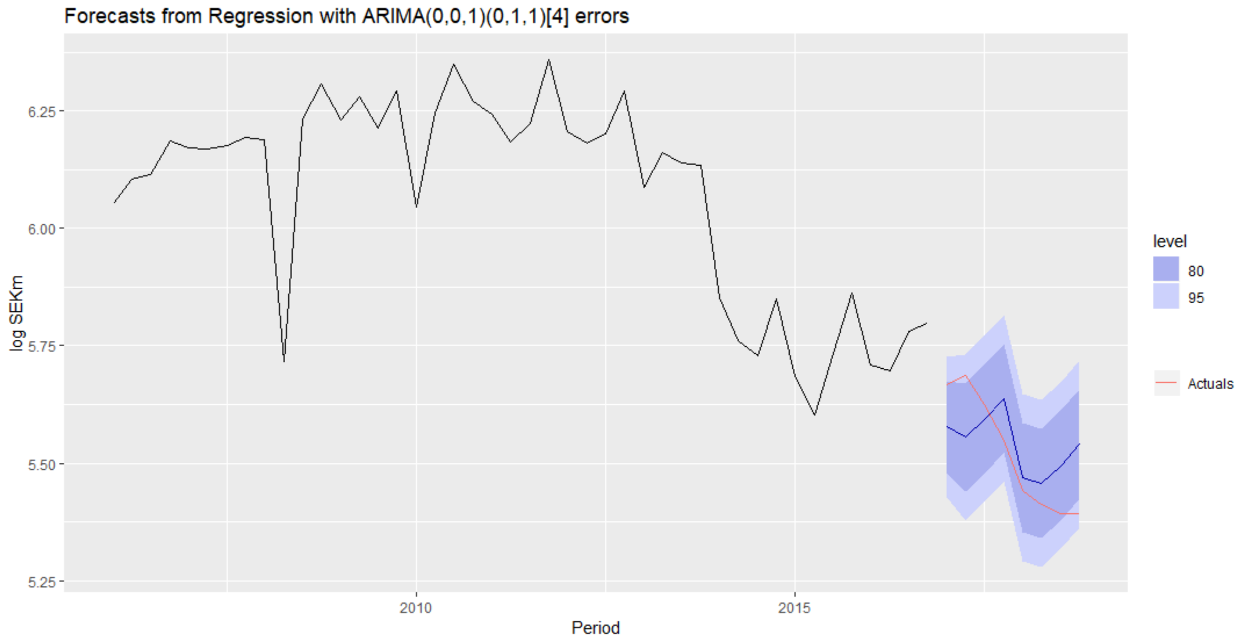

Figure 19: VG ARIMA forecast vs actual observations
Source: Authors' elaboration

The residuals of Fit 3 are plotted in figure 20 below where all spikes are within the bounds. As such, it seems the model specification captures the available information in the data. The Ljung-Box test also confirms that the residuals are white noise as the p-value of 0.2585 is above 0.05. The coefficients of the estimated model are presented in table 16:

Coefficients ARIMA(0,0,1)(0,1,1)[4]

	Estimate	Std. Error	z-value	Pr(>|z|)	
ma1	0.627930	0.196010	3.203600	0.001357	**
sma1	-0.889395	0.272748	-3.260900	0.001111	**
outlier	-0.503349	0.058878	-8.549000	0.000000	***
struc	-0.212928	0.057451	-3.706300	0.000210	***
drift	-0.024541	0.006543	-3.750800	0.000176	***

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 16: VG ARIMA coefficients
Source: Authors' elaboration

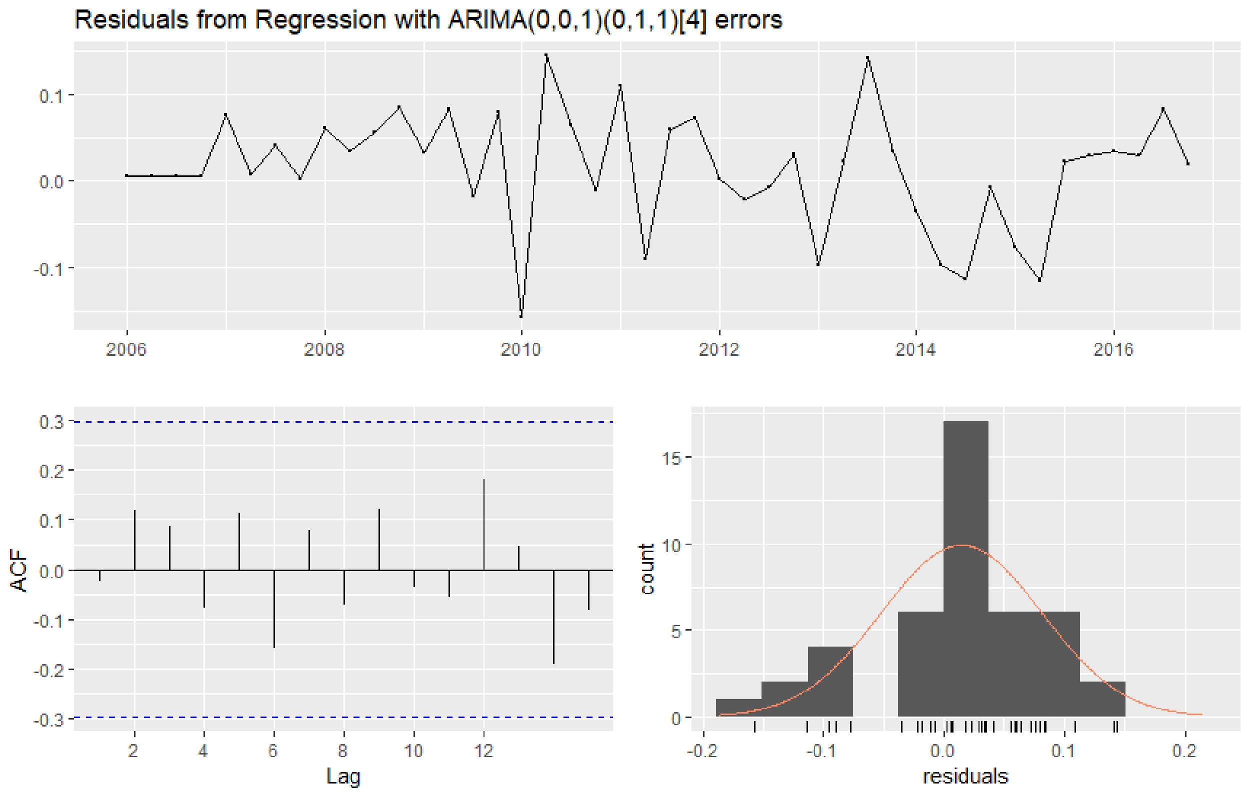

Figure 20: VG ARIMA residuals
Source: Authors' elaboration

Forecasting using final model

Given the similar information criterion scores and the results of the pseudo out of sample forecasting errors, the final model chosen for the VG time series is consequently Fit 3, ARIMA (0,0,1)(0,1,1)[4] with dummy regressors modelling (1) the outlier in Q2 2008, (2) the structural break in Q3 2013 and (3) the change in trend following the structural break. Using this model specification on the full data sets, the forecasts for 2019 and 2020 are plotted in figure 21 and summarized in table 17 on the next page:

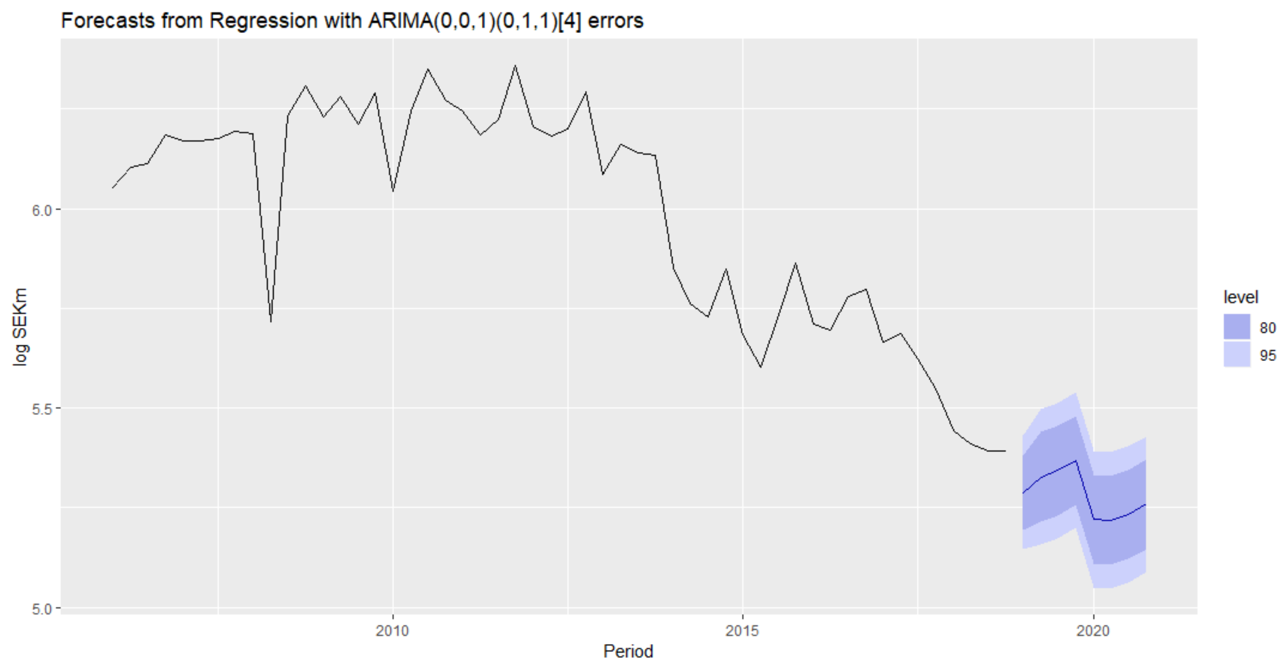

Figure 21: VG forecast from final ARIMA model (graph)
Source: Authors' elaboration

Forecasts from ARIMA(0,0,1)(0,1,1)[4]

Year	Quarter	log SEKm	SEKm
2019	Q1	5.2875	198
2019	Q2	5.3276	206
2019	Q3	5.3430	209
2019	Q4	5.3693	215
2020	Q1	5.2212	185
2020	Q2	5.2173	184
2020	Q3	5.2328	187
2020	Q4	5.2590	192

Table 17: VG forecast from final ARIMA model (output)
Source: Authors' elaboration

5.4 Governmental tax revenue impact from the market liberalization

The reform of the gambling market entails additional gambling activity within three different areas; (1) sports betting (2) horse race betting and (3) commercial interactive (online) gaming. As this paper only focuses on AB Svenska Spel, the additional activity within the second category, i.e. horse race betting, is outside the scope of the study as this betting category is operated by AB Trav och Galopp (ATG). As such, the additional activity within the first and third categories are within the domain of what was previously controlled exclusively by AB Svenska Spel.

The forecasted post regulation total market gross wins have been provided by H2 Gambling Capital which constructed their forecasts by incorporating the following aspects:

- Confirmed current or future changes in regulation and taxation
- Maturity of product
- Confirmed product development
- Balance/supply of land based vs. interactive channels
- GDP/broadband/mobile growth and benchmark markets

Regrettably, the authors of this paper have not been able to retrieve the detailed assumptions which have led to the forecasted values used in table 18 on the next page. Consequently, the applied forecasting method has not been available for scrutiny and prevented a potential discussion regarding the validity of the forecasted numbers. One important piece of information which would have enriched the analysis is knowing which channelization ratio the figures are based on. However, as previously discussed, H2 Gambling Capital is a widely used source for gambling statistics and one of the primary sources used by AB Svenska Spel itself. As such, the authors of this paper continue the analysis using the figures provided, emphasizing that as there are many forecasted figures used in the analysis, the results presented below should be viewed as nothing other than estimates.

SEKm				
Betting	**2017**	**2018**	**2019**	**2020**
Sports betting	1,783	1,887	1,918	1,944
Additional sports betting post-regulation	0	0	2,483	2,588
Horse race betting	4,145	4,129	4,170	4,204
Additional horse race betting post regulation	0	0	930	727
Total betting	**5,928**	**6,016**	**9,501**	**9,463**
Gaming				
Bingo	220	216	212	208
Gaming machines	1,118	898	1,087	1,073
Casino Cosmopol	1,111	1,081	1,147	1,161
Restaurant casinos	177	172	167	162
Online poker	91	89	85	82
Additional commercial interactive gaming post-regulation	0	0	3,659	3,975
Total gaming	**2,716**	**2,456**	**6,356**	**6,661**
Lotteries				
Games of chance	4,877	4,830	4,842	4,848
National/regional/local lotteries	3,461	3,312	3,379	3,437
Total lotteries	**8,338**	**8,142**	**8,221**	**8,285**
Total regulated gambling market	**16,982**	**16,614**	**24,078**	**24,410**
Total AB Svenska Spel	**8,979**	**8,786**	**9,078**	**9,108**
Additional sports betting post-regulation	*0*	*0*	*2,483*	*2,588*
Additional commercial interactive gaming post-regulation	*0*	*0*	*3,659*	*3,975*
Total regulated AB Svenska Spel domain	**8,979**	**8,786**	**15,220**	**15,672**

Table 18: Total gross wins for Svenska Spel domain of the Swedish gambling market 2017-2020
Source: Authors' elaboration

Table 18 above provides an overview of the regulated gambling market in Sweden, populated with actual data during 2017 - 2018 and forecasted data provided by H2 Gambling Capital for the years 2019 - 2020. The overview shows the expected effect on the regulated gambling market as the new licensing system is activated in 2019, thus incorporating foreign online gambling entities gambling activity within the regulated platform.

As discussed, the additional activity is divided between three categories, where only the categories within the domain previously exclusively controlled by AB Svenska Spel will be considered in this analysis. The bottom line in table 18 illustrates the expected size of this domain where the additional activity from the sports betting and interactive (online) gaming categories has been included. The forecasts created in section 5.1, 5.2 and 5.3 using the three different ARIMA models have summarized in table 19 below and aggregated for a total estimate of the gross win of AB Svenska Spel, given the assumption that the regulation had remained unchanged.

Although AB Svenska Spel will technically be competing on the same terms as the other licensees within the new system, the entire gross wins of AB Svenska Spel will be calculated as income. The reasoning behind this logic is that as AB Svenska Spel is a wholly state-owned organization, taxation will not impact the overall income ultimately controlled by the Swedish Government. A tax of 18 percent on gross wins or a dividend of an equal amount will result in the same cash flow for the Swedish Government. Consequently, when calculating the additional income from the market liberalization, the 18 percent tax rate will be applied to the gross wins of the estimated additional gambling activity within the regulated system, while the complete estimated gross wins of Svenska Spel are classified as income. The total income from the domain of AB Svenska Spel post-regulation is compared to the forecasts produced in section 5.1-5.3 to reach an estimated income gain from the market liberalization of SEKbn 1.5 in 2019 and SEKbn 1.7 in 2020.

SEKm	**2019**	**2020**
Additional sports betting post-regulation	2,483	2,588
Additional commercial interactive gaming post-regulation	3,659	3,975
Total additional post-regulation	**6,142**	**6,564**
Tax rate	*18%*	*18%*
Additional tax income	**1,106**	**1,181**
AB Svenska Spel	9,078	9,108
Total income AB Svenska Spel domain	**10,184**	**10,290**
- Forecasted AB Svenska Spel (no regulation)	-8,647	-8,580
Gain from market liberalization	**1,537**	**1,710**

Table 19: Forecasted tax income gain from market liberalization 2019-2020
Source: Authors' elaboration

5.5 Market structure post-regulation

One of the objectives of this paper, based on the theories of imperfect markets and gambling economics, is to define which market structure AB Svenska Spel competes in post-regulation. Pre-regulation is according to AB Svenska Spel, a market based on pure monopoly within the regulated system. With the liberalization of the Swedish gambling market, allowing for entry of foreign online gambling entities, the market is now characterized by an oligopolistic nature. Firstly, it can be concluded that there are few firms in the given market serving many consumers with entry barriers that consist of a licensing system and tax on firm proceeds, thus motivating an oligopolistic view of the new market structure. By mid-April 2019, the number of entities that had granted a gambling license amounted to 80 (Spelinspektionen, 2019). However, the authors of this paper also suggest that a monopolistic competition view can be applied to the market. This view is supported by the fact that 29 percent of the respondents in Novus 2018 survey "public opinions about gambling" chose other gambling entities than AB Svenska Spel (Spelinspektionen, 2019). It thus implies the theoretical assumption that consumers have symmetric information and can change to different operators given changes in price or consumer preferences. The analysis of information symmetry is supported by Thalheimer and Ali (2003), Philander (2012), Leal et al. (2014) as well as Arvidsson et al. (2017) who studied elasticities and found substitutional effects between online-offline gambling entities as well as substitutional effects between state-owned AB Svenska Spel and foreign online gambling entities. Customers are aware about the existing firms and the prices among competitors in the market, suggesting that the phenomenon of cannibalization exists which further supports the argument and theory of imperfect markets.

Moreover, the marginal cost of producing one more unit of gambling can be seen as constant due to the fact that programming, servers as well as other important operating cost is independent of the number of played games, which is supported by Hurley and McDonough (2007) as well as Navin and Sullivan (2007). The license cost is assumed to be a sunk cost. It is furthermore concluded by AB Svenska Spel that decreasing profits is due to increased competition, mandatory registration of gambling as well as bonus restrictions, suggesting a market characterized of Bertrand oligopoly since the only strategic variable left for firm to control is price (i.e. the hold rate at which rate that is retained by the firm and not the consumer for a given game).

A monopolistic competition view of the Swedish gambling market is also motivated by differentiation in terms of bonuses, free-spins and VIP-membership (Spelinspektionen, 2019). With regards to product differentiation, despite post-regulation limitations on registrations bonuses in conjunction with a customer's first deposit, operators offer different types of bonuses. Moreover, as concluded by Spelinspektionen (2016), gambling advertisement has radically increased in the market which is a way for firms to differentiate themselves in the industry. Increased investments in gambling advertisement in Sweden is supported by Binde (2009b), Hing et al. (2014) and Folkhälsomyndigheten (2017) and may be seen as a tool for firms to differentiate its products. Specifically, findings from both Hing et al. (2014) and Binde (2009b) suggest that advertising activities are initiated in order to attract customer from competitors in the market with the purpose of increasing their market share. Thus, differentiation tools in terms of bonuses, comparative advertising, free-spins and VIP-membership as a niche marketing strategy supports the theory of monopolistic competition, with Bertrand characteristics based on price as the strategic variable controlled by the firm. However, the analysis cannot conclude that the supplied products are homogenous given the fact that different operators offer different types of gambling games. Differentiated products are a way for firms to avoid the Bertrand trap, thus being able to earn positive economic profits given the assumption that firms set prices above a constant marginal cost. This supports the theoretical assumptions as well as the real-world competitive market in Sweden. As described by Spelinspektionen (2019), the Swedish gambling market is strategically important for many firms due to high earnings. Short-term economic profits thus yield increased competition and entry.

New firms entering the market, differentiation strategies, as well as price as the strategic variable, supports the theories of both monopolistic competition and Bertrand oligopoly in the Swedish gambling market post-regulation. Imperfect market structures with heterogeneity are supported by Hurley and McDonough (2007) who concluded that the gambling market studied is characterized somewhere between pure monopoly and Bertrand competition. However, previous research by Navin and Sullivan (2007) who studied entry and market structure in nearby local gambling venues in the U.S. assumed a market characterized by Cournot competition, suggesting that Bertrand oligopoly is not applicable due to "non-overlapping sales territories" and homogeneity.

While this might be the case when studying local or nearby gambling entities given a specific area, "non-overlapping sales territories" in the Swedish gambling market cannot be applicable since entities within the licensing system are operationally based online and registered abroad. Furthermore, the assumption of homogeneity has proved to be contradicting for the Swedish market in accordance with the above analysis.

The conclusions by Navin and Sullivan (2007) that state legislators should approve more licenses can further be applied for the Swedish gambling market in the sense that customers outside the regulated system are now within it. All things held equal, even if price (hold rate) as the strategic variable were to decrease, resulting in lower tax base, the overall customer base post-regulation will increase substantially, which may offset lower prices due to increase in gambling volumes, which is also concluded by Navin and Sullivan (2007). Thus, based on the defined market structures, the assumption that firms price above a constant marginal cost and that the aggregate levels of gambling volumes are either constant or increasing given entry, it thus suggests that, in terms of the economics of tax policy, governmental tax revenue will increase. In accordance with comparative studies on gambling tax from similar countries by Nordström et al. (2016); given the assumption that the results from tax policies in similar countries can be applied to the Swedish gambling market, it suggests that the channelization rate will lie between 88 percent – 95 percent. A tax rate of 18 percent yielding a channelization rate at this level suggests that, under the assumption that gamblers stay within the regulated system, foreign entities will enter the Swedish market by applying for a license in order to gain positive economic profits, which in turn increases governmental tax revenue. This is supported by the forecasting tax revenues from section 5.4.

To conclude, the Swedish gambling market post-regulation is characterized by monopolistic competition and Bertrand oligopoly due to the following: (1) Few firms serving many consumers, (2) entry barriers in terms of license requirement, (3) substitutional effects between firms, (4) differentiated products, (5) differentiated marketing strategies, (6) prices above constant marginal cost, (7) symmetric information, (8) transaction cost and (9) price (hold rate) as the strategic variable.

6. Discussion

In this chapter, a discussion of the findings from the empirical results and analysis will be presented. The chapter restates the research questions posed in section 1.3 and will be answered individually.

How will governmental tax revenues from the sector of the gambling market previously controlled by AB Svenska Spel develop post-regulation?

The forecasted development of Sports and Lottery, Casino Cosmopol (incl. online poker) and gaming machines (Vegas) in section 5.1, 5.2 and 5.3 show that the Sports and Lottery category is the only category of the three which was expected to rise during the coming two years assuming the no re-regu. Gross wins from Casino Cosmopol incl. online poker and Vegas gaming machines are both projected to continue their downward sloping trajectories. Sports and Lottery sales have been able to maintain a steady level of gross wins over the past years of increased presence from foreign gambling entities. However, as the market has expanded significantly, the steady level of gross wins has meant that AB Svenska Spel's share of total gross wins has gradually been diluted, suggesting that they have been able to maintain their existing consumers while the foreign entities have been able to attract new business. Land-based casinos (Casino Cosmopol) and land-based gaming machines (Vegas) have been under greater pressure as their products have been made readily attainable through from foreign online gambling entities. The results suggest that the limited product offering of AB Svenska Spel is not able to compete with the abundance of gambling products offered in the online platforms of foreign online gambling entities. As AB Svenska Spel lose traction on the market, the incentives to introduce a regulation reform increase for each year, which passes from both an economic perspective as the alternative cost of foregone tax revenues increases. From a sociological perspective, the percentage of total gambling is conducted on uncontrolled platforms. With a total market demand set on an upward trajectory whilst AB Svenska Spel barely maintaining their level of gross wins, suggest that a regulation change would have been imminent, had it not been introduced in 2019.

The empirical findings in section 5.4 calculated a forecasted governmental tax revenue gain of SEKbn 1.5 in 2019 and SEKbn 1.7 in 2020 from the market liberalization. The estimated figures would be a healthy contribution to the Swedish national treasury and facilitates a discussion on how the excess funds available post-regulation best could be utilized. The Swedish Government has motivated the regulation change from a consumer protection perspective, arguing that the licensing system was a necessary measure to regain control of the gambling market. However, ensuring that the protection measures are effective requires that a high channelization ratio is achieved. By extension, ensuring a high channelization ratio requires that regulatory entities utilize the control measures which have been included within the jurisdiction of the new regulation. These preventative measures include IP blocking and the ability to collaborate with banks to prohibit transactions to between non-licensed gambling firms and consumers. The future will tell how these measures will be utilized and to what extent. However, if the regulatory authorities do not take a tough stance on enforcing the prevention methods, it risks compromising the entire licensing system. If gambling firms detect a viable opportunity to circumvent the system, it will be difficult to prevent the firms from taking it. Although the licensing system grants the gambling firms a level of legitimacy which would be foregone by firms operating outside the system, such an opportunity provides economic incentives in terms of significantly lower taxation which will may potentially be attractive enough to justify the loss in credibility.

The taxation income captured from foreign online gambling entities provides an opportunity to live up to the promise of regaining control of the market. However, it comes at a cost which is paid by the firms through the taxation on gross win. If the Swedish Government utilizes the tax income to ensure that no firms can operate outside the system, it could allow for an effective system which protects consumers from falling into the pitfalls of problem gambling. Furthermore, if governmental tax income from the gambling market is utilized for harm minimization, it should do so by directing funds that improve monitoring and control, such as the self-exclusion program, automated notifications when a certain limit has been exceeded as well as a program that pre-commits both consumers money and time spent on gambling.

However, if the government sees the tax revenue as an extra income which is put to better use elsewhere, it risks allowing firms to develop methods which compromise the system and start a negative spiral where fewer licensed firms results in lower tax income and thus less resources available to enforce a high channelization ratio. A low channelization ratio will likely revert the problems which the new system intended to fix as players outside the system are not covered by the protective measures required to be incorporated in the systems of the licensed firms.

Another aspect of the new regulation which has been widely debated is that of gambling advertising. As mentioned in section 3.6, advertising expenditure reached SEKbn 7.4 during 2018, an increase by 35 percent the year before and 95 percent increase compared to 2016. The new regulation states that gambling advertisement should be “moderate”. While the phrase is vague by definition, it is possible to argue without great difficulty that gambling advertisement has been anything other than moderate in the first months of the new regulation. In fact, in the first month, since the new regulation was activated, marketing expenditures increased by 38 percent compared with the same period in 2018. The fierce increase has caused AB Svenska Spel to significantly increase their expenditures by a staggering 260 percent y/y since opening the market to competition (Frick, 2019). A recent study has found that the aggressive marketing has started to tire the Swedish public, with almost nine of out ten stating that there is an abundance of gambling commercials and over half of the study participants claiming they would like to see a ban on gambling commercials (SVT, 2019). The Minister for Public Administration, Ardalan Shekarabi, responded in early 2019 stating that if the firms themselves do not wind down on advertisement, new regulations will follow (SVT, 2019). The statement has been further backed by recent news of an investigation into possible restrictions on gambling advertisement. The investigation is an example of how the governmental tax revenue gain can be utilized to deliver on the promise of increasing consumer protection under the new regulation.

What market structure will AB Svenska Spel compete in post-regulation?

This study has found that the regulated gambling market prior to the re-regulation January 1st, 2019 which was characterized as a monopoly has now changed to a market identified as Bertrand oligopoly combined with monopolistic competition. The defined market characteristics are in accordance with previous theories on the gambling industry presented both in the literature review and the empirical analysis. First of all, there are few firms serving many customers. Furthermore, entry barriers and transaction costs consist of a licensing system as well as taxes on gross win with strict requirements from the government on how firms shall act in the regulated market. According to the theories of Bertrand, such a market structure implies that firms will compete with prices such that long run profits are equivalent to zero. For firms to price above marginal cost and thus earn positive economic profits, differentiation strategies are implemented. Moreover, based on the theories of monopolistic competition, goods are differentiated with close but not perfect substitutes which allows firms to take some control of the price variable.

Previous theories can also be connected to the Swedish gambling market that price, or the so-called hold rate (i.e. percentage of the stake/wager retained by the firm from the gambler), is considered as the strategic variable. Lowering price is therefore equivalent to a decrease in the hold rate and an increase in the payout rate (i.e. percentage of the stake/wager that is retained to the gambler). However, for firms to price above marginal cost and avoid the Bertrand trap where profits are equivalent to zero, differentiation strategies are being implemented. This includes bonuses, advertising, VIP-membership and free-spins. It is also shown that consumers have symmetric information, which is proven by the mere fact that that 29 percent of the respondents from the Swedish public opinions about gambling survey chose other foreign online gambling entities than AB Svenska Spel. It thus implies that consumers can “shop around” given changes in prices or preferences. This is also proven empirically by previous research presented both in the literature review and empirical analysis who found substitutional effects between AB Svenska Spel and foreign online gambling entities.

Monopolistic competition and Bertrand oligopoly have led the Swedish market in which AB Svenska Spel competes in to intense and aggressive advertising and differentiation from foreign online gambling entities. As suggested above, advertising is seen as an important differentiation strategy for firms. Prior research has shown that advertising does not necessarily make non-gamblers to gamble, but that it is an effective tool in order to attract customers from competitors and therefore, increase market share. As discussed in section 6.1, the new regulation says that gambling advertising shall be used in moderate terms. This has not been fulfilled according to the Swedish Government and have just recently informed the market that total ban of gambling advertising may be needed if firms themselves do not act, also discussed in section 6.1. Given the assumption of such event, firms will face a tougher market to compete in since it will be harder to show the differentiation to consumers, decreasing information symmetry. Intuitively, such regulation that forbids advertising will decrease margins and may lead to a phase where firms potentially do not obtain a gambling license. If such an event occurs, channelization rate may be affected negatively if foreign online gambling entities decide to operate outside the system.

All things held equal, assuming the channelization rate will be at the same level as countries similar to Sweden, the post-regulation market can then assume a channelization rate of 88 – 95 percent, meaning that a vast majority of the gamblers will stay within the regulated system. As presented in the empirical results and analysis, governmental tax revenue post-regulation is estimated to increase by SEKbn 1.5 in 2019 and SEKbn 1.7 in 2020. Whether such tax revenues will prevail in the long-run remains to be seen. Intuitively, as long as economic profits can be extracted from the Swedish gambling market post-regulation, firms will still be present with increased competition to be expected. As such, governmental tax revenue from the gambling industry should be carefully used within the gambling industry itself in order to create an effective market as possible for all stakeholders.

The increase in advertising and marketing expenditures may also be understood from a competitive point of view. With the introduction of taxation, this is a critical blow to the profitability of the business. Foreign online gambling entities have been able to enjoy non-Swedish taxation up until January 1st, 2019.

As the taxation significantly impacts the profitability of gambling business in Sweden, gambling firms are racing to firmly establish their presence while outcompeting inferior firms which cannot afford the same level of media presence. As such, it is likely that the number of firms will see a consolidation of the industry in the coming years, which may help alleviate the pressure on marketing expenditures. In fact, the post-regulation competition is severely more intense and was addressed by Breitung (2017) before the regulation became effective that increasing costs, lower margins and decreasing profits will likely lead to increasing mergers and acquisitions and consolidate the regulated gambling market. Breitung (2017) further concluded that for entities to be profitable, economies of scale are needed in order to tackle the high costs that comes with the regulation, as well as scalable IT infrastructures with the ability to be present in several markets at the same time. Similar conclusions have also been addressed by Kärrman (2018), stating that smaller firms will be acquired by larger firms as they have economies of scale which can absorb the acquisition costs and gain access to more customers in the existing market. Evidence of the arguments are found in recent cases, where one of the largest gambling entities in the U.K., William Hill, acquired the publicly traded entity Mr. Green & Co, and delisted it from the Stockholm Exchange (William Hill, 2019). Another acquisition case that followed shortly after, was when European Entertainment Intressenter Bidco AB bought the publicly listed entity Cherry AB and delisted it from the Stockholm Exchange (Aktiespararna, 2019). Both firms have obtained gambling licenses and are active in the Swedish market, suggesting that consolidation is ongoing following increased competition where market power yields competitive advantage.

Moreover, with respect to increasing costs and decreasing margins as stated above, it can be shown from firms' Q1 2019 results that short-run profits from the regulated system have been decreasing compared to Q4 2018 as well as Q1 2018. For instance, Kindred, one of the largest foreign online gambling entities in the Nordic region, describes the first quarter post-regulation in Sweden as difficult, primarily due to restrictions on bonuses, advertisement and taxes, i.e. the cost side of the firm. The re-regulation has resulted in a decrease of GBPm 18.9 in group revenue compared to Q4 2018 (Finwire, 2019).

Similar negative results can be shown from another entity, Global Gaming, which states that restrictions, as well as increased advertising costs, have affected the results sharply (Finwire, 2019). Also AB Svenska Spel have reported similar effects showing a decrease in overall gross win for the quarter compared to the quarter before and the same quarter last year (Hofbauer, 2019). However, many of the representatives in the industry agree that short-run decrease in profits for the first quarter post-regulation was according to expectations due to structural changes of the new regulation which increased overall costs and are expected to stabilize in the long-run (Finwire, 2019). If the cost side of the firm reverts to normal levels and revenue gradually increases given an increase in overall gambling, it will benefit both firms and the Swedish Government. However, the effects on the third important stakeholder in the industry, the consumers, need to be carefully evaluated post-regulation as well.

7. Conclusions and further research

The authors of this paper have studied the Swedish gambling market and the re-regulation of the market which came into effect January 1st, 2019. The new regulation can be summarized in three categories: (1) licensing system for gambling firms who wish to conduct business within Sweden; (2) requirements on player protection mechanisms which aim to limit players developing problematic gambling behaviors through credit restrictions, gambling behavioral test, limits, self-restriction through online registry, and bonus limitations; (3) taxation on gross win of 18 percent.

Like any significant reform, the re-regulation of the Swedish gambling market provides both opportunities and challenges. The governmental tax revenues captured by the market reform allow the Swedish government to increase the funds from the gambling industry and the resources which can potentially be allocated towards measures which prevent problem gambling. However, ensuring a high channelization ratio will require significant attention from regulatory authorities in order to combat attempts to circumvent the new licensing system. Insignificant attention to the maintenance of the regulation system will likely undermine the system, causing a reduction in the channelization ratio and by extension, a reduction in tax revenues and increased gambling on uncontrolled platforms.

An oligopolistic market structure where competition is intense given few firms in the industry should favor the end consumers in terms of price and broad product spectrum. In terms of AB Svenska Spel, it can be concluded that increased competition has affected their underlying business. However, despite help functions and supporting tools provided by the gambling regulation that mitigates problem gambling, the characteristics of the industry has shown that differentiation and aggressive advertising may counteract the sole purpose of the re-regulation. It can be concluded that competition in controversial industries such as the gambling market requires intervention from the government. How and to what extent the government should intervene is beyond the scope of this research. Governmental interference in restricting or banning gambling advertising surely violates the freedom of speech and should be carefully evaluated whether such action is rational, given the fact tax revenue from the industry is considered acceptable.

Further, one can discuss whether AB Svenska Spel's has a preventive social responsibility in the market or just to function as a monetary tool for the government to secure tax revenues. The future will show how the market will develop and how the Swedish government decides to allocate the captured tax revenues.

Further research

This paper is the first of its kind to apply empirical forecasting methods on AB Svenska Spel and its underlying gambling categories. The findings from the forecasting models as well as the market structure definitions can be used to further extend the research on AB Svenska Spel or gambling in general. Moreover, as shown, gambling as a phenomenon, particularly online gambling, is increasing across countries with similar gambling regulations and should consequently receive greater attention as a field of study in the near future. Understanding the relationship between gambling and stakeholders within the industry will be important in order to build theoretical and empirical models, but also in order to find causality.

Hence, the authors of this paper recommend further studies concerning the Swedish gambling market. For instance, using this paper as a foundation, once post-regulation data on state-owned AB Svenska Spel is available in a significant amount of data points, an interesting research approach is to study pre- and post-effects of the policy change in terms gambling volumes, both on aggregate market- and individual level. Domestic post-regulation research can be further extended including analysis on governmental tax revenue, social efficiency in terms of consumer- and producer surplus, industrial competition as well as changes in demographical characteristics connected to different type's gambling. Once data on gambling behavior is available post-regulation, it would be interesting to see whether there is a substantial change in individual behavior and attitudes towards gambling. If so, a before- and after method would be applicable to see whether any causality exists between the regulation change and the potential behavioral changes.

Moreover, using panel data, comparative research could be applied between countries with similar regulations and demographical characteristics, such as Denmark and the U.K. Such research concentration may be focused on, but not limited to, evaluating market efficiency enhances due to the liberalization of the gambling market from a monopoly to a structure consisting of a licensing system and tax paid on the proceeds. Comparing policy- and market efficiency between countries may shed light on whether the regulation is effective in several different aspects, such as minimizing and mitigating problem gambling, whether the channelization ratio is at a desirable level, whether the given market is subject to consolidation and how gambling advertising affects consumers in the respective countries.

Beyond market efficiency, monetary incentives, gambling activity and volumes in general, it is worth studying how policy changes in industries with potentially harmful and immoral products affect corporate social responsibility (CSR) strategies. More particularly, is there a relationship between regulation, harmful goods, in this case gambling, and companies' CSR implementation? If so, how and to what extent do companies conduct CSR in such industries?

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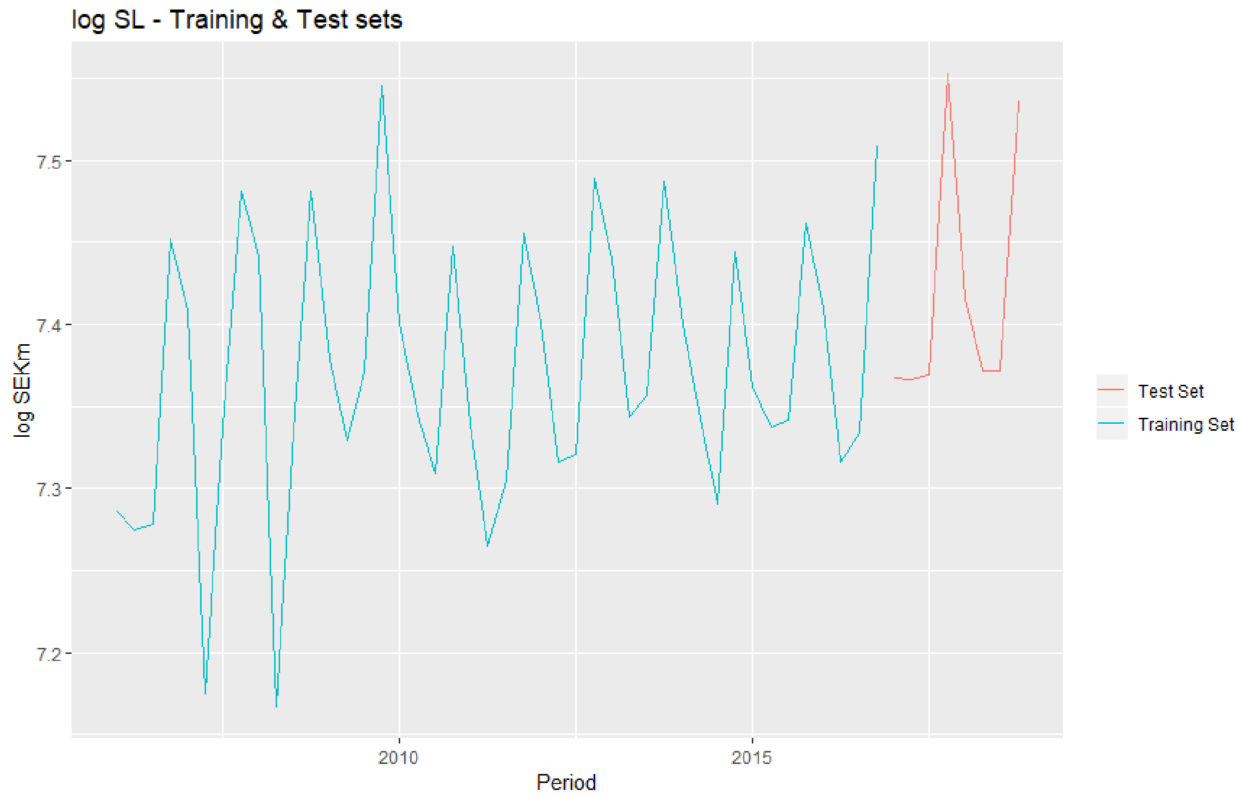
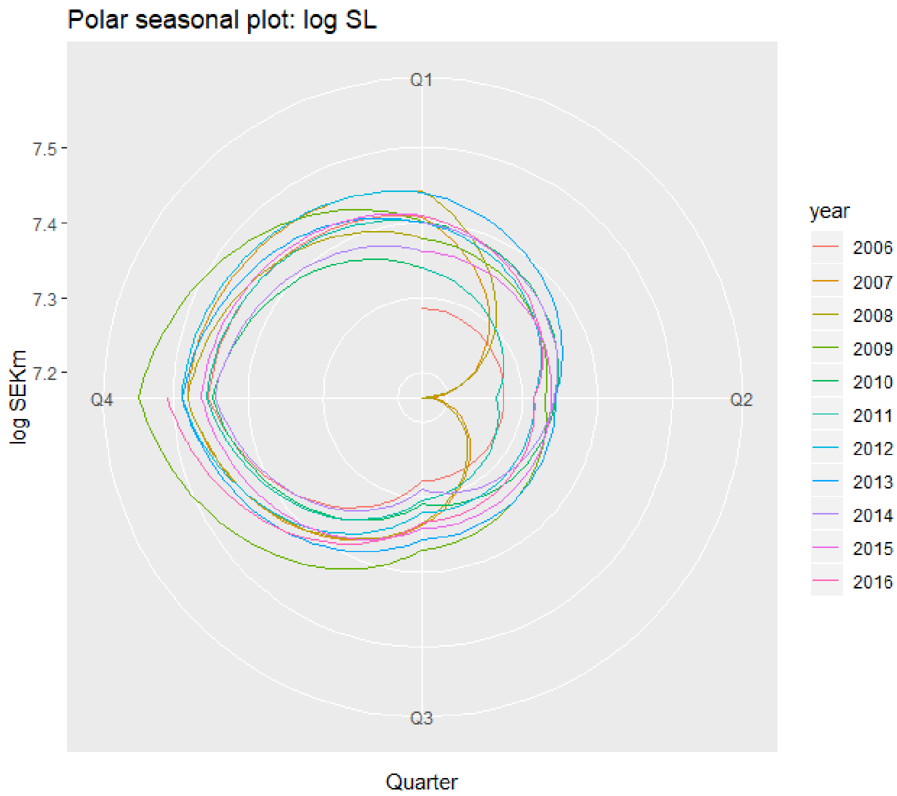
Appendix

A.1 ARIMA: Sports and Lottery (SL)



A1: SL training and test sets
Source: Authors' elaboration



A2: SL polar seasonal plot
Source: Authors' elaboration

```
###############################################
# Augmented Dickey-Fuller Test Unit Root Test #
###############################################

Test regression drift


Call:
lm(formula = z.diff ~ z.lag.1 + 1 + z.diff.lag)

Residuals:
      Min        1Q    Median        3Q       Max
-0.068297 -0.024518 -0.004875  0.019932  0.168309

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.004584   0.008211   0.558  0.58112
z.lag.1     -0.878199   0.243040  -3.613  0.00117 **
z.diff.lag1  0.090732   0.222794   0.407  0.68692
z.diff.lag2  0.481185   0.211211   2.278  0.03054 *
z.diff.lag3  0.380551   0.183596   2.073  0.04751 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.04689 on 28 degrees of freedom
Multiple R-squared:  0.4715,    Adjusted R-squared:  0.396
F-statistic: 6.245 on 4 and 28 DF,  p-value: 0.001008


Value of test-statistic is: -3.6134 6.5454

Critical values for test statistics:
      1pct  5pct 10pct
tau2 -3.58 -2.93 -2.60
phi1  7.06  4.86  3.94
```

A3: SL ADF test – seasonally differenced
Source: Authors’ elaboration

```
###############################################
# Augmented Dickey-Fuller Test Unit Root Test #
###############################################

Test regression drift


Call:
lm(formula = z.diff ~ z.lag.1 + 1 + z.diff.lag)

Residuals:
     Min       1Q   Median       3Q      Max
-0.08318 -0.02285  0.01044  0.01777  0.10738

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   9.1551     2.4344   3.761 0.000734 ***
z.lag.1      -1.2411     0.3301  -3.759 0.000736 ***
z.diff.lag1   0.3028     0.2888   1.049 0.302699
z.diff.lag2   0.3458     0.2804   1.234 0.226959
z.diff.lag3   0.1629     0.2276   0.716 0.479551
z.diff.lag4   0.6708     0.1757   3.818 0.000628 ***
z.diff.lag5   0.4185     0.1448   2.889 0.007112 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.03916 on 30 degrees of freedom
Multiple R-squared:  0.897,     Adjusted R-squared:  0.8764
F-statistic: 43.56 on 6 and 30 DF,  p-value: 1.721e-13


Value of test-statistic is: -3.7594 7.1934

Critical values for test statistics:
      1pct  5pct 10pct
tau2 -3.58 -2.93 -2.60
phi1  7.06  4.86  3.94
```

A4: SL ADF test – no difference
Source: Authors’ elaboration

```
        Estimate  Std. Error z value  Pr(>|z|)    
sma1  -0.79410930 0.16537416 -4.8019 1.572e-06 ***
drift  0.00115888 0.00063739  1.8182   0.06904 .  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

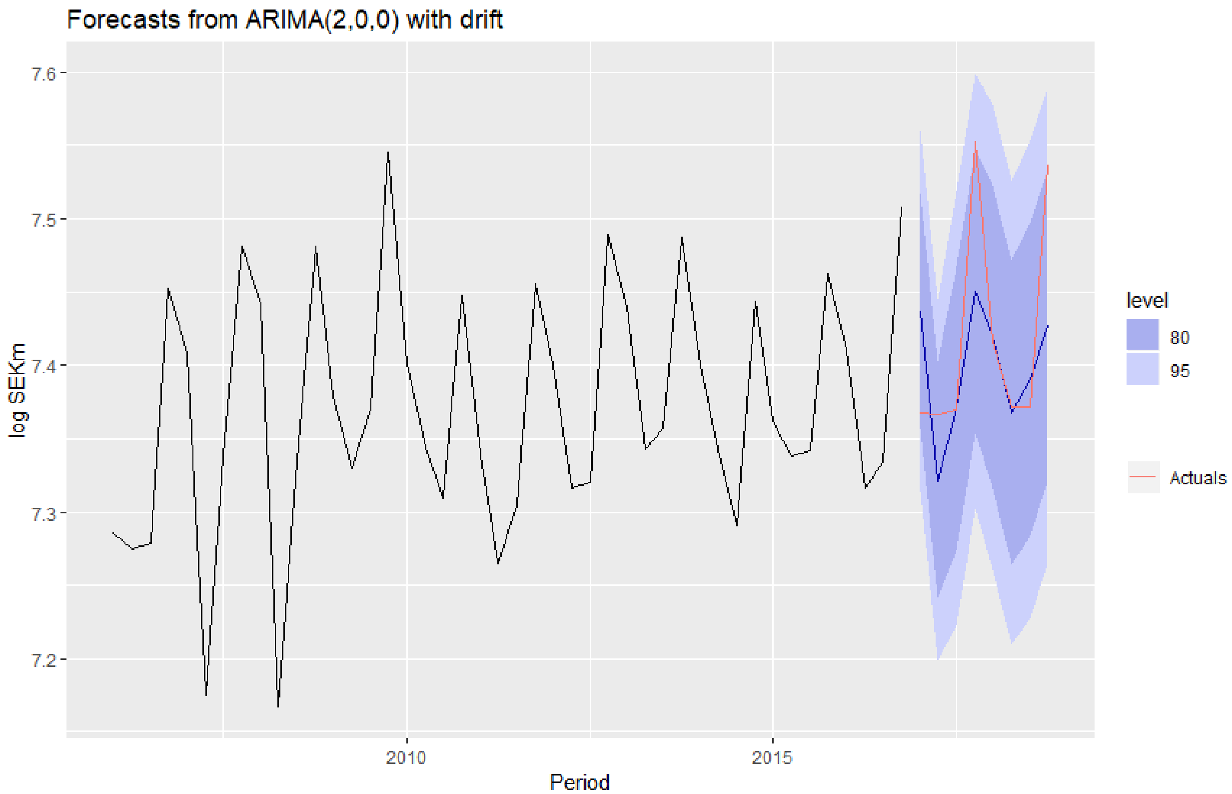
A5: SL fit 1 coefficients – ARIMA(0,0,0)(0,1,1)[4] with drift
Source: Authors' elaboration

```
            Estimate Std. Error  z value  Pr(>|z|)    
ar1        0.0036017  0.1146469   0.0314   0.97494    
ar2       -0.6732124  0.1101185  -6.1135 9.745e-10 ***
intercept  7.3465608  0.0115402 636.6037 < 2.2e-16 ***
drift      0.0011086  0.0004770   2.3241   0.02012 *  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

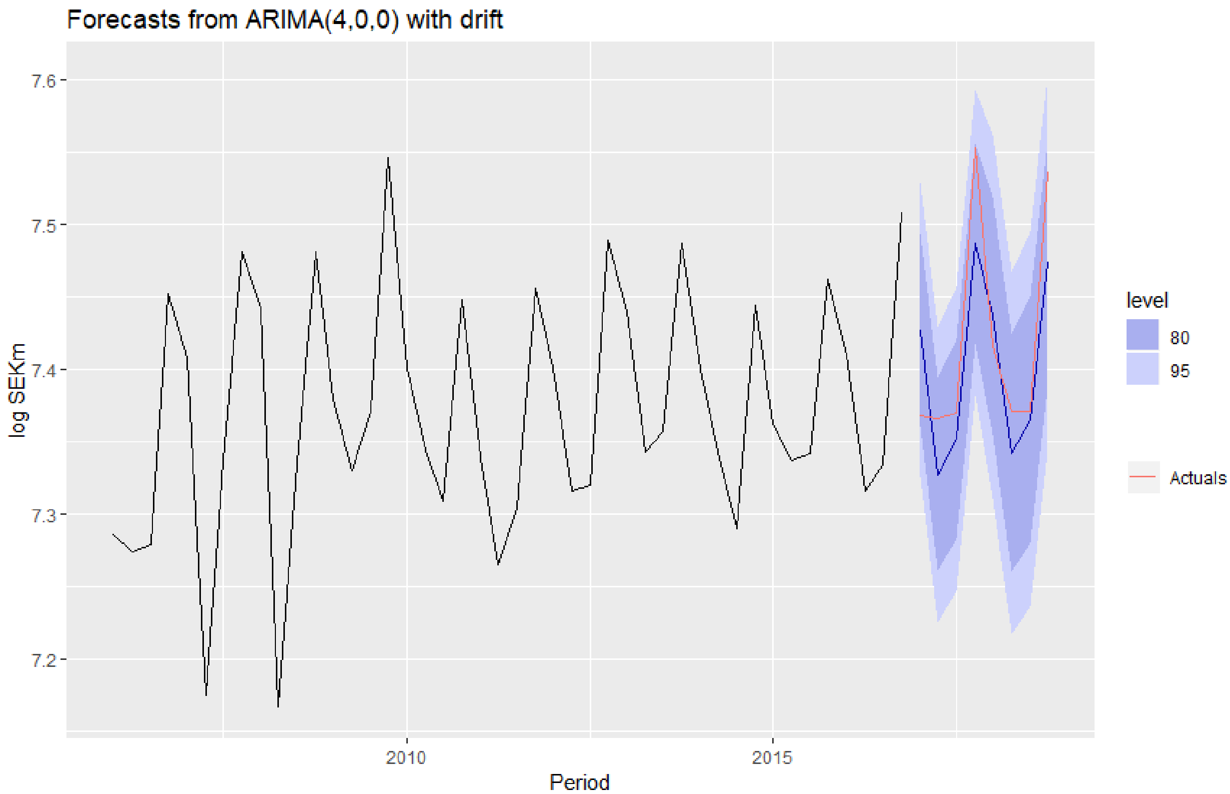
A6: SL fit 2 coefficients – ARIMA(2,0,0) with drift
Source: Authors' elaboration

```
             Estimate  Std. Error  z value  Pr(>|z|)    
ar1       -0.02725850  0.12501353  -0.2180   0.82739    
ar2       -0.26894203  0.11987718  -2.2435   0.02487 *  
ar3       -0.06486034  0.12500150  -0.5189   0.60385    
ar4        0.59006436  0.12342898   4.7806 1.748e-06 ***
intercept  7.34077899  0.01776963 413.1082 < 2.2e-16 ***
drift      0.00129835  0.00068261   1.9020   0.05717 .  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

A7: SL fit 3 coefficients – ARIMA(4,0,0) with drift
Source: Authors' elaboration

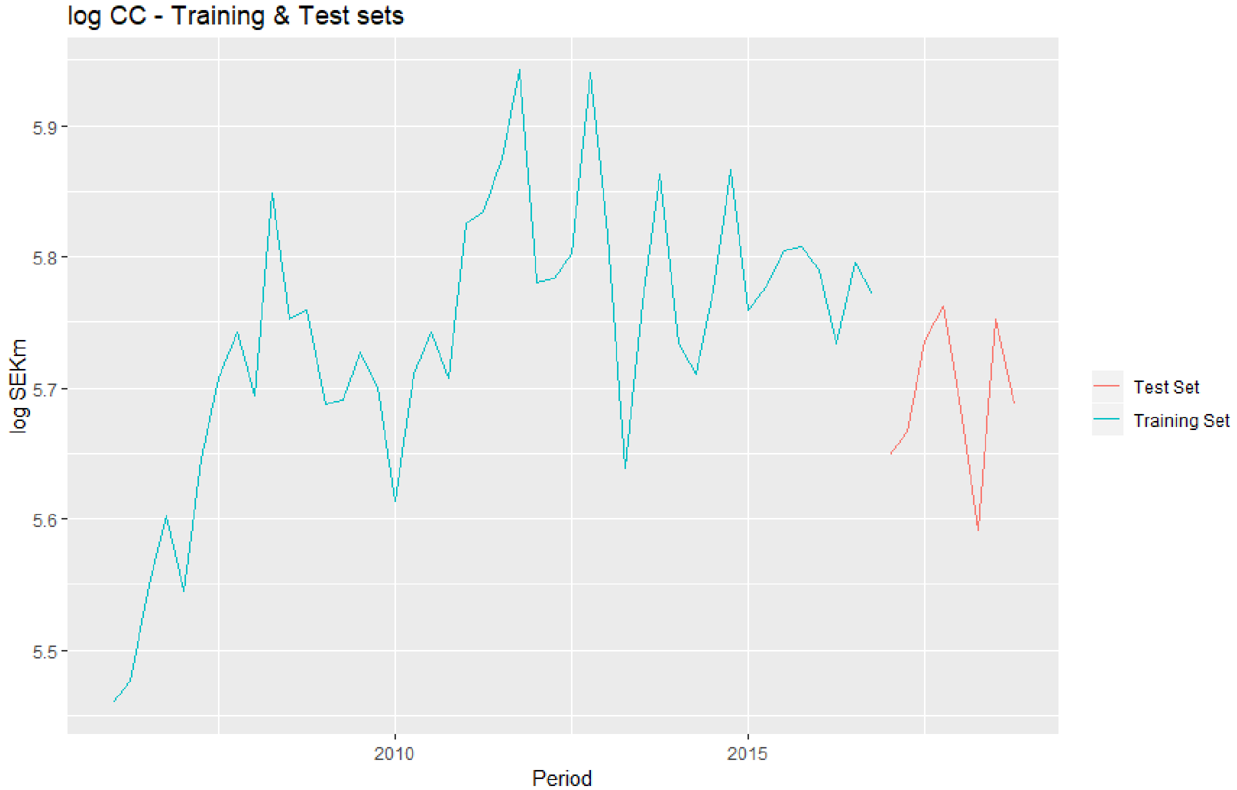


A8: SL fit 2 forecast vs actual observations
Source: Authors' elaboration

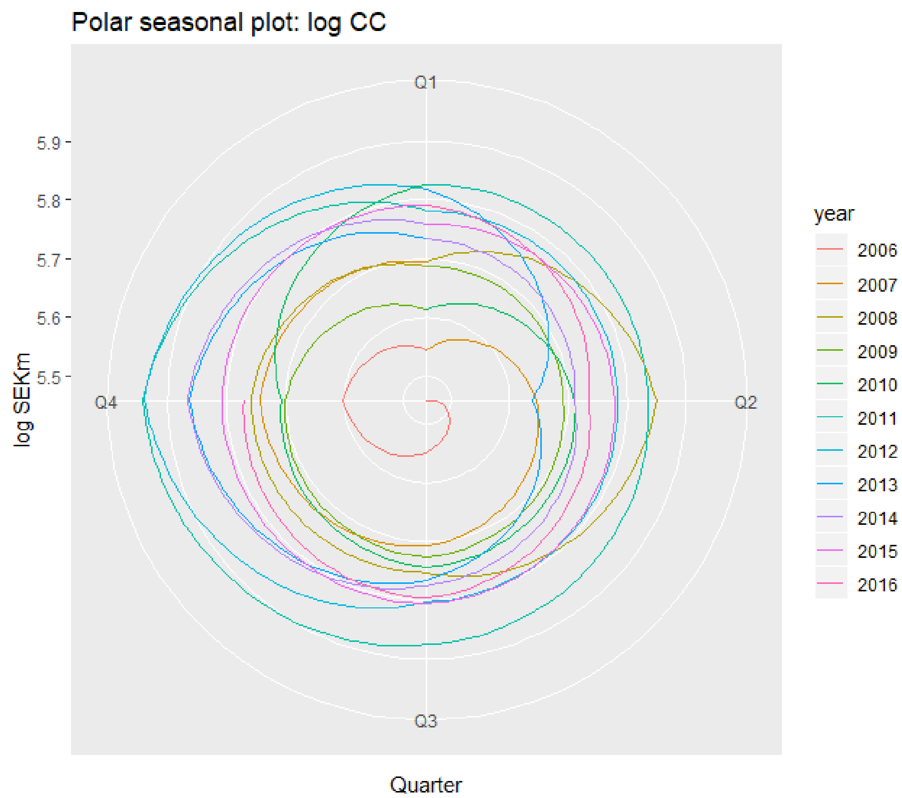


A9: SL fit 3 forecast vs actual observations
Source: Authors' elaboration

A.2 ARIMA: Casino Cosmopol incl. online poker (CC)



A10: CC training and test sets
Source: Authors' elaboration



A11: CC polar seasonal plot
Source: Authors' elaboration

```
################################################
# Augmented Dickey-Fuller Test Unit Root Test #
################################################

Test regression drift


Call:
lm(formula = z.diff ~ z.lag.1 + 1 + z.diff.lag)

Residuals:
     Min       1Q   Median       3Q      Max
-0.12492 -0.04425 -0.00748  0.02925  0.15426

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   3.2648     1.1616   2.811  0.00825 **
z.lag.1      -0.5652     0.2014  -2.806  0.00835 **
z.diff.lag1  -0.0397     0.1761  -0.226  0.82297
z.diff.lag2  -0.2576     0.1504  -1.712  0.09627 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.06832 on 33 degrees of freedom
Multiple R-squared:  0.3927,    Adjusted R-squared:  0.3375
F-statistic: 7.113 on 3 and 33 DF,  p-value: 0.000817


Value of test-statistic is: -2.8062 4.0499

Critical values for test statistics:
      1pct  5pct 10pct
tau2 -3.58 -2.93 -2.60
phi1  7.06  4.86  3.94
```

A12: CC ADF test – no difference
Source: Authors' elaboration

```
###############################################
# Augmented Dickey-Fuller Test Unit Root Test #
###############################################

Test regression drift


Call:
lm(formula = z.diff ~ z.lag.1 + 1 + z.diff.lag)

Residuals:
      Min        1Q    Median        3Q       Max 
-0.162740 -0.045640 -0.002994  0.027977  0.161353 

Coefficients:
             Estimate Std. Error t value Pr(>|t|)    
(Intercept)  0.005002   0.012222   0.409  0.68507    
z.lag.1     -2.287824   0.374952  -6.102 8.09e-07 ***
z.diff.lag1  0.798296   0.263078   3.034  0.00476 ** 
z.diff.lag2  0.241711   0.163775   1.476  0.14975    
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.07274 on 32 degrees of freedom
Multiple R-squared:  0.7343,    Adjusted R-squared:  0.7094 
F-statistic: 29.48 on 3 and 32 DF,  p-value: 2.465e-09


Value of test-statistic is: -6.1016 18.6692 

Critical values for test statistics: 
      1pct  5pct 10pct
tau2 -3.58 -2.93 -2.60
phi1  7.06  4.86  3.94
```

A13: CC ADF test – first difference
Source: Authors' elaboration

```
     Estimate Std. Error z value  Pr(>|z|)    
ma1  -0.46381    0.13816 -3.3571 0.0007875 ***
sma1  0.36160    0.13378  2.7030 0.0068727 ** 
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

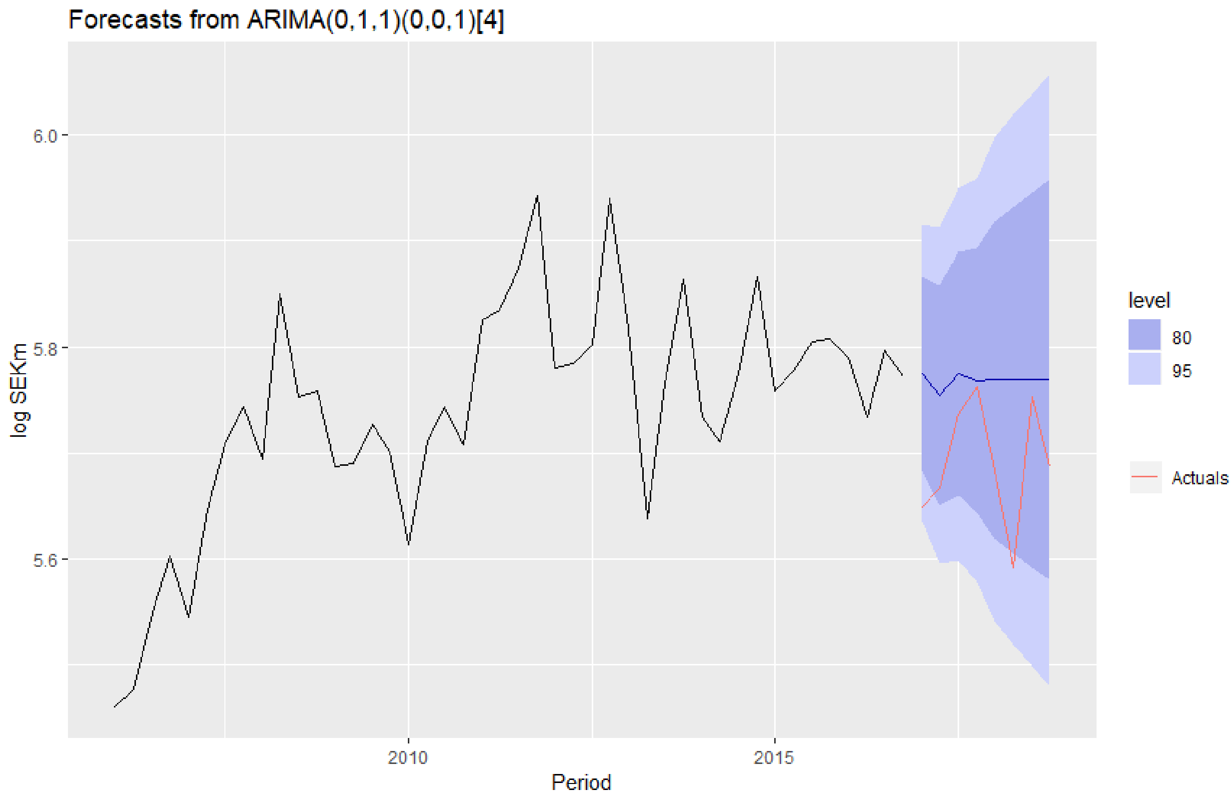
A14: CC fit 1 coefficients – ARIMA(0,1,1)(0,0,1)[4]
Source: Authors' elaboration

```
     Estimate Std. Error z value  Pr(>|z|)    
ma1  -0.37477    0.15027 -2.4940   0.01263 *  
sma1 -0.71353    0.17402 -4.1002 4.128e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

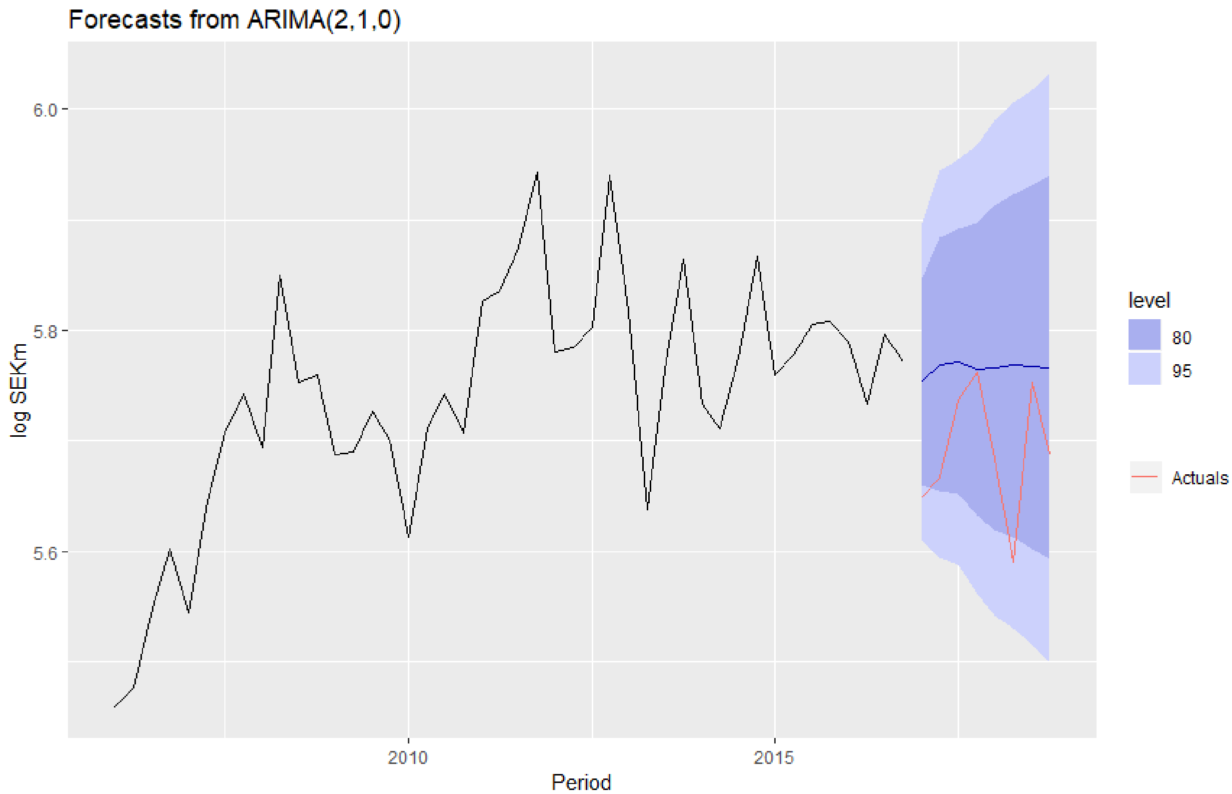
A15: CC fit 2 coefficients – ARIMA(0,1,1)(0,1,1)[4]
Source: Authors' elaboration

```
    Estimate Std. Error z value Pr(>|z|)  
ar1 -0.30523    0.13820 -2.2086 0.027202 *
ar2 -0.40475    0.13701 -2.9542 0.003135 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

A16: CC fit 3 coefficients – ARIMA(2,1,0)
Source: Authors' elaboration

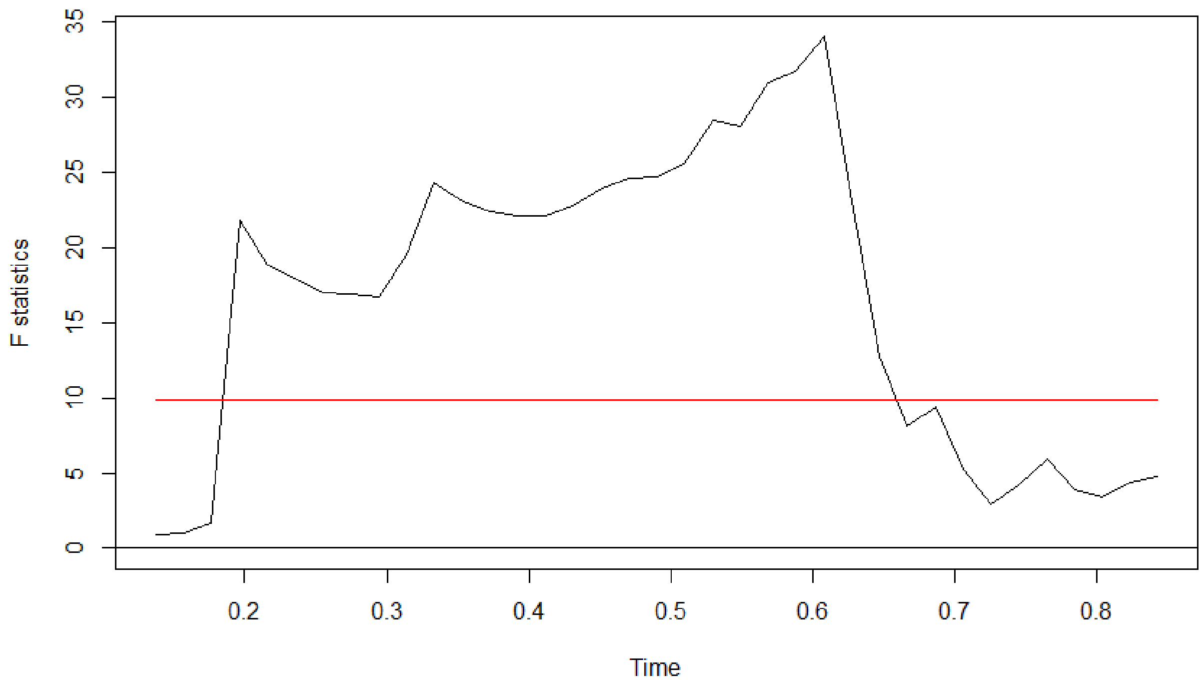


A17: CC fit 1 forecast vs actual observations
Source: Authors' elaboration



A18: CC fit 3 forecast vs actual observations
Source: Authors' elaboration

A.3 ARIMA: Vegas gaming machines (VG)

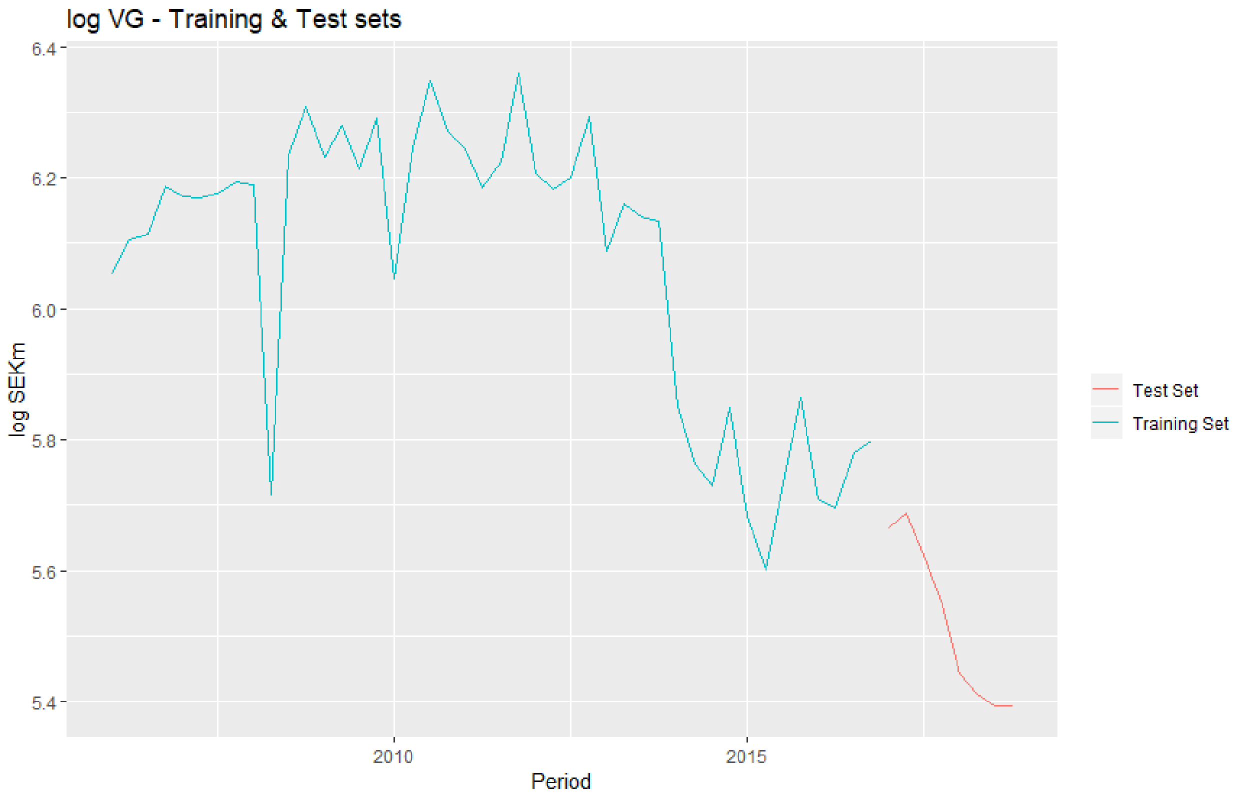


A19: VG QLR plot
Source: Authors' elaboration

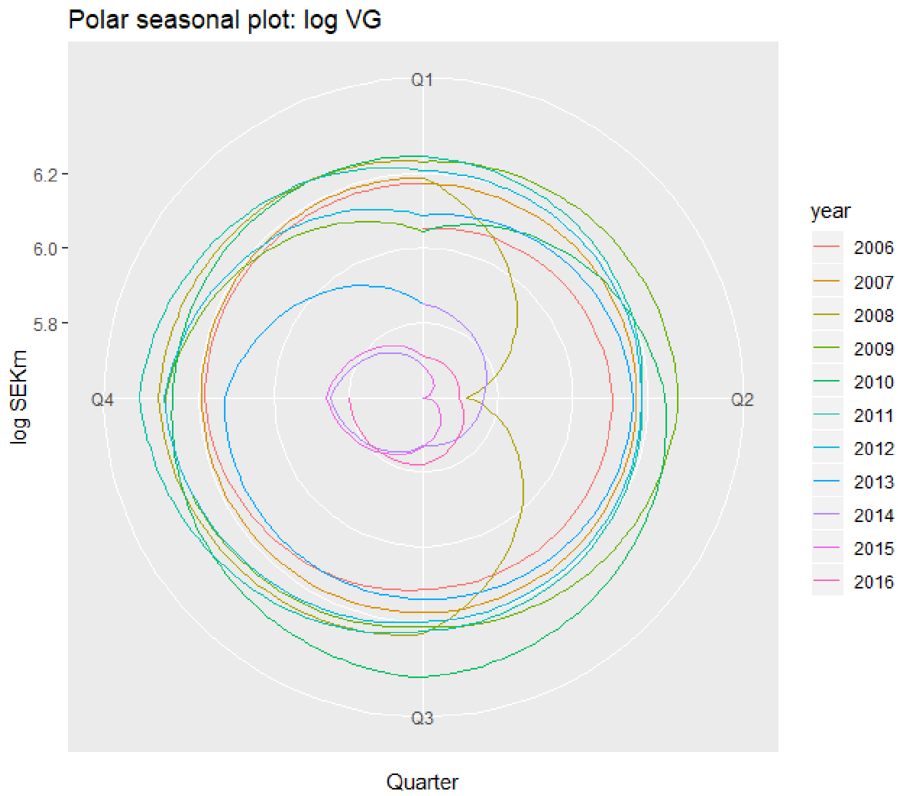
	No difference			1st difference		
	out	*struc*	*drift*	*out*	*struc*	*drift*
2006-03-01	0	0	0	na	na	na
2006-06-01	0	0	0	0	0	0
2006-09-01	0	0	0	0	0	0
2006-12-01	0	0	0	0	0	0
2007-03-01	0	0	0	0	0	0
2007-06-01	0	0	0	0	0	0
2007-09-01	0	0	0	0	0	0
2007-12-01	0	0	0	0	0	0
2008-03-01	0	0	0	0	0	0
2008-06-01	1	0	0	1	0	0
2008-09-01	0	0	0	-1	0	0
2008-12-01	0	0	0	0	0	0
2009-03-01	0	0	0	0	0	0
2009-06-01	0	0	0	0	0	0
2009-09-01	0	0	0	0	0	0
2009-12-01	0	0	0	0	0	0
2010-03-01	0	0	0	0	0	0
2010-06-01	0	0	0	0	0	0
2010-09-01	0	0	0	0	0	0
2010-12-01	0	0	0	0	0	0
2011-03-01	0	0	0	0	0	0
2011-06-01	0	0	0	0	0	0
2011-09-01	0	0	0	0	0	0
2011-12-01	0	0	0	0	0	0
2012-03-01	0	0	0	0	0	0
2012-06-01	0	0	0	0	0	0
2012-09-01	0	0	0	0	0	0
2012-12-01	0	0	0	0	0	0
2013-03-01	0	0	0	0	0	0
2013-06-01	0	0	0	0	0	0
2013-09-01	0	1	1	0	1	1
2013-12-01	0	1	2	0	0	1
2014-03-01	0	1	3	0	0	1
2014-06-01	0	1	4	0	0	1
2014-09-01	0	1	5	0	0	1
2014-12-01	0	1	6	0	0	1
2015-03-01	0	1	7	0	0	1
2015-06-01	0	1	8	0	0	1

2015-09-01	0	1	9	0	0	1
2015-12-01	0	1	10	0	0	1
2016-03-01	0	1	11	0	0	1
2016-06-01	0	1	12	0	0	1
2016-09-01	0	1	13	0	0	1
2016-12-01	0	1	14	0	0	1
2017-03-01	0	1	15	0	0	1
2017-06-01	0	1	16	0	0	1
2017-09-01	0	1	17	0	0	1
2017-12-01	0	1	18	0	0	1
2018-03-01	0	1	19	0	0	1
2018-06-01	0	1	20	0	0	1
2018-09-01	0	1	21	0	0	1
2018-12-01	0	1	22	0	0	1

A20: VG dummy variables in original and first differenced form
Source: Authors' elaboration



A21: VG training and test sets
Source: Authors' elaboration



A22: VG polar seasonal plot
Source: Authors' elaboration

```
###############################################
# Augmented Dickey-Fuller Test Unit Root Test #
###############################################

Test regression drift


Call:
lm(formula = z.diff ~ z.lag.1 + 1 + z.diff.lag)

Residuals:
     Min       1Q   Median       3Q      Max 
-0.43895 -0.05950  0.02638  0.07436  0.31750 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)  
(Intercept)  0.52932    0.72706   0.728   0.4717  
z.lag.1     -0.09025    0.11953  -0.755   0.4556  
z.diff.lag1 -0.39197    0.18313  -2.140   0.0398 *
z.diff.lag2 -0.29684    0.17309  -1.715   0.0957 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.1479 on 33 degrees of freedom
Multiple R-squared:  0.2289,    Adjusted R-squared:  0.1588 
F-statistic: 3.266 on 3 and 33 DF,  p-value: 0.03349


Value of test-statistic is: -0.755 0.5955 

Critical values for test statistics: 
      1pct  5pct 10pct
tau2 -3.58 -2.93 -2.60
phi1  7.06  4.86  3.94
```

A23: VG ADF test – no difference
Source: Authors' elaboration

```
###############################################
# Augmented Dickey-Fuller Test Unit Root Test #
###############################################

Test regression drift


Call:
lm(formula = z.diff ~ z.lag.1 + 1 + z.diff.lag)

Residuals:
     Min       1Q   Median       3Q      Max
-0.43894 -0.05297  0.02043  0.07477  0.29212

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.02578    0.02504  -1.030   0.3109
z.lag.1     -2.22121    0.41010  -5.416 5.92e-06 ***
z.diff.lag1  0.68504    0.30106   2.275   0.0297 *
z.diff.lag2  0.23573    0.17320   1.361   0.1830
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.1472 on 32 degrees of freedom
Multiple R-squared:  0.7237,	Adjusted R-squared:  0.6978
F-statistic: 27.93 on 3 and 32 DF,  p-value: 4.593e-09


Value of test-statistic is: -5.4162 14.6699

Critical values for test statistics:
      1pct  5pct 10pct
tau2 -3.58 -2.93 -2.60
phi1  7.06  4.86  3.94
```

A24: VG ADF test – first difference
Source: Authors' elaboration

```
              Estimate Std. Error z value  Pr(>|z|)    
sar1          0.9457805  0.0694465 13.6188 < 2.2e-16 ***
sma1         -0.6986645  0.1781802 -3.9211 8.814e-05 ***
drift        -0.0059748  0.0356266 -0.1677    0.8668    
ss.sub[, 2] -0.5048113  0.0563018 -8.9662 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

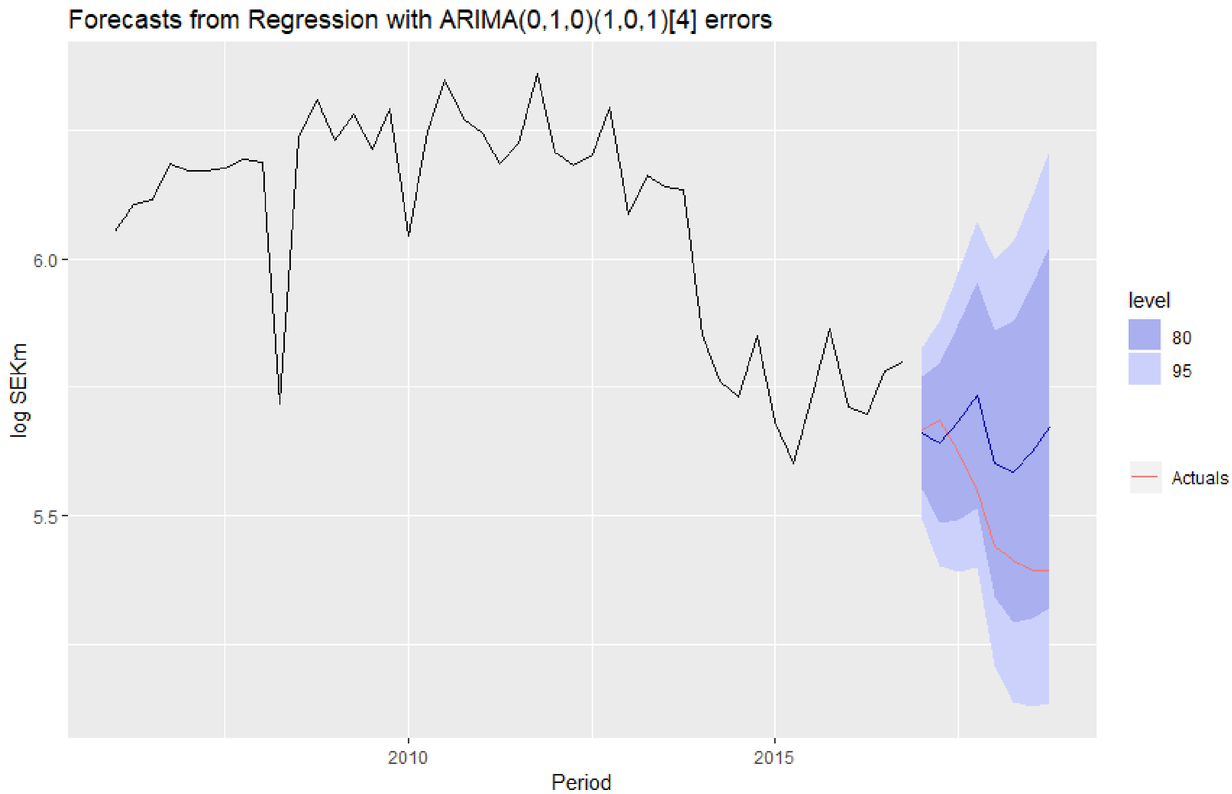
A25: VG fit 1 coefficients ARIMA(0,1,0)(1,0,1)[4]
Source: Authors' elaboration

```
              Estimate Std. Error z value  Pr(>|z|)    
ar1           0.810941   0.118530  6.8416  7.83e-12 ***
sar1          0.893517   0.106949  8.3546 < 2.2e-16 ***
sma1         -0.572177   0.208112 -2.7494  0.005971 ** 
intercept     6.039507   0.174229 34.6642 < 2.2e-16 ***
ss.sub[, 2] -0.508001   0.058520 -8.6808 < 2.2e-16 ***
ss.sub[, 3] -0.120158   0.098139 -1.2244  0.220814    
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

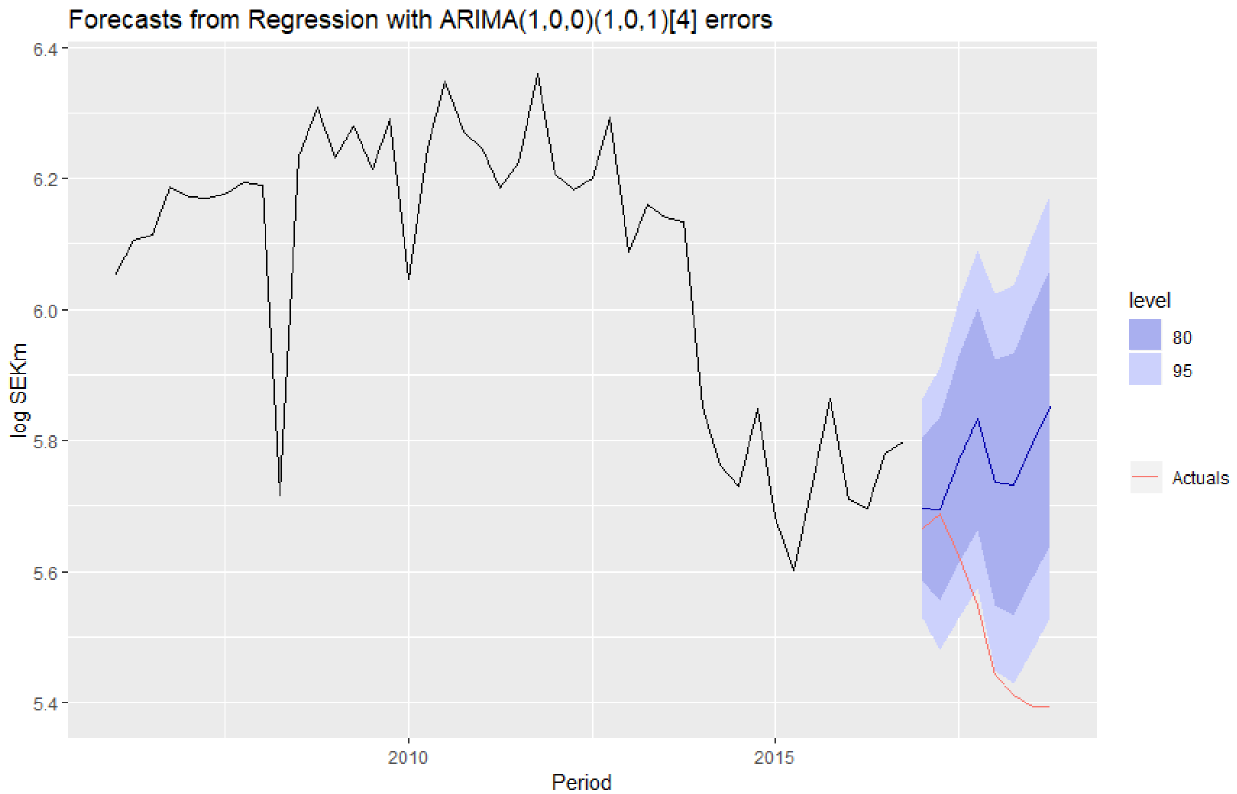
A26: VG fit 2 coefficients ARIMA(1,0,0)(1,0,1)[4]
Source: Authors' elaboration

```
              Estimate Std. Error z value  Pr(>|z|)    
ma1           0.627930   0.196010  3.2036 0.0013574 ** 
sma1         -0.889395   0.272748 -3.2609 0.0011107 ** 
ss.sub[, 2] -0.503349   0.058878 -8.5490 < 2.2e-16 ***
ss.sub[, 3] -0.212928   0.057451 -3.7063 0.0002103 ***
ss.sub[, 4] -0.024541   0.006543 -3.7508 0.0001763 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

A27: VG fit 3 coefficients ARIMA(0,0,1)(0,1,1)[4]
Source: Authors' elaboration



A28: VG fit 1 forecast vs actual observations
Source: Authors' elaboration



A29: VG fit 2 forecast vs actual observations
Source: Authors' elaboration