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The Impact of the COVID-19 (Coronavirus) on The Borsa Istanbul Sector Index Returns: An Event Study

COVID-19 (Koronavirüs)'un Borsa İstanbul Sektör Endeks Getirileri Üzerindeki Etkisi: Bir Olay Çalışması

İlkut Elif KANDİL GÖKER^{a*}, Binali Selman EREN^b, Süleyman Serdar KARACA^c

^a Dr. Öğr. Üyesi, Kırıkkale Üniversitesi, İİBF, İşletme Bölümü, Kırıkkale / TÜRKİYE
ORCID: 0000-0002-5290-3514

^b Arş. Gör., Bitlis Eren Üniversitesi, İİBF, İşletme Bölümü, Bitlis / TÜRKİYE
ORCID: 0000-0001-5136-6406

^c Prof. Dr., Tokat Gaziosmanpaşa Üniversitesi, İİBF, İşletme Bölümü, Tokat / TÜRKİYE
ORCID: 0000-0002-5424-5359

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ÖZ

Bu çalışma COVID-19 salgınının Borsa İstanbul sektör endeks getirileri üzerindeki etkisini analiz etmeyi amaçlamaktadır. COVID-19 ilk olarak 2019 yılı aralık ayında Çin'in Wuhan kentinde ortaya çıkmış olup kısa sürede pek çok ülkeye yayılmıştır. Dünya Sağlık Örgütü tarafından pandemi ilan edilmesi ile gerek ulusal gerekse uluslararası düzeyde ticari ve mali hareketlilikler kısıtlanmıştır. Bu durum hem finansal hem de reel sektörü doğrudan etkilemiştir. Dünyada daha önce yaşanan salgıların ülke ekonomileri üzerine etkileri incelediğinde sektör bazında farklılaşmalar olduğu görülmüştür. Bu noktadan hareket ederek bu çalışma, salgından etkilenme durumunu sektör bazında ortaya koymaktadır. BIST'te yer alan 26 sektöre ait veriler kullanılarak yapılan olay çalışması bulgularına göre, incelenen olay dönemlerinin çoğunda çoğu sektörün negatif Birikimli Ortalama Olağanüstü Getiri (CAAR) elde ettiği, bazı dönemlerde ise farklı sektörlerin CAAR değerlerinin pozitif olduğu görülmüştür. Farklı olay pencerelerine göre oranlar değişimle birlikte en yüksek kaybın Spor, Turizm ve Taşımacılık sektörlerinde olduğu tespit edilmiştir.

ABSTRACT

This study aims to analyze the impact of the COVID-19 outbreak on the Borsa Istanbul sector index returns. COVID-19 first emerged in Wuhan, China in December 2019 and spread to many countries in a short time. With the declaration of the COVID-19 outbreak a global pandemic by the World Health Organization on March 11, 2020, commercial and financial mobility is restricted at both national and international levels. This directly affects both the financial and real sectors. When the effects of previous outbreaks on the economies of the countries are analyzed, it is observed that there are differences on a sector basis. From this point of view this study reveals the impact of the pandemic on sector basis. The data of 26 sectors in BIST are analyzed by the event study. According to the findings, in most of the event windows examined, most of the sectors have negative cumulative abnormal returns (CAAR); in some periods, it is seen that few sectors have positive CAARs. Although the abnormal return rates vary according to different event windows, the highest loss is found in the Sports, Tourism and Transportation sectors.

* Sorumlu yazar/Corresponding author.
e-posta: elifkandil@kku.edu.tr

GENİŞLETİLMİŞ ÖZET

Bugüne kadar küresel ölçekte pek çok salgın hastalık ortaya çıkmıştır. 20. yüzyılda bilinen en eski salgın 1918’de ortaya çıkan İspanyol Gribi’dir. İspanyol gribi, tüm dünyada 40 milyon insanın ölümüne ve 4 trilyon dolardan daha fazla maliyete sebep olmuştur. 2002 yılında ise Çin’de ortaya çıkıp geri kalan Asya ülkelerine hızla yayılan SARS salgını yaşanmıştır. Dünya Sağlık Örgütü verilerine göre SARS, 900 insanın ölümü ve Dünya Bankası verilerine göre global ekonomide 54 milyar dolara mal olmuştur. Daha yakın geçmiş olan 2013-2016 döneminde 11.300 insanın ölümü ve 53 milyar dolar maliyete sebep olan Ebola salgını ise Afrika’da ortaya çıkmıştır. Bugün ise dünyanın pek çok ülkesi 2019 yılı aralık ayında Çin’de ortaya çıkıp dünyaya hızla yayılan COVID-19 salgını ile mücadele etmektedir. Dünya Sağlık Örgütü COVID-19’u 11 Mart 2020 tarihinde bir pandemi olarak ilan etmiş ve ülkeleri salgının kontrol altına alınabilmesi için sıkı önlemler almaları konusunda yönlendirmiştir.

COVID-19’un ortaya çıkması ile birlikte bu salgının özellikle ekonomi üzerindeki etkisi, borsa getirileri üzerindeki etkisi, sektörler üzerinde yarattığı etki, ülkelerin finansal piyasaları arasındaki etkileşime olan etkisi çalışmalara konu olmaya başlamıştır. Bu çalışma, COVID-19 salgınının Borsa İstanbul (BIST) endeks getirileri üzerindeki etkisini sektör bazında ortaya koyarak literatüre katkı sağlamayı amaçlamıştır. BIST bünyesinde yer alan 26 adet sektör endeksi çalışmaya dahil edilmiştir. Araştırma verileri, 02/01/2019-09/04/2020 tarihleri arasında 26 endeksi oluşturan şirketlerin hisse senetleri günlük kapanış değerlerinden oluşmaktadır. Karşılaştırma endeksi olarak ise BIST100 endeksi seçilmiştir. Analizler için kullanılan veriler yahoo finance (www.finance.yahoo.com) internet adresinden çekilmiştir. Çalışmada, verileri analiz etmek için farklı performans ölçümleri ile ekonomik, politik veya sosyal bir olayın hisse senetleri fiyatları üzerindeki etkilerinin test edilmesi amacıyla kullanılan “olay çalışması” yöntemi kullanılmıştır. Çalışmada olay tarihi olarak 11 Mart 2020 tarihi dikkate alınmıştır. Bu tarihin baz alınmasının temel nedeni, Dünya Sağlık Örgütü’nün COVID-19 (Koronavirüs) salgını bu tarihte pandemi olarak ilan etmesi ve Türkiye’de de Sağlık Bakanlığı tarafından bu tarihte ilk vakanın açıklanmış olmasıdır. Olay çalışmasında tahmin penceresi literatürdeki (Cheung, 2011; Consolandi ve diğ., 2009; Curran ve Moran, 2007) çalışmalar dikkate alınacak şekilde $t = -250$ ve $t = -20$ şeklinde belirlenmiştir. Olay pencerelerinin uzunluğu da literatürdeki çalışmalar doğrultusunda $(-20...+20)$, $(-10...+10)$, $(-5...+5)$, $(-2...+2)$, $(-1...+1)$, $(0...0)$, $(0...+10)$, $(0...+20)$ şeklinde belirlenmiştir.

Elde edilen bulgular olay pencereleri bakımından incelendiğinde; $(-20;+20)$ gözlem döneminde en yüksek kaybın %30 negatif CAAR değeri ile Tekstil Deri sektöründe yaşandığı, pozitif getirinin ise Spor ve Madencilik sektörlerinde gerçekleştiği görülmektedir. $(-10;+10)$ gözlem döneminde Spor sektörünün %60 kayıp yaşadığı ve bu sektörü Turizm, Tekstil ve Deri ve Taşımacılık sektörlerinin takip ettiği, bu dönemde pozitif bir CAAR değerine ulaşan sektörün olmadığı görülmektedir. $(-5;+5)$ gözlem döneminde yine Spor sektörü %48 negatif CAAR elde etmiş; bankacılık sektörü ise pozitif CAAR değerine ulaşan tek sektör olmuştur. $(-2;+2)$ gözlem döneminde ise Spor sektörü %37 oranı ile en yüksek negatif CAAR değerini elde etmiş; Sigortacılık sektörü ise %9 ile en yüksek pozitif CAAR değerini elde etmiştir. $(-1;+1)$ gözlem döneminde Spor sektörü %33 ile yine en yüksek kaybı yaşayan sektör olmuştur. Bu gözlem döneminde tüm sektörler negatif CAAR değeri elde etmiştir. Olay gününde $(0;0)$ ise Spor, Turizm, Yatırım Ortaklığı sektörleri negatif CAAR elde ederken, Yiyecek İçecek, Toptan ve Perakende Satış sektörleri pozitif CAAR elde etmiştir. Ancak elde edilen sonuçların anlamlı olmadığı görülmüştür. Olay gününden sonraki döneme bakıldığında $(0;+10)$ gözlem döneminde Spor, Turizm, Tekstil Deri sektörleri negatif CAAR elde ederken, Yiyecek İçecek, Kimya, Petrol, Plastik, Bankacılık ve Madencilik sektörleri pozitif CAAR elde etmiştir. Son olarak $(0;+20)$ gözlem döneminde ise Aracı Kurum ve Sigortacılık sektörlerinde en yüksek negatif CAAR elde edilirken pozitif en yüksek CAAR değeri ise Madencilik ve Yiyecek-İçecek sektörlerinde gerçekleşmiştir.

Borsa İstanbul bünyesinde yer alan sektörlerin büyük çoğunluğunun kısa, orta ve uzun pencere dönemlerinin çoğunda negatif CAAR değeri elde ettiği tespit edilmiştir. Elde edilen sonuçlar farklı tahmin pencereleri için değişimle birlikte genel olarak spor, turizm ve tekstil sektörlerinin pandemiden en olumsuz etkilenen sektörler olduğu görülmektedir. Özellikle spor sektörünün en yüksek negatif CAAR değeri elde eden sektör olduğu görülmüştür. COVID-19, henüz kalıcı tedavi yöntemlerinin geliştirilemediği, aşısı üzerinde çalışmaların yürütüldüğü ve dolayısıyla insanlar üzerindeki olumsuz etkisi devam etmekte olan bir salgındır. Bu nedenle geleceğe yönelik yaratmış olduğu bir belirsizlik durumu söz konusudur. Bu durum öncelikle lüks tüketim olmak üzere birçok sektörün nakit akış beklentilerini doğrudan etkilemektedir. Örneğin askıya alınan spor müsabakalarının ne zaman başlayacağı, eskisi kadar talep görüp görmeyeceği, yerli ve yabancı turistlerin konaklama hizmetlerinden faydalanıp faydalanmayacağı konusunda büyük bir belirsizlik söz konusudur. Bu gelişmeler ışığında yatırımcıların bu sektörlerle yaptıkları yatırımlar yavaşlamıştır. Öte yandan, gıda, kimya ve bankacılık sektörlerinde olumlu bir CAAR görülmesi, bu sektörlerin temel tüketim mal ve hizmetlerinin üretildiği sektörler olmasından kaynaklanmaktadır. Olağanüstü olaylarla karşılaşan insanlar önce temel ihtiyaçlarını karşılamak için güdüyle hareket etmektedir. Bu nedenle, bu sektörlerdeki nakit akışları hızla devam etmekte ve bu sektörler yatırımcılar için daha cazip hale gelmektedir.

Her sektör, reel ve finansal sektörlerin önemli bir parçasını teşkil etmektedir. Yaşanan gelişmeler karşısında yatırımcıların talebinin canlanması, güven ortamının yaratılmasına bağlıdır. Sürecin ne zaman sonlandırılacağı bilinmemekle birlikte, tüm güvenlik öneminin en katı şekilde alındığı ve insan sağlığının her zaman öncelikli olacağı algısı, kesintili nakit akışları yeniden canlandırılacaktır. Bu, yatırımcıları tekrar bu sektörlere yatırım yapmaya teşvik edecektir.

Introduction

There have been many epidemic diseases in the world so far. In the 20th century, the oldest known epidemic among those was the global influenza of 1918 (Spanish Influenza). It caused the death of 40 million people worldwide and cost more than US\$ 4 trillion in 1918 and 1919. In 2002, outbreak of SARS emerged in China and spread to the remaining Asian countries. According to World Health Organization statistics, 900 people died and the cost of SARS to the global economy was US \$ 54 billion according to the World Bank. Ebola outbreak occurred in Africa in the 2013-2016 period, resulting in 11,300 human deaths and the US \$ 53 billion loss from the economy in West Africa (Fernandez, 2020).

COVID-19 originated in China in December 2019. As COVID-19 started to spread in many countries after China, the World Health Organization declared COVID-19 is a global pandemic on March 11, 2020. Like many epidemics that the world has experienced before, it not only leads to the death of countless people, but also causes great losses in the national economies. Fernandez (2020) states that in March 2020, many indices in the world have registered their biggest one-day falls on record. The worst performing stock markets of Brazil, Colombia, Greece, Norway, Austria, Argentina, South Africa, Russia, Thailand, Belgium, and Poland are -48%, -47%, -44%, -42%, -41%, -40%, -40%, -40%, -39%, -39% and -38% respectively. It is stated that there is no sector which hasn't been affected by the COVID-19 outbreak. Oil, gas, and coal firms have the highest negative returns with -50%. The negative returns of Travel & Leisure, Aerospace & Defense, Mining & Metals, Life Insurance, Banks, Household goods, Autos & Parts, Personal Goods and Media firms are -40%, -40%, -38%, -36%, -35%, -34%, -32%, -32%, -32% respectively. The VIX index which is referred to as the fear index has risen significantly in the aftermath of the 2008 global financial crisis. However, there are studies in the literature suggesting that despite the present COVID-19, financial markets in China still remain strong and stable relatively (Xinhua, 2020).

COVID-19 is a particular disease that affects many major economies of the world adversely. Because the governments have to keep workers away from work and customers from consumption. The households who don't get their salaries feel financially distressed and slow their spending so the manufacturers have suspended production to observe the new purchasing behavior of consumers and firms. The reductions in cash flows bring about business bankruptcies (Baldvin and Mauro, 2020:2). In addition to these cold facts, the course of COVID-19 brings along a huge uncertainty. Like manufacturers and consumers, the investors also slow their activities. The quite low rate of foreign investment in BIST is seen in the first quarter of 2020. This period involves COVID-19 outbreak. The motivation of this study emerges from this point of view. It is expected that all sectors in BIST have been affected positively or negatively by COVID-19. But it is not known whether all sectors affected negatively or not. Additionally which sector affected the most is another question. This study examines the impact of COVID-19 on sector index returns in BIST.

Literature

There are many studies examining the effects of outbreaks on national economies. (Hai, Zhao and Wang, 2004; Overby, Rayburn and Hammond, 2004; Pine and McKercher, 2004; Siu and Wong, 2004). Most of these studies emphasize that epidemic diseases affect the tourism sector negatively, primarily and worst. This is due to the decrease in flights and occupancies, making it difficult for companies to manage their costs. Additionally, it is stated that the short-term negative impact in the stock markets also arises due to the negative shock in demand in this sector. The decrease in demand is the result from that international activities become more

risky and difficult. Besides the effects of outbreaks on the economy, more specifically, the effect on stock returns has been investigated in many countries.

In the literature, studies investigating the effect of outbreaks of SARS on financial markets and stock returns are in the majority. In one of these studies, Nippani and Washer (2004) examine the impact of SARS on stock markets of some selected countries for the period of 1 June 2002- 25 February 2003. The leading stock indices of Canada, China, Hong Kong, Singapore, Vietnam, Thailand, and Philippines during the SARS outbreak are compared with the period before the SARS burst. Additionally they compare the stock indices of mentioned countries during the SARS outbreak with S&P 1200 Global Index by using conventional t-test and Mann-Whitney U test. They compare the daily returns for the pre-event window, short-event window, and long-event window with non-SARS period returns. According to the results, only two countries, China and Vietnam, are impacted by SARS. China's Shanghai Composite Index doesn't underperform, while Vietnam's VSE index performs negatively compared to S&P 1200 global average. Contrary to Nippani and Washer (2004), Chen, Jang and Kim (2007) focus on one country rather than addressing many countries. They examine the impact of the SARS outbreak in 2003 on the Taiwan tourism industry. They state that the epidemic affects almost all sectors negatively, but it affects the tourism sector the most. Their event study results show that the stocks of the tourism sector experience a 29% decrease within one month after the outbreak.

In another study, Chen, Chen, Tang, and Huang (2009) investigate whether the SARS outbreak has a positive or negative impact on the airline, tourism, department store, and biotech industries listed on Taiwan Stock Exchange and over the counter market throughout 2003. In the study, daily stock closing prices and Taiwan Stock Exchange Capitalization Weighted Stock Index values are used for the 20 days before and after the May 22, 2003 (SARS outbreak date). While previous studies found that the SARS outbreak has a negative impact on Asian and even global markets, this study, conversely, has shown that the SARS outbreak has a positive effect in certain sectors in Taiwan by adding a GARCH process to the event study method used in many studies. According to the findings they obtained, it revealed that the hospitality industry is the most sensitive sector to the SARS outbreak and the return of stocks of Taiwan biotech companies is positive after the announcement of the SARS outbreak.

Ali, Nassir, Hassan, and Abidin (2010) analyze the effects of some dramatic events occurring in the world between 1987 and 2006 on stock returns in the Malaysia Stock Exchange. These dramatic events are the following: The Gulf Crisis, the September 11th, SARS outbreak, Invasion of Iraq, and 2004 Asian Tsunami. In their study, only the SARS outbreak provides significant results. According to the event study results, there is a stock overreaction behavior during the SARS outbreak. Wang, Yang and Chen (2013) investigate four infectious diseases' impact on the performance of biotechnology stocks in the past ten years in Taiwan. Enterovirus 71, Dengue Fever, SARS, and H1N1 are contagious diseases. According to the results, there are significantly positive CAR before day 2, while there are significantly negative CAR after day 12. The authors comment that investors think that the epidemic will have an effect in favor of biotechnology companies when the disease first appear, but with the spread of the epidemic, their share performances will be worsened. When they narrow the window of analysis, they find a significantly negative CAR within 2 weeks of the announcement date. Chen, Lee, Lin, and Chen (2018) investigate the impact of the outbreak on the long-term relationship between the Chinese stock market and four Asian exchanges (Hong Kong, Taiwan, Singapore, Japan) in the 1998-2008 period, covering the 5 years before and after the SARS outbreak occurs. The stock market of the country, which is the source of the epidemic, and the stock markets of the countries less affected by the epidemic and highly infected are discussed. According to the findings, the SARS epidemic reduces the integration between the stock markets of the five

Asian countries. This shows that it is easier for investors to earn via portfolio diversification in the SARS epidemic situation compared to a financial crisis. Ichev and Marinc (2018) examine the impact of announcements made by the World Health Organization and mass-media news on the Ebola outbreak in the 2014-2016 period, considering the geographic proximity of information. They find that the Ebola outbreak mostly affects the stock returns of companies operating in West African Countries and the U.S. Conclusively, they confirm that the geographic proximity of the information to the financial markets increases the importance of the Ebola outbreak event and its impact on companies' returns.

Many studies examine the impact of the Covid -19 on the countries' economies. In one of these studies, Sansa (2020) analyzes the effect of COVID-19 on financial markets in the period from March 1, 2020 to March 25, 2020 for China and the USA. Confirmed cases constitute an independent variable while Shanghai Stock Exchange and Dow Johns are dependent variables of his simple regression. The findings reveal that there is a significantly positive relationship between confirmed cases of COVID-19 and financial markets. Zeren and Hızarcı (2020) choose China, South Korea, France, Italy, Germany, and Spain, which are the countries where COVID-19 is seen most intensively, to be examined. In these countries, they examine the cointegration relationship between stock market indices and the number of the COVID-19 daily total cases and deaths. Structural break unit root tests that they use have shown that the structural break in the stock market indices in the countries under consideration is in March. According to the cointegration analysis findings, they state that there is a long-term significant relationship between COVID-19 daily total case and China and South Korea and Spain stock market indices, but the mentioned relationship is not valid for Italy, France, and Germany stock indices. Like Zeren and Hızarcı (2020), Gunay (2020) also examines cointegration between financial markets and COVID-19. In his study, it is aimed to primarily examine the impact of COVID-19 on stock volatility and correlations between stock market indices of the United States, Italy, Spain, China, the United Kingdom, and Turkey. The data from January 3, 2005 to April 3, 2020 are divided into four subintervals. Modified ICSS, dynamic conditional correlation multivariate GARCH, and DCC-MVFIGARCH models are employed. And, it is concluded that all stock markets have structural breaks in the inspected period. But China and Turkish stock markets don't exhibit structural breaks caused by the COVID-19. Additionally, the highest increase in co-movement is observed between Chinese and Turkish stock markets. Alber (2020) tries to address whether coronavirus cases, coronavirus deaths, new coronavirus cases, and novel coronavirus deaths affect stock returns or not. Six countries (China, France, Germany, Italy, Spain, USA) that have the highest number of cumulative cases are used for the period from March 1, 2020 till April 10, 2020. According to the results, it is concluded that stock market returns are sensitive to coronavirus cases more than deaths and sensitive to cumulative coronavirus cases more than new cases. The negative effect of coronavirus on stock market return is confirmed for only China, France, Germany, and Spain. Yan (2020), examines how COVID-19 affects Chinese stock markets in a window of fifth days in the period from January 20, 2020 till April 7, 2020. The results show that the coronavirus leads the stock prices to fall sharply. However stock returns reverse in every ten trading days based on the firm size. Besides, one of the important research questions -the effect of COVID-19 outbreak on the global economy- is examined by Şenol and Zeren (2020). They use case and death numbers as the indicator of pandemics and Morgan Stanley Capital International (MSCI) Indices of World, European, Emerging Markets, and G7 as independent variables. The data range from 21 January 2020 to 07 April 2020. According to Fourier Cointegration test results, it is concluded that there is a long-run relationship between stock markets and COVID-19.

Data and Methodology

This study aims to analyze the impact of the COVID-19 outbreak on Borsa Istanbul sector index returns. For this purpose, a total of 26 sector indices are included in the study. These sector indices are shown in Table 1.

Table 1: Sector Indexes

	Indices	Number of Firms Included		Indices	Number of Firms Included
1	Industrials	168	14	Information Technology	18
2	Financials	104	15	Wood Paper Printing	15
3	Services	66	16	Banks	14
4	Holding & Investments	39	17	Construction	9
5	Real Estate Invest Trusts	33	18	Tourism	9
6	Metal Products Machinery	30	19	Electricity	8
7	Chem Petrol Plastic	28	20	Investment Trusts	9
8	Non-Metal Min. Product	26	21	Transportation	8
9	Food Beverage	22	22	Brokerage Houses	5
10	Textile Leather	20	23	Insurance	6
11	Basic Metal	20	24	Leasing Factoring	7
12	Technology	19	25	Sports	4
13	Wholesale & Retail Trade	17	26	Mining	4

Resource:kap.gov.tr

The data of the study consist of daily closing prices of the shares of the companies in 26 indices from January 2, 2019, to April 9, 2020. BIST100 index is chosen as the benchmark index. The data used for the analyzes are obtained from yahoo finance (www.finance.yahoo.com).

“Event Study” method is used to analyze the data. Event study is an appropriate method to test the effects of an economic, political, or social event on stock prices with different performance measures (Basdas and Oran, 2014).

The efficient market hypothesis is the basis of the event study method. The efficient market hypothesis states that investors in the markets are simultaneously informed of price changes and cannot achieve abnormal returns. Efficient markets are analyzed in three different forms in terms of obtaining information and cost. Weak form efficiency postulates that market prices reflect all information about past prices. In such markets, investors cannot access new information simultaneously. Besides, some undisclosed information is already known to certain market participants. Semi-strong form efficiency is defined as the situation where market prices reflect all publicly disclosed information. Investors named as insider learners in this type of market are primarily informed. Therefore, some market participants who obtain insider information can earn a profit over the average market return by using this information that is not known to the public. Strong form efficiency postulates that prices reflect all the information that can be used to determine the true value. In this case, prices include not only publicly disclosed information, but also all information related to macro and microeconomics. Besides, insider information reaches all investors simultaneously. In such a market, no investor can predict stock prices more accurately than the other. Therefore, it is not possible to obtain excessive returns by conducting technical and fundamental analysis in markets with such efficiency (Malkiel and Fama, 1970).

A standard event study method consists of 7 steps (Basdas and Oran, 2014). These steps are, respectively, defining the event, determining selection criteria, calculating normal and abnormal returns, choosing the prediction procedure, testing procedure, experimental results, and interpretation of the results.

In the study, the date of the event is considered on March 11, 2020. Because, World Health Organization declared the COVID-19 outbreak as a pandemic on that date and the Ministry of Health in Turkey announced the first case for Turkey on that date.

In the event study, the prediction window is determined as $t = -250$ and $t = -20$, considering the studies in the literature (Cheung, 2011; Consolandi et al., 2009; Curran and Moran, 2007). The length of the event windows are determined as $(-20 \dots +20)$, $(-10 \dots +10)$, $(-5 \dots +5)$, $(-2 \dots +2)$, $(-1 \dots +1)$, $(0 \dots 0)$, $(0 \dots +10)$, $(0 \dots +20)$ in line with the studies in the literature. The forecast window, event window, and event day are shown in Figure 1.

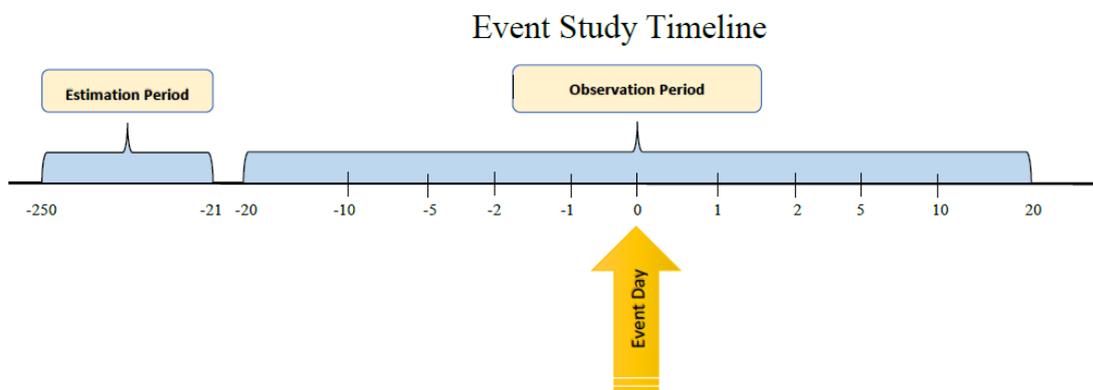


Figure 1: Event Study Timeline

There are many alternative models in the implementation of the event study. One of the most preferred of these models is the market model. (Agrawal and Kamakura, 1995; Cheung, 2011; Curran and Moran, 2007).

In this study, the market model is taken into account in calculating returns.

$$R_{i,t} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

$R_{i,t}$ = Daily return of the stock

R_{mt} = Returns of the market portfolio in period t

ε_{it} = Error term

Expected returns for stock i are calculated as follows.:

$$E(R_{i,t}) = \alpha + \beta(R_{m,t}) \quad (2)$$

$E(R_{i,t})$ = Expected return of i stock on day t

α = The point where the regression line crosses the y-axis

β = The slope of the regression line

$R_{m,t}$ = Returns of the market portfolio in period t

Accordingly, abnormal return is calculated as follows;

$$AR_{i,t} = R_{i,t} - \alpha - (\beta(R_{m,t})) \quad (3)$$

$AR_{i,t}$ = Abnormal return of the stock i on day t

$R_{i,t}$ = Daily return of i stock on day t

$R_{m,t}$ = Returns of the market portfolio in period t

α and β coefficients in the model are obtained via an ordinary least squares OLS regression analysis.

$$E(\varepsilon_i) = 0 \quad Var(\varepsilon_i) = \sigma_\varepsilon^2 \quad (4)$$

Average abnormal returns for each day in the event window period are calculated as follows:

$$AAR_t = \frac{1}{n} \sum_{i=1}^n AR_{it} \quad (5)$$

AAR_t : Average abnormal return for all companies in time t

AR_{it} : Abnormal return of the stock i on day t

n : Number of firms on t day

Cumulative average abnormal returns (CAAR) for the event window period are calculated as follows;

$$CAAR_{(\tau_1, \tau_2)} = \frac{1}{n} \sum_{i=1}^n CAAR_{(\tau_1, \tau_2)} \quad (6)$$

Daily returns of stocks are calculated as follows;

$$R_{i,t} = \left[\frac{(P_{i,t} - P_{i,t-1})}{P_{i,t-1}} \right] \times 100 \quad (7)$$

$R_{i,t}$: Daily return of i stock on day t

$P_{i,t}$: Closing price of the share i on t day

$P_{i,t-1}$: Closing price of the share i on t-1 day

BIST 100 index for Turkey is taken into account in the calculation of market returns.

$$R_{m,t} = \left[\frac{(E_{m,t} - E_{m,t-1})}{E_{m,t-1}} \right] \times 100 \quad (8)$$

$R_{m,t}$ = Returns of (BIST100) index on t day

$E_{m,t}$ = Closing value of the index on day t

$E_{m,t-1}$ = Closing value of the index on day t-1

Results

At this stage of the study, the impact of the COVID-19 outbreak on index returns of Borsa Istanbul sectors was examined for observation periods determined by the day of the event. This effect was demonstrated using cumulative average abnormal returns (CAAR). CAAR values around the event dates used in the study are calculated separately for each index in the periods of (-20...+20), (-10...+10), (-5...+5), (-2...+2), (-1...+1), (0...0), (0...+10), (0...+20). Analysis results also include tests developed by Event Study Metrics (ESM).

Table 2: Statistical Tests and Assumptions

Statistical Tests	Assumptions
t-Test	<ul style="list-style-type: none"> - Abnormal returns have a normal distribution. - There is no correlation between abnormal returns calculated according to two different events. - The variance of abnormal returns is fixed on the day of the event and other days.
Patell Z	This test is developed by Patell (1976) on the assumption that homogeneous dispersion of abnormal returns will not always be achieved.
Boehmer et al.	This test, developed by Boehmer et al. (1991), is a test to eliminate the problem that the variance of the abnormal returns expressed as “event induced variance” is not constant.
Corrado Rank Test	This test is a non-parametric test developed by Corrado (1989) and does not require an assumption for the distribution of abnormal returns.
Generalized Sign Test	The sign test is a test based on the ratio of positive cumulative abnormal returns in the event window. The major disadvantage of this test is that it does not take into account the magnitude of the abnormal returns.

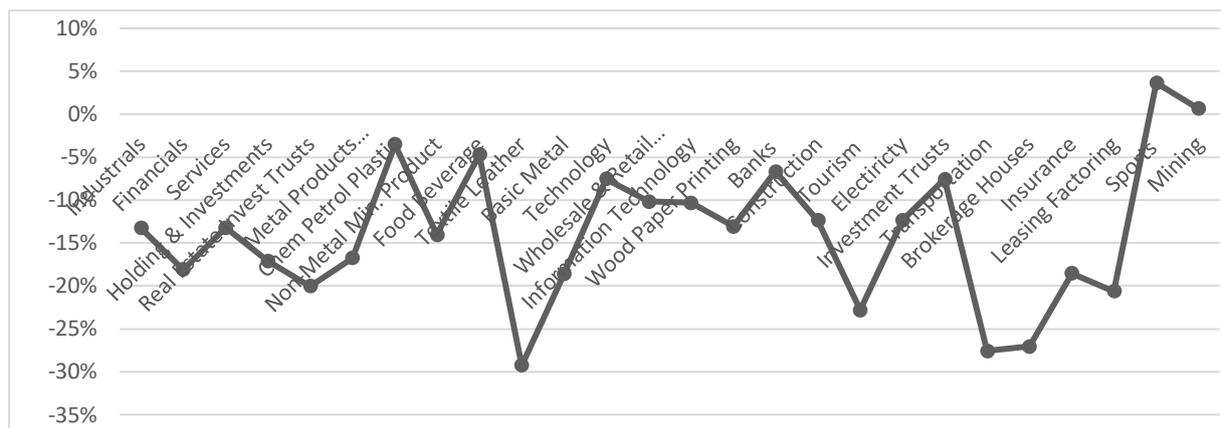
Resource: Babacan and Gökhan (2013)

Table 3: CAAR (-20...20)

Indices	CAAR	pos:neg	t-test time-series	t-test cross-sectional	patell z	boehmer et al.	corrado rank	sign test
Industrials	-0.1327	30:138	94.370 (0.0000)* **	-94.030 (0.0000)* **	-98.411 (0.0000)* **	-93.356 (0.0000)* **	-17.392 (0.0820)* *	-65.655 (0.0000)* **
Financials	-0.1811	17:87	-88.448 (0.0000)* **	-89.234 (0.0000)* **	-94.657 (0.0000)* **	-82.377 (0.0000)* **	-18.921 (0.0000)* **	-54.757 (0.0000)* **
Services	-0.1323	17:49	-55.602 (0.0000)* **	-51.228 (0.0000)* **	-53.319 (0.0000)* **	-42.169 (0.0000)* **	-12.743 (0.2025)	-29.535 (0.0031) ***
Holding & Investments	-0.1711	8:31	-52.257 (0.0000)* **	-52.197 (0.0000)* **	-53.610 (0.0000)* **	-41.924 (0.0000)* **	-21.130 (0.0346)* *	-29.591 (0.0031)* **
Real Estate Invest Trusts	-0.2004	3:30	-58.439 (0.0000)* **	-65.500 (0.0000)* **	-58.947 (0.0000)* **	-66.531 (0.0000)* **	-10.456 (0.2958)	-39.419 (0.0001)* **
Metal Products Machinery	-0.1674	2:28	-51.698 (0.0000)* **	-84.723 (0.0000)* **	-54.700 (0.0000)* **	-81.824 (0.0000)* **	-19.574 (0.0503)* *	-39.767 (0.0001)* **
Chem. Petrol Plastic	-0.0352	10:18	-12.403 (0.2149)	-0.7222 (0.4701)	-12.968 (0.1947)	-0.8344 (0.404)	-10.301 (0.303)	-0.7881 (0.4306)
Non-Metal Min. Product	-0.1403	3:23	-41.648 (0.0000)* **	-59.825 (0.0000)* **	-46.265 (0.0000)* **	-59.421 (0.0000)* **	-12.155 (0.2242)	-31.212 (0.0018)* **
Food Beverage	-0.047	7:15	-12.328 (0.2176)	-11.919 (0.2333)	-11.198 (0.2628)	-10.499 (0.2938)	-11.394 (0.2545)	-11.721 (0.2412)

Textile Leather	- 0.292 7	1:19	-65.347 (0.0000)* **	-73.462 (0.0000)* **	-67.872 (0.0000)* **	-65.874 (0.0000)* **	-18.881 (0.0000)* **	-34.064 (0.0018)* **
Basic Metal	- 0.185 9	0:19	-43.101 (0.0000)* **	-78.327 (0.0000)* **	-47.975 (0.0000)* **	-87.465 (0.0000)* **	-17.934 (0.0729)*	-37.068 (0.0002)* **
Technology	- 0.075 5	4:15	-14.585 (0.1447)	-15.037 (0.1327)	-0.7884 (0.4305)	-0.6056 (0.5448)	-0.4876 (0.6259)	-13.266 (0.1846)
Wholesale & Retail Trade	- 0.101 7	6:11	-22.205 (0.0264)* *	-22.309 (0.0257)* *	-17.001 (0.0891)*	-13.326 (0.1827)	-16.661 (0.0957)*	-0.5807 (0.5615)
Information Technology	- 0.103 1	3:15	-18.795 (0.0602)* *	-22.966 (0.0216)* *	-16.939 (0.0903)*	-18.635 (0.0624)*	-0.769 (0.4419)	-16.758 (0.0938)*
Wood Paper Printing	- 0.130 9	3:12	-23.378 (0.0194)* *	-34.741 (0.0005)* **	-23.670 (0.0179)* *	-34.365 (0.0006)* **	-14.885 (0.1366)	-17.855 (0.0742)*
Banks	- 0.066 8	3:11	-12.483 (0.2119)	-21.159 (0.0343)* *	-16.704 (0.0948)*	-21.232 (0.0337)* *	-12.683 (0.2047)	-13.033 (0.1925)
Constructio n	- 0.123 6	2:07	-20.529 (0.0401)* *	-22.184 (0.0265)* *	-19.562 (0.0504)* *	-25.802 (0.0099)* **	-0.9178 (0.3587)	-13.694 (0.1709)
Tourism	- 0.228 3	1:08	-33.726 (0.0007)* **	-30.140 (0.0026)* **	-33.370 (0.0008)* **	-34.096 (0.0007)* **	-11.996 (0.2303)	-18.712 (0.0613)*
Electricity	- 0.123 3	2:06	-17.052 (0.0882)*	-28.073 (0.005)* *	-19.810 (0.0476)* *	-24.428 (0.0146)* **	-0.524 (0.6003)	-12.654 (0.2057)
Investment Trusts	- 0.075 7	3:06	-0.9753 (0.3294)	-0.4955 (0.6202)	-0.6441 (0.5195)	-0.3776 (0.7057)	-0.3252 (0.745)	-0.4885 (0.6252)
Transportati on	- 0.275 7	0:08	-41.440 (0.0000)* **	-37.680 (0.0002)* **	-46.672 (0.0000)* **	-28.317 (0.0046)* **	-19.755 (0.0482)* *	-24.263 (0.0153)* *
Brokerage Houses	- 0.270 5	1:04	-22.993 (0.0215)* *	-15.039 (0.1326)	-21.474 (0.0318)* *	-12.130 (0.2251)	-13.622 (0.1731)	-0.9602 (0.3369)
Insurance	- 0.185 6	0:06	-31.306 (0.0017)* **	-31.614 (0.0016)* **	-46.522 (0.0000)* **	-28.090 (0.005)* **	-15.161 (0.1295)	-21.231 (0.0337)* *
Leasing Factoring	- 0.206 1	2:05	-22.009 (0.0277)* *	-20.791 (0.0376)* *	-20.272 (0.0426)* *	-21.127 (0.0346)* *	-0.9174 (0.3589)	-0.7065 (0.4799)
Sports	0.036 4	3:01	0.3323 (0.7396)	0.1982 (0.8429)	0.26 (0.7948)	0.1442 (0.8853)	-0.1367 (0.8913)	13.490 (0.1773)
Mining	0.006 3	3:01	0.0803 (0.936)	0.1386 (0.8898)	0.0189 (0.9849)	0.0295 (0.9765)	-0.3704 (0.7111)	10.969 (0.2727)

*, **, *** shows statistical significance at the level of 10%, 5% and 1 respectively.



Graph1: CAAR (-20...20)

In Table 3 and Graph 1, the highest loss in CAAR 20 days before and after the event day (11/03/2020) is seen in the Textile Leather index as approximately 30% negative return. It is seen that the abnormal returns of 19 of the 20 companies in the Textile Leather index are negative. This is followed by Transportation (-27.5%), Brokerage Houses (-27%) and Tourism (-22%) indices respectively.

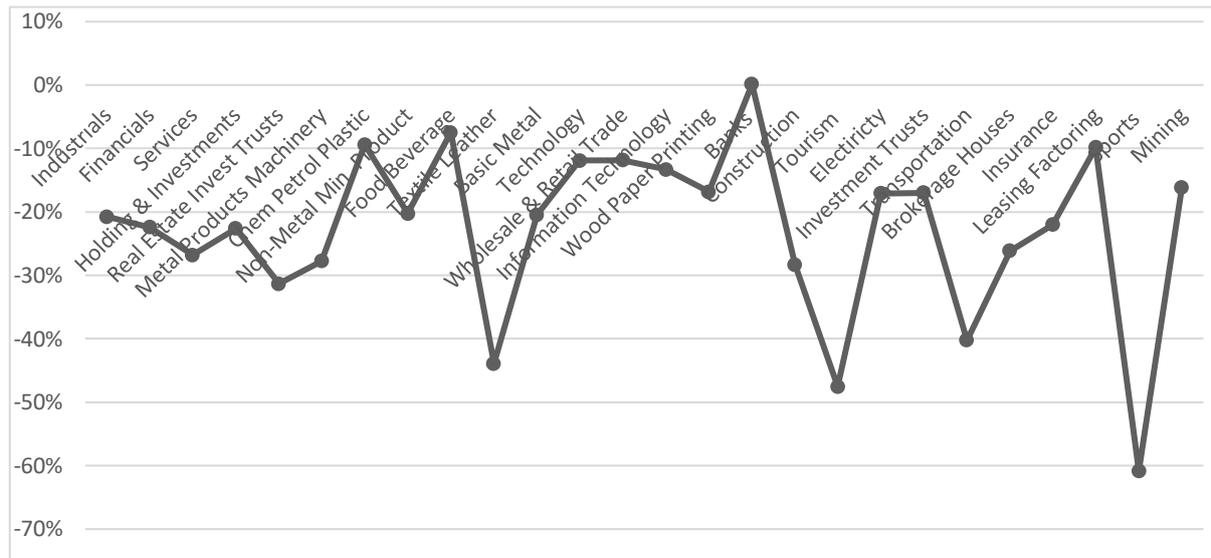
There are two industry indices: Sports and Mining, which have a positive return in terms of CAAR 20 days before and after the event day (11/03/2020). However, the values of these two sectors are not statistically significant.

Table 4: CAAR (-10...10)

	CAAR	pos: neg	t-test time-series	t-test cross-sectional	patell z	boehmer et al.	corrado rank	sign test
Industrials	-0.2076	24:144	-206,325 (0.0000)* **	-121,993 (0.0000)* **	-215,605 (0.0000)* **	-123,056 (0.0000)* **	-35,577 (0.0004)* **	-75,007 (0.0000)* **
Financials	-0.2241	18:86	-152.958 (0.0000)* **	-109.626 (0.0000)* **	-158.613 (0.0000)* **	-90.381 (0.0000)* **	-33.958 (0.0007)* **	-52.768 (0.0000)* **
Services	-0.2679	12:54	-15.7266 (0.0000)* **	-7.9053 (0.0000)* **	-14.9094 (0.0000)* **	-6.3654 (0.0000)* **	-3.7276 (0.0002)* **	-4.194 (0.0000) ***
Holding & Investments	-0.2261	7:32	-9.6465 (0.0000)* **	-6.3592 (0.0000)* **	-9.6491 (0.0000)* **	-5.0499 (0.0000)* **	-3.8226 (0.0001)* **	-3.2817 (0.001)* *
Real Estate Invest Trusts	-0.3132	1:32	-12.7617 (0.0000)* **	-11.0664 (0.0000)* **	-13.1421 (0.0000)* **	-10.54 (0.0000)* **	-3.2852 (0.001)** *	-4.645 (0.0000)* **
Metal Products Machinery	-0.2776	1:29	-11.9802 (0.0000)* **	-10.7259 (0.0000)* **	-12.8737 (0.0000)* **	-10.8558 (0.0000)* **	-4.1896 (0.0000)* **	-4.346 (0.0000)* **
Chem. Petrol Plastic	-0.0937	7:21	-4.6177 (0.0000)* **	-1.7026 (0.0886)* *	-5.0986 (0.0000)* **	-2.0685 (0.0386)* *	-2.5753 (0.01)** **	-1.933 (0.0532)* *
Non-Metal Min. Product	-0.2023	4:22	-8.3865 (0.0000)* **	-6.3124 (0.0000)* **	-9.3592 (0.0000)* **	-6.5951 (0.0000)* **	-2.72 (0.0065)* **	-2.7235 (0.0065)* **
Food Beverage	-0.0747	7:15	-2.7379 (0.0062)* **	-1.9565 (0.0504)* *	-2.2734 (0.023)** **	-1.5513 (0.1208) *	-1.5974 (0.1102) *	-1.1721 (0.2412) *

Textile Leather	- 0.439 3	0:20	-13.705 (0.0000)* **	-12.0694 (0.0000)* **	-14.4852 (0.0000)* **	-10.6258 (0.0000)* **	-4.5664 (0.0000)* **	-3.8585(0.0001)** *
Basic Metal	- 0.204 3	2:17	-6.6184 (0.0000)* **	-5.8083 (0.0000)* **	-6.8665 (0.0000)* **	-5.6621 (0.0000)* **	-2.2861 (0.0222)* *	-2.7771 (0.0055)* **
Technology	- 0.119 1	5:14	-3.2147 (0.0013)* **	-2.8171 (0.0048)* **	-2.695 (0.007)** *	-2.4264 (0.0152)* *	-1.1031 (0.27)	-0.8189 (0.4128)
Wholesale & Retail Trade	- 0.118 3	6:11	-3.6095 (0.0003)* **	-1.6099 (0.1074)*	-2.4466 (0.0144)* **	-0.8682 (0.3853)	-2.1968 (0.028)**	-0.5807 (0.5615)
Information Technology	- 0.133 2	4:14	-3.3945 (0.0007)* **	-3.1264 (0.0018)* **	-3.1121 (0.0019)* **	-3.0621 (0.0022)* **	-1.2744 (0.2025)	-1.1514 (0.2496)
Wood Paper Printing	- 0.168 1	3:12	-4.1948 (0.0000)* **	-2.5487 (0.0108)* **	-4.1977 (0.0000)* **	-2.6913 (0.0071)* **	-2.4157 (0.0157)* *	-1.7855 (0.0742)*
Banks	0.001 3	6:08	0.0349 (0.9721)	0.0368 (0.9707)	0.9297 (0.3525)	0.8366 (0.4028)	0.4018 (0.6879)	0.4429 (0.6579)
Constructio n	- 0.283 4	1:08	-6.5761 (0.0000)* **	-4.2096 (0.0000)* **	-6.4237 (0.0000)* **	-4.6564 (0.0000)* **	-3.6365 (0.0003)* **	-2.0395 (0.0414)* *
Tourism	- 0.475 4	0:09	-9.8122 (0.0000)* **	-12.2854 (0.0000)* **	-9.9123 (0.0000)* **	-11.4603 (0.0000)* **	-4.4221 (0.0000)* **	-2.5468 (0.0109)* **
Electricity	- 0.171	2:06	-3.3044 (0.001)** *	-2.2481 (0.0246)* *	-3.4809 (0.0005)* **	-2.0594 (0.0395)* *	-1.8569 (0.0633)*	-1.2654 (0.2057)
Investment Trusts	-0.17	1:08	-3.0601 (0.0022)* **	-1.2546 (0.2096)	-3.3522 (0.0008)* **	-1.4899 (0.1362)	-1.7374 (0.0823)*	-1.8423 (0.0654)*
Transportati on	- 0.402 2	0:08	-8.4463 (0.0000)* **	-4.5682 (0.0000)* **	-9.6556 (0.0000)* **	-3.5307 (0.0004)* **	-4.1957 (0.0000)* **	-2.4263 (0.0153)* *
Brokerage Houses	- 0.261 3	1:04	-3.1028 (0.0019)* **	-2.6706 (0.0076)* **	-3.5929 (0.0003)* **	-2.0303 (0.0423)* *	-2.0597 (0.0394)* *	-0.9602 (0.3369)
Insurance	- 0.220 3	1:05	-5.1933 (0.0000)* **	-3.1266 (0.0018)* **	-5.8808 (0.0000)* **	-2.5568 (0.0106)* **	-2.1893 (0.0286)* *	-1.2983 (0.1942)
Leasing Factoring	- 0.098 4	2:05	-1.4682 (0.142)	-2.2651 (0.0235)* *	-1.4894 (0.1364)	-1.7029 (0.0886)*	-0.5539 (0.5797)	-0.7065 (0.4799)
Sports	- 0.608 2	0:04	-7.7646 (0.0000)* **	-4.4196 (0.0000)* **	-7.7655 (0.0000)* **	-4.1619 (0.0000)* **	-2.9731 (0.0029)* **	-1.6928 (0.0905)*
Mining	- 0.161	0:04	-2.8606 (0.0042)* **	-7.4797 (0.0000)* **	-2.8325 (0.0046)* **	-5.8404 (0.0000)* **	-1.8204 (0.0687)*	-1.9065 (0.0566)* *

*, **, *** shows statistical significance at the level of 10%, 5% and 1 respectively.



Graph 2: CAAR (-10...10)

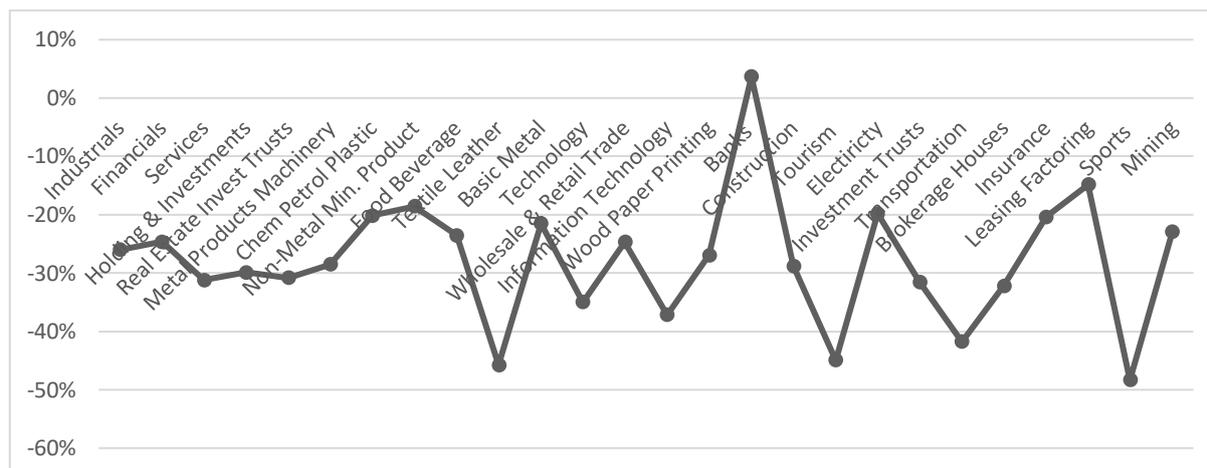
In Table 4 and Graph 2, the highest loss in CAAR 10 days before and after the event day (11/03/2020) is seen in the Sports index as approximately 60% negative return. The abnormal returns of all 4 companies in the Sports index are negative. This is followed by the Tourism (-47.5%), Textile Leather (-43%) and Transportation (-40%) indices respectively.

Table 5: CAAR (-5...5)

Indices	CAAR	pos:neg	t-test time-series	t-test cross-sectional	patell z	boehmer et al.	corrado rank	sign test
Industrials	-0.2601	7:161	-357,097 (0.0000)* **	-185,384 (0.0000)* **	-370,289 (0.0000)* **	-195,978 (0.0000)* **	-61,148 (0.0000)** *	-101,505 (0.0000)* **
Financials	-0.2463	10:94	-232.288 (0.0000)* **	-122.582 (0.0000)* **	-236.794 (0.0000)* **	-105.953 (0.0000)* **	-53.087 (0.0000)** *	-70.668 (0.0000)* **
Services	-0.312	4:62	-25.3058 (0.0000)* **	-11.5823 (0.0000)* **	-25.0167 (0.0000)* **	-9.9682 (0.0000)* **	-5.8944 (0.0000)** *	-6.1788 (0.0000)* **
Holding & Investments	-0.2988	1:38	-17.617 (0.0000)* **	-9.8957 (0.0000)* **	-18.0579 (0.0000)* **	-9.7201 (0.0000)* **	-6.4594 (0.0000)** *	-5.217 (0.0000)* **
Real Estate Invest Trusts	-0.3085	0:33	-17.371 (0.0000)* **	-10.6613 (0.0000)* **	-17.8607 (0.0000)* **	-10.977 (0.0000)* **	-4.7797 (0.0000)** *	-4.9966 (0.0000)* **
Metal Products Machinery	-0.285	0:30	-16.9979 (0.0000)* **	-12.504 (0.0000)* **	-17.8773 (0.0000)* **	-12.974 (0.0000)* **	-5.9984 (0.0000)** *	-4.7152 (0.0000)* **
Chem. Petrol Plastic	-0.2016	1:27	-13.7316 (0.0000)* **	-5.096 (0.0000)* **	-14.2134 (0.0000)* **	-5.9316 (0.0000)* **	-5.4446 (0.0000)** *	-4.2228 (0.0000)* **
Non-Metal Min. Product	-0.1856	3:23	-10.6327 (0.0000)* **	-5.6264 (0.0000)* **	-11.8476 (0.0000)* **	-5.7621 (0.0000)* **	-3.6307 (0.0003)** *	-3.1212 (0.0018)* **
Food Beverage	-0.2355	1:21	-11.9232 (0.0000)* **	-7.4965 (0.0000)* **	-11.4452 (0.0000)* **	-8.2306 (0.0000)* **	-5.1407 (0.0000)** *	-3.7477 (0.0002)* **

Textile Leather	- 0.457 7	0:20	-19.7271 (0.0000)* **	-10.99 (0.0000)* **	-20.4081 (0.0000)* **	-10.5444 (0.0000)* **	-6.7901 (0.0000)** *	-3.8585 (0.0001)* **
Basic Metal	- 0.215 3	1:18	-9.6376 (0.0000)* **	-5.9583 (0.0000)* **	-9.8699 (0.0000)* **	-6.1736 (0.0000)* **	-3.6802 (0.0002)** *	-3.242 (0.0012)* **
Technology	- 0.349 9	0:19	-13.0464 (0.0000)* **	-7.6069 (0.0000)* **	-12.8236 (0.0000)* **	-8.4164 (0.0000)* **	-4.4869 (0.0000)** *	-3.3574 (0.0008)* **
Wholesale & Retail Trade	- 0.246 9	2:15	-10.4052 (0.0000)* **	-4.4634 (0.0000)* **	-9.6414 (0.0000)* **	-3.559 (0.0004)* **	-4.8161 (0.0000)** *	-2.5447 (0.0109)* **
Information Technology	- 0.371 7	0:18	-13.0873 (0.0000)* **	-8.5939 (0.0000)* **	-13.1318 (0.0000)* **	-9.5209 (0.0000)* **	-4.5874 (0.0000)** *	-3.2489 (0.0012)* **
Wood Paper Printing	- 0.269 4	1:14	-9.2895 (0.0000)* **	-5.5568 (0.0000)* **	-9.5938 (0.0000)* **	-6.1389 (0.0000)* **	-5.0925 (0.0000)** *	-2.8292 (0.0047)* **
Banks	0.036 4	7:07	13.13 (0.1892)	10.45 (0.296)	43.606 (0.0000)* **	21.751 (0.0296)* *	13.867 (0.1655)	10.2 (0.3054)
Constructio n	- 0.288 2	0:09	-9.2394 (0.0000)* **	-4.005 (0.0001)* **	-8.7454 (0.0000)* **	-4.894 (0.0000)* **	-4.9903 (0.0000)** *	-2.7096 (0.0067)* **
Tourism	- 0.449 3	0:09	-12.8141 (0.0000)* **	-9.0541 (0.0000)* **	-12.8829 (0.0000)* **	-9.3735 (0.0000)* **	-5.5034 (0.0000)** *	-2.5468 (0.0109)* **
Electricity	- 0.198 4	2:06	-5.2992 (0.0000)* **	-2.6943 (0.0071)* **	-5.7266 (0.0000)* **	-2.5921 (0.0095)* **	-3.0351 (0.0024)** *	-1.2654 (0.2057)
Investment Trusts	- 0.315 1	1:08	-7.8359 (0.0000)* **	-4.6719 (0.0000)* **	-7.3025 (0.0000)* **	-3.6879 (0.0002)* **	-3.6974 (0.0002)** *	-1.8423 (0.0654)* **
Transportati on	- 0.417 8	0:08	-12.1229 (0.0000)* **	-4.9159 (0.0000)* **	-13.9108 (0.0000)* **	-3.5351 (0.0004)* **	-6.4139 (0.0000)** *	-2.4263 (0.0153)* *
Brokerage Houses	- 0.321 7	0:05	-5.2779 (0.0000)* **	-2.9791 (0.0029)* **	-5.7572 (0.0000)* **	-3.3436 (0.0008)* **	-3.5435 (0.0004)** **	-1.8691 (0.0616)* **
Insurance	- 0.203 7	0:06	-6.6341 (0.0000)* **	-4.9128 (0.0000)* **	-7.7215 (0.0000)* **	-3.964 (0.0001)* **	-3.6193 (0.0003)** *	-2.1231 (0.0337)* *
Leasing Factoring	- 0.148 3	0:07	-3.0577 (0.0022)* **	-2.7115 (0.0067)* **	-3.1124 (0.0019)* **	-2.3074 (0.021)** **	-1.8387 (0.066)* **	-2.2394 (0.0251)* *
Sports	- 0.483 5	0:04	-8.5295 (0.0000)* **	-4.3869 (0.0000)* **	-8.4382 (0.0000)* **	-4.1212 (0.0000)* **	-2.8833 (0.0039)** *	-1.6928 (0.0905)* **
Mining	- 0.229 5	0:04	-5.6335 (0.0000)* **	-5.1403 (0.0000)* **	-5.5226 (0.0000)* **	-4.9555 (0.0000)* **	-3.3413 (0.0008)** *	-1.9065 (0.0566)* *

*,**,*** shows statistical significance at the level of 10%, 5% and 1 respectively.



Graph 3: CAAR (-5...5)

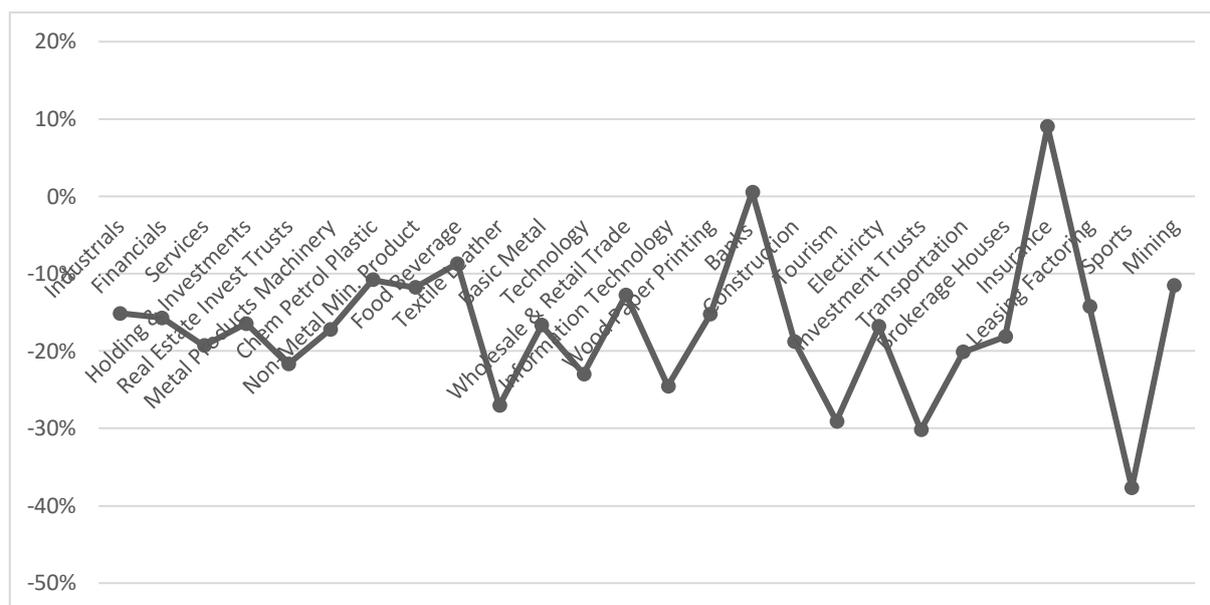
In Table 5 and Graph 3, the highest loss in CAAR 5 days before and after the event day (11/03/2020) is seen in the Sports index as approximately 48% negative return. The abnormal returns of all 4 companies in the Sports index are negative. This is followed by the Textile Leather (-%45) ve Tourism (-%44) indices respectively. However, the values of these two sectors are not statistically significant.

Table 6: CAAR (-2...2)

Indices	CAAR	pos: neg	t-test time-series	t-test cross-sectional	patell z	boehmer et al.	corrado rank	sign test
Industrials	-0.1511	13:155	-307.734 (0.0000)* **	-154.644 (0.0000)* **	-314.939 (0.0000)* **	-165.654 (0.0000)* **	-44.079 (0.0000)* **	-92.153 (0.0000)* **
Financials	-0.1571	12:92	-219.674 (0.0000)* **	-118.213 (0.0000)* **	-205.721 (0.0000)* **	-95.923 (0.0000)* **	-40.148 (0.0001)* **	-66.691 (0.0000)* **
Services	-0.1931	7:59	-23.2349 (0.0000)* **	-10.3236 (0.0000)* **	-22.844 (0.0000)* **	-9.3223 (0.0000)* **	-4.7398 (0.0000)* **	-5.4345 (0.0000)* **
Holding & Investments	-0.1644	4:35	-14.379 (0.0000)* **	-7.9662 (0.0000)* **	-13.203 (0.0000)* **	-6.2707 (0.0000)* **	-4.5154 (0.0000)* **	-4.2494 (0.0000)* **
Real Estate Invest Trusts	-0.217	0:33	-18.1168 (0.0000)* **	-11.0766 (0.0000)* **	-18.1986 (0.0000)* **	-12.0658 (0.0000)* **	-3.9682 (0.0001)* **	-4.9966 (0.0000)* **
Metal Products Machinery	-0.1721	1:29	-15.2249 (0.0000)* **	-8.4599 (0.0000)* **	-15.442 (0.0000)* **	-10.1811 (0.0000)* **	-4.348 (0.0000)* **	-4.346 (0.0000)* **
Chem. Petrol Plastic	-0.1079	3:25	-108.976 (0.0000)* **	-41.502 (0.0000)* **	-104.447 (0.0000)* **	-45.583 (0.0000)* **	-35.212 (0.0004)* **	-34.595 (0.0005)* **
Non-Metal Min. Product	-0.118	4:22	-100.273 (0.0000)* **	-57.113 (0.0000)* **	-111.731 (0.0000)* **	-59.468 (0.0000)* **	-27.739 (0.0055)* **	-27.235 (0.0065)* **
Food Beverage	-0.0868	2:20	-65.196 (0.0000)* **	-51.102 (0.0000)* **	-62.845 (0.0000)* **	-52.175 (0.0000)* **	-28.953 (0.0038)* **	-33.184 (0.0009)* **
Textile Leather	-0.2707	0:20	-173.090 (0.0000)* **	-96.914 (0.0000)* **	-178.521 (0.0000)* **	-90.406 (0.0000)* **	-49.217 (0.0000)* **	-38.585 (0.0001)* **

Basic Metal	- 0.166 6	1:18	-110.625 (0.0000)* **	-62.891 (0.0000)* **	-118.396 (0.0000)* **	-73.348 (0.0000)* **	-34.124 (0.0006)* **	-32.420 (0.0012)* **
Technology	- 0.229 8	1:18	-127.107 (0.0000)* **	-63.230 (0.0000)* **	-121.541 (0.0000)* **	-65.029 (0.0000)* **	-33.640 (0.0008)* **	-28.497 (0.0044)* **
Wholesale & Retail Trade	- 0.127 3	6:11	-79.583 (0.0000)* **	-30.029 (0.0027)* **	-73.290 (0.0000)* **	-23.640 (0.0181)* *	-33.398 (0.0008)* **	-0.5807 (0.5615)
Information Technology	- 0.245 5	0:18	-128.213 (0.0000)* **	-70.085 (0.0000)* **	-125.926 (0.0000)* **	-73.120 (0.0000)* **	-35.166 (0.0004)* **	-32.489 (0.0012)* **
Wood Paper Printing	- 0.152 5	2:13	-78.017 (0.0000)* **	-36.670 (0.0002)* **	-81.227 (0.0000)* **	-38.775 (0.0001)* **	-37.236 (0.0002)* **	-23.073 (0.021)* **
Banks	0.005 7	6:08	0.3069 (0.7589)	0.2083 (0.835)	33.736 (0.0007)* **	17.562 (0.0791)*	13.580 (0.1745)	0.4429 (0.6579)
Constructio n	- 0.187 9	0:09	-89.371 (0.0007)* **	-40.508 (0.0001)* **	-85.980 (0.0007)* **	-49.822 (0.0007)* **	-43.660 (0.0007)* **	-27.096 (0.0067)* **
Tourism	- 0.290 9	0:09	-123.072 (0.0001)* **	-67.449 (0.0001)* **	-125.809 (0.0001)* **	-63.935 (0.0001)* **	-43.216 (0.0001)* **	-25.468 (0.0109)* **
Electricity	- 0.168	1:07	-66.550 (0.0000)* **	-33.519 (0.0008)* **	-71.265 (0.0000)* **	-35.431 (0.0004)* **	-33.611 (0.0008)* **	-19.735 (0.0484)* *
Investment Trusts	- 0.301 9	0:09	-111.346 (0.0000)* **	-93.973 (0.0000)* **	-113.752 (0.0000)* **	-107.135 (0.0000)* **	-40.966 (0.0000)* **	-25.191 (0.0118)* **
Transportati on	- 0.201 2	0:08	-86.600 (0.0000)* **	-40.420 (0.0001)* **	-95.745 (0.0000)* **	-32.301 (0.0012)* **	-39.333 (0.0001)* **	-24.263 (0.0153)* *
Brokerage Houses	- 0.181 2	0:05	-44.090 (0.0000)* **	-24.224 (0.0154)* *	-46.262 (0.0000)* **	-31.662 (0.0015)* *	-24.657 (0.0137)* *	-18.691 (0.0616)* *
Insurance	0.090 3	0:06	-43.609 (0.0000)* **	-26.804 (0.0074)* **	-38.531 (0.0001)* **	-34.390 (0.0006)* **	-23.425 (0.0192)* *	-21.231 (0.0337)* *
Leasing Factoring	- 0.142 3	1:06	-43.520 (0.0000)* **	-31.447 (0.0017)* **	-46.634 (0.0000)* **	-26.434 (0.0082)* **	-18.278 (0.0676)* **	-14.729 (0.1408)
Sports	- 0.376 7	0:04	-98.557 (0.0000)* **	-67.060 (0.0000)* **	-97.180 (0.0000)* **	-60.058 (0.0000)* **	-32.306 (0.0012)* **	-16.928 (0.0905)* **
Mining	- 0.115 5	0:04	-42.062 (0.0000)* **	-40.160 (0.0001)* **	-40.864 (0.0000)* **	-37.504 (0.0002)* **	-22.706 (0.0232)* *	-19.065 (0.0566)* *

*,**,*** shows statistical significance at the level of 10%, 5% and 1 respectively.



Graph 4: CAAR (-2...2)

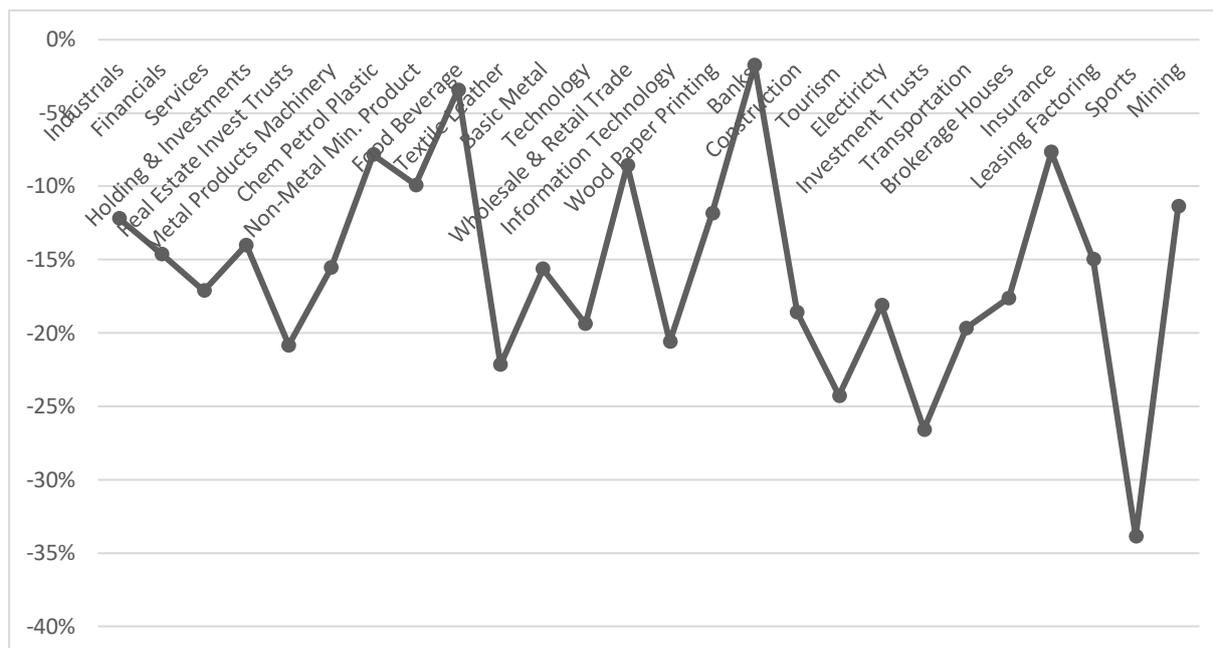
In Table 6 and Graph 4, the highest loss in CAAR 2 days before and after the event day (11/03/2020) is seen in the Sports index as approximately 37% negative return. The abnormal returns of all 4 companies in the Sports index are negative. This is followed by the Investment Trusts (-30%) and Tourism (-29%) indices respectively. Also, as can be seen in Graph 4, it has been determined that there is a 9% positive return in the Insurance sector and 0.50% in the banking sector 2 days before and after the event day. However, the values of the banking sector are not statistically significant.

Table 7: CAAR (-1...1)

Indices	CAAR	pos: neg	t-test time-series	t-test cross-sectional	patell z	boehmer et al.	corrado rank	sign test
Industrials	-0.122	17:151	-320.702 (0.0000)* **	-126.483 (0.0000)* **	-331.700 (0.0000)* **	-135.211 (0.0000)* **	-47.149 (0.0000)* **	-85.918 (0.0000)* **
Financials	-0.146	12:92	-263.697 (0.0000)* **	-112.712 (0.0000)* **	-245.259 (0.0000)* **	-88.317 (0.0000)* **	-51.115 (0.0000)* **	-64.702 (0.0000)* **
Services	-0.1712	9:57	-265.930 (0.0000)* **	-95.432 (0.0000)* **	-258.761 (0.0000)* **	-81.164 (0.0000)* **	-55.733 (0.0000)* **	-49.383 (0.0000)* **
Holding & Investments	-0.14	3:36	-158.036 (0.0000)* **	-63.617 (0.0000)* **	-141.866 (0.0000)* **	-43.555 (0.0000)* **	-51.807 (0.0000)* **	-45.719 (0.0000)* **
Real Estate Invest Trusts	-0.2083	0:33	-224.518 (0.0000)* **	-111.855 (0.0000)* **	-224.822 (0.0000)* **	-131.928 (0.0000)* **	-51.367 (0.0000)* **	-49.966 (0.0000)* **
Metal Products Machinery	-0.1555	2:28	-177.637 (0.0000)* **	-88.990 (0.0000)* **	-178.963 (0.0000)* **	-101.504 (0.0000)* **	-50.514 (0.0000)* **	-39.767 (0.0001)* **
Chem. Petrol Plastic	-0.0783	4:24	-102.062 (0.0000)* **	-26.995 (0.0069)* **	-97.052 (0.0000)* **	-29.143 (0.0036)* **	-34.930 (0.0005)* **	-30.779 (0.0021)* **
Non-Metal Min. Product	-0.0991	3:23	-108.720 (0.0000)* **	-57.859 (0.0000)* **	-119.546 (0.0000)* **	-59.729 (0.0000)* **	-32.138 (0.0013)* **	-31.212 (0.0018)* **

Food Beverage	- 0.034 2	5:17	-33.116 (0.0009)* **	-17.560 (0.0791)*	-33.232 (0.0009)* **	-19.401 (0.0524)* *	-17.025 (0.0887)*	-20.306 (0.0423)* *
Textile Leather	- 0.221 5	0:20	-182.799 (0.0000)* **	-92.509 (0.0000)* **	-189.073 (0.0000)* **	-87.418 (0.0000)* **	-52.056 (0.0000)* **	-38.585 (0.0001)* **
Basic Metal	- 0.156 2	1:18	-133.911 (0.0000)* **	-73.986 (0.0000)* **	-150.384 (0.0000)* **	-79.574 (0.0000)* **	-46.176 (0.0000)* **	-32.420 (0.0012)* **
Technology	- 0.193 7	0:19	-138.328 (0.0000)* **	-74.241 (0.0000)* **	-132.716 (0.0000)* **	-87.350 (0.0000)* **	-40.049 (0.0001)* **	-33.574 (0.0008)* **
Wholesale & Retail Trade	- 0.085 5	6:11	-68.965 (0.0000)* **	-19.840 (0.0473)* *	-54.627 (0.0000)* **	-12.954 (0.1952)	-32.722 (0.0011)* **	-0.5807 (0.5615)
Information Technology	- 0.205 9	0:18	-138.830 (0.0000)* **	-83.532 (0.0000)* **	-135.973 (0.0000)* **	-100.368 (0.0000)* **	-41.277 (0.0000)* **	-32.489 (0.0012)* **
Wood Paper Printing	- 0.118 3	2:13	-78.145 (0.0000)* **	-25.135 (0.012)* *	-83.926 (0.0000)* **	-29.064 (0.0037)* **	-40.813 (0.0000)* **	-23.073 (0.021)* **
Banks	- 0.017 1	6:08	-11.791 (0.2384)	-0.5998 (0.5487)	19.098 (0.0562)* *	0.8799 (0.3789)	0.2291 (0.8188)	0.4429 (0.6579)
Construction	- 0.186	0:09	-114.190 (0.0000)* **	-52.588 (0.0000)* **	-114.929 (0.0000)* **	-71.518 (0.0000)* **	-55.412 (0.0000)* **	-27.096 (0.0067)* **
Tourism	- 0.242 8	1:08	-132.600 (0.0000)* **	-62.524 (0.0000)* **	-140.162 (0.0000)* **	-56.220 (0.0000)* **	-47.362 (0.0000)* **	-18.712 (0.0613)*
Electricity	- 0.181 1	1:07	-92.584 (0.0000)* **	-41.671 (0.0000)* **	-103.242 (0.0000)* **	-48.617 (0.0000)* **	-48.503 (0.0000)* **	-19.735 (0.0484)* *
Investment Trusts	- 0.265 8	0:09	-126.548 (0.0000)* **	-116.164 (0.0000)* **	-135.843 (0.0000)* **	-69.739 (0.0000)* **	-50.991 (0.0000)* **	-25.191 (0.0118)* **
Transportation	- 0.196 6	0:08	-109.258 (0.0000)* **	-65.490 (0.0000)* **	-118.928 (0.0000)* **	-75.693 (0.0000)* **	-53.031 (0.0000)* **	-24.263 (0.0153)* **
Brokerage Houses	- 0.176 2	0:05	-55.357 (0.0000)* **	-39.603 (0.0001)* **	-56.238 (0.0000)* **	-80.536 (0.0000)* **	-38.571 (0.0001)* **	-18.691 (0.0616)*
Insurance	- 0.076 7	2:04	-47.863 (0.0000)* **	-16.442 (0.1001)*	-30.475 (0.0023)* **	-15.489 (0.1214)	-18.505 (0.0642)*	-0.4734 (0.6359)
Leasing Factoring	- 0.149 7	0:07	-59.086 (0.0000)* **	-40.449 (0.0001)* **	-65.385 (0.0000)* **	-33.633 (0.0008)* **	-28.600 (0.0042)* **	-22.394 (0.0251)* *
Sports	- 0.338 5	0:04	-114.339 (0.0000)* **	-116.330 (0.0000)* **	-112.605 (0.0000)* **	-102.508 (0.0000)* **	-36.127 (0.0003)* **	-16.928 (0.0905)*
Mining	- 0.113 7	0:04	-53.444 (0.0000)* **	-80.945 (0.0000)* **	-52.641 (0.0000)* **	-94.339 (0.0000)* **	-28.647 (0.0042)* **	-19.065 (0.0566)* *

*,**,*** shows statistical significance at the level of 10%, 5% and 1 respectively.



Graph-5: CAAR (-1...1)

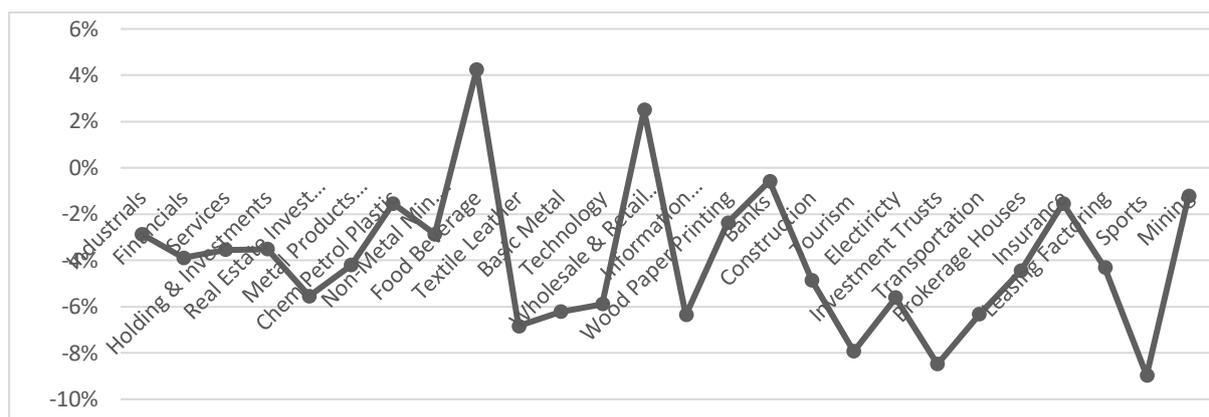
In Table 7 and Graph 5, the highest loss in CAAR 1 day before and after the event day (11/03/2020) is seen in the Sports index as approximately 33% negative return. The abnormal returns of all 4 companies in the Sports index are negative. This is followed by Investment Trusts (-26.5%) and Tourism (-24%) indices respectively.

Table 8: CAAR (0...0)

Indices	CAAR	pos: neg	t-test time-series	t-test cross-sectional	patell z	boehmer et al.	corrado rank	sign test
Industrials	-0.0287	40:128	-130.559 (0.0000)* **	-63.315 (0.0000)* **	-139.402 (0.0000)* **	-64.320 (0.0000)* **	-23.100 (0.0209)* *	-50.068 (0.0000)* **
Financials	-0.0389	16:88	-121.690 (0.0000)* **	-72.321 (0.0000)* **	-110.071 (0.0000)* **	-45.630 (0.0000)* **	-28.684 (0.0041)* **	-56.746 (0.0000)* **
Services	-0.0354	10:56	-95.192 (0.0000)* **	-37.018 (0.0002)* **	-81.848 (0.0000)* **	-24.530 (0.0142)* *	-26.866 (0.0072)* **	-46.902 (0.0000)* **
Holding & Investments	-0.0352	5:34	-68.767 (0.0000)* **	-32.104 (0.0013)* **	-54.625 (0.0000)* **	-15.560 (0.1197)* *	-28.806 (0.004)* **	-39.268 (0.0001)* **
Real Estate Invest Trusts	-0.0555	3:30	-103.628 (0.0000)* **	-73.126 (0.0000)* **	-101.912 (0.0000)* **	-78.483 (0.0000)* **	-27.753 (0.0055)* **	-39.419 (0.0001)* **
Metal Products Machinery	-0.0421	4:26	-83.365 (0.0000)* **	-62.652 (0.0000)* **	-87.106 (0.0000)* **	-66.379 (0.0000)* **	-26.901 (0.0071)* **	-32.382 (0.0012)* **
Chem. Petrol Plastic	-0.0155	7:21	-34.960 (0.0005)* **	-11.503 (0.25) **	-37.746 (0.0002)* **	-12.958 (0.1951) **	-20.574 (0.0396)* *	-19.330 (0.0532)* *
Non-Metal Min. Product	-0.0287	6:20	-54.541 (0.0000)* **	-48.915 (0.0000)* **	-58.001 (0.0000)* **	-46.694 (0.0000)* **	-16.421 (0.1006)* **	-19.281 (0.05389) **
Food Beverage	0.0425	16:06	71.320 (0.0000)* **	33.375 (0.0008)* **	73.821 (0.0000)* **	33.420 (0.0008)* **	16.816 (0.0927)* **	26.913 (0.0071)* **

Textile Leather	- 0.068 4	0:20	-97.740 (0.0000)* **	-87.779 (0.0000)* **	-106.792 (0.0000)* **	-76.968 (0.0000)* **	-32.535 (0.0011)* **	-38.585 (0.0001)* **
Basic Metal	- 0.062 2	1:18	-92.306 (0.0000)* **	-67.237 (0.0000)* **	-107.974 (0.0000)* **	-80.737 (0.0000)* **	-34.178 (0.0006)* **	-32.420 (0.0012)* **
Technology	- 0.058 9	1:18	-72.876 (0.0000)* **	-51.531 (0.0000)* **	-70.028 (0.0000)* **	-54.954 (0.0000)* **	-25.109 (0.012)** *	-28.497 (0.0044)* **
Wholesale & Retail Trade	0.025	7:10	34.928 (0.0005)* **	0.9609 (0.3366)	58.804 (0.0000)* **	12.438 (0.2136)	-0.2385 (0.8115)	-0.0897 (0.9286)
Information Technology	- 0.063 6	1:17	-74.285 (0.0000)* **	-57.073 (0.0000)* **	-74.254 (0.0000)* **	-66.037 (0.0000)* **	-26.771 (0.0074)* **	-32.489 (0.0012)* **
Wood Paper Printing	- 0.023 7	4:11	-27.093 (0.0067)* **	-14.437 (0.1488)	-31.762 (0.0015)* **	-17.190 (0.0856)*	-18.977 (0.0577)* *	-12.637 (0.2063)
Banks	- 0.005 8	6:08	-0.6973 (0.4856)	-0.7298 (0.4655)	0.403 (0.687)	0.398 (0.6906)	0.0296 (0.9764)	0.4429 (0.6579)
Constructio n	- 0.048 7	0:09	-51.805 (0.0000)* **	-39.873 (0.0001)* **	-51.843 (0.0000)* **	-55.946 (0.0000)* **	-31.093 (0.0019)* **	-27.096 (0.0067)* **
Tourism	- 0.079 3	0:09	-74.969 (0.0000)* **	-52.021 (0.0000)* **	-81.914 (0.0000)* **	-48.843 (0.0000)* **	-28.077 (0.005)** *	-25.468 (0.0109)* **
Electricity	- 0.056 1	1:07	-49.677 (0.0000)* **	-46.731 (0.0000)* **	-60.414 (0.0000)* **	-44.721 (0.0000)* **	-30.196 (0.0025)* **	-19.735 (0.0484)* *
Investment Trusts	- 0.084 9	0:09	-70.006 (0.0000)* **	-55.710 (0.0000)* **	-74.331 (0.0000)* **	-61.110 (0.0000)* **	-28.482 (0.0044)* **	-25.191 (0.0118)* **
Transportati on	- 0.063 3	0:08	-60.870 (0.0000)* **	-69.913 (0.0000)* **	-68.307 (0.0000)* **	-109.665 (0.0000)* **	-31.600 (0.0016)* **	-24.263 (0.0153)* **
Brokerage Houses	- 0.044 4	2:03	-24.156 (0.0157)* *	-17.115 (0.087)*	-25.135 (0.012)** *	-18.797 (0.0601)*	-13.325 (0.1827)	-0.0514 (0.959)
Insurance	- 0.015 5	0:06	-16.770 (0.0935)*	-21.711 (0.0299)* *	-13.731 (0.1697)	-28.509 (0.0044)* **	-15.323 (0.1254)	-21.231 (0.0337)* *
Leasing Factoring	- 0.043 2	1:06	-29.510 (0.0032)* **	-25.816 (0.0098)* **	-37.177 (0.0002)* **	-23.643 (0.0181)* *	-17.872 (0.0739)*	-14.729 (0.1408)
Sports	- 0.089 7	0:04	-52.456 (0.0000)* **	-139.837 (0.0000)* **	-52.864 (0.0000)* **	-136.260 (0.0000)* **	-20.367 (0.0417)* *	-16.928 (0.0905)*
Mining	- 0.012 1	2:02	-0.9822 (0.326)	-13.302 (0.1835)	-0.9285 (0.3532)	-14.442 (0.1487)	-0.7052 (0.4807)	0.0958 (0.9237)

*,**,*** shows statistical significance at the level of 10%, 5% and 1 respectively.

**Graph-6: CAAR (0...0)**

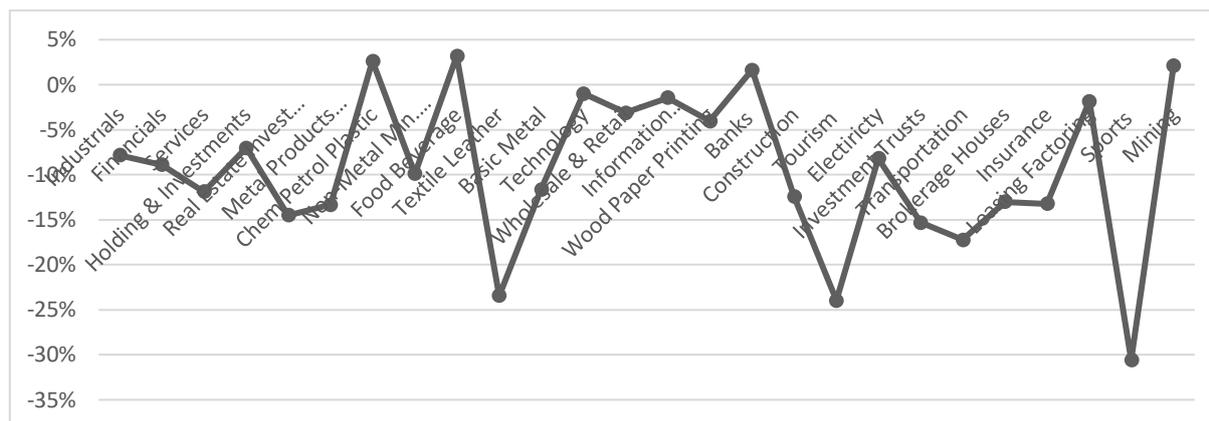
In Table 8 and Graph 6, the highest loss in CAAR on event day (11/03/2020) is seen in the Sports index as approximately 8.5% negative return. The abnormal returns of all 4 companies in the Sports index are negative. This is followed by Investment Trusts (-8%) and Tourism (-7.5%) indices respectively. According to the CAAR on the event day, the Food Beverage and Wholesale & Retail Trade indices appear to have positive CAAR values, 4%, and 2.5%, respectively.

Table 9: CAAR (0...10)

Indices	CAAR	pos: neg	t-test time-series	t-test cross-sectional	patell z	boehmer et al.	corrado rank	sign test
Industrials	-0.0785	43:125	-107.794 (0.0000)* **	-55.269 (0.0000)* **	-105.534 (0.0000)* **	-51.745 (0.0000)* **	-13.047 (0.192)	-45.392 (0.0000)* **
Financials	-0.089	28:76	-83.936 (0.0000)* **	-53.599 (0.0000)* **	-81.043 (0.0000)* **	-40.503 (0.0001)* **	-11.204 (0.2625)	-34.867 (0.0005)* **
Services	-0.1188	15:51	-96.325 (0.0000)* **	-49.888 (0.0000)* **	-81.035 (0.0000)* **	-34.687 (0.0005)* **	-16.295 (0.1032) *	-34.497 (0.0006)* **
Holding & Investments	-0.0702	13:26	-41.375 (0.0000)* **	-20.613 (0.0393)* *	-27.159 (0.0066)* **	-11.323 (0.2575)	-0.9615 (0.3363)	-13.463 (0.1782)
Real Estate Invest Trusts	-0.1449	4:29	-81.563 (0.0000)* **	-63.594 (0.0000)* **	-83.019 (0.0000)* **	-56.792 (0.0000)* **	-13.878 (0.1652)	-35.904 (0.0003)* **
Metal Products Machinery	-0.1332	4:26	-79.422 (0.0000)* **	-51.001 (0.0000)* **	-86.857 (0.0000)* **	-54.574 (0.0000)* **	-18.866 (0.0592) **	-32.382 (0.0012)* **
Chem. Petrol Plastic	0.0263	11:17	17.885 (0.0737)*	0.5093 (0.6105)	15.979 (0.1101)	0.5007 (0.6166)	0.0521 (0.9585)	-0.4065 (0.6844)
Non-Metal Min. Product	-0.0988	5:21	-56.596 (0.0000)* **	-52.252 (0.0000)* **	-60.015 (0.0000)* **	-49.527 (0.0000)* **	-13.917 (0.164)	-23.258 (0.02)**
Food Beverage	0.0318	14:08	16.102 (0.1073)*	10.186 (0.3084)	22.054 (0.0274)* *	13.381 (0.1809)	0.157 (0.8753)	18.328 (0.0668)*
Textile Leather	-0.2344	1:19	-101.049 (0.0000)* **	-92.439 (0.0000)* **	-107.116 (0.0000)* **	-85.206 (0.0000)* **	-28.768 (0.004)* **	-34.064 (0.0007)* **

Basic Metal	- 0.116 2	1:18	-52.016 (0.0000)* **	-35.811 (0.0003)* **	-49.051 (0.0000)* **	-37.268 (0.0002)* **	-11.204 (0.2625)	-32.420 (0.0012)* **
Technology	-0.01	7:12	-0.3735 (0.7088)	-0.3223 (0.7472)	0.0519 (0.9586)	0.0445 (0.9645)	0.2944 (0.7685)	0.1965 (0.8443)
Wholesale & Retail Trade	- 0.031 1	6:11	-13.125 (0.1893)	-0.5534 (0.58)	0.3291 (0.7421)	0.1061 (0.9155)	-0.9497 (0.3422)	-0.5807 (0.5615)
Information Technology	- 0.014 5	6:09	-0.5117 (0.6089)	-0.4422 (0.6583)	-0.2299 (0.8182)	-0.1965 (0.8442)	0.1758 (0.8605)	-0.1026 (0.9183)
Wood Paper Printing	- 0.040 6	6:09	-13.998 (0.1616)	-0.8334 (0.4046)	-10.428 (0.297)	-0.6408 (0.5217)	-0.2557 (0.7982)	-0.2201 (0.8258)
Banks	0.016 3	6:08	0.587 (0.5572)	12.422 (0.2142)	0.936 (0.3493)	10.481 (0.2946)	0.7803 (0.4352)	0.4429 (0.6579)
Constructio n	- 0.124 3	2:07	-39.844 (0.0001)* **	-25.423 (0.011)** *	-35.903 (0.0003)* **	-22.478 (0.0246)* *	-18.939 (0.0582) **	-13.694 (0.1709)
Tourism	- 0.239 9	1:08	-68.428 (0.0000)* **	-47.358 (0.0000)* **	-68.412 (0.0000)* **	-48.757 (0.0000)* **	-23.046 (0.0212) **	-18.712 (0.0613)*
Electricity	- 0.082	2:06	-21.897 (0.0285)* *	-19.037 (0.057)**	-22.598 (0.0238)* *	-17.074 (0.0878)*	-0.2142 (0.8304) *	-12.654 (0.2057)
Investment Trusts	- 0.153 2	0:09	-38.096 (0.0001)* **	-68.780 (0.0000)* **	-38.828 (0.0001)* **	-67.391 (0.0000)* **	-0.6311 (0.528)	-25.191 (0.0118)* **
Transportati on	- 0.172 3	1:07	-50.007 (0.0000)* **	-36.060 (0.0003)* **	-57.580 (0.0000)* **	-25.872 (0.0097)* **	-16.982 (0.0895) *	-17.108 (0.0871)*
Brokerage Houses	-0.13	0:05	-21.332 (0.0329)* *	-31.470 (0.0016)* **	-21.211 (0.0339)* *	-36.816 (0.0002)* **	-11.005 (0.2711)	-18.691 (0.0616)*
Insurance	- 0.132 2	0:06	-43.058 (0.0000)* **	-24.029 (0.0163)* *	-58.995 (0.0000)* **	-18.965 (0.0579)*	-20.188 (0.0435) **	-21.231 (0.0337)* *
Leasing Factoring	- 0.018 3	4:03	-0.3778 (0.7055)	-0.3251 (0.7451)	-0.1033 (0.9177)	-0.0821 (0.9345)	0.33868 (0.7349)	0.8264 (0.4086)
Sports	- 0.305 7	0:04	-53.924 (0.0000)* **	-20.344 (0.0419)* *	-52.980 (0.0000)* **	-19.266 (0.054)* *	-17.955 (0.0726) *	-16.928 (0.0905)*
Mining	0.021 3	2:02	0.5237 (0.6005)	13.826 (0.1668)	0.5498 (0.5824)	15.727 (0.1158)	0.049 (0.9609)	0.0958 (0.9237)

*,**,*** shows statistical significance at the level of 10%, 5% and 1 respectively.



Graph 7: CAAR (0...10)

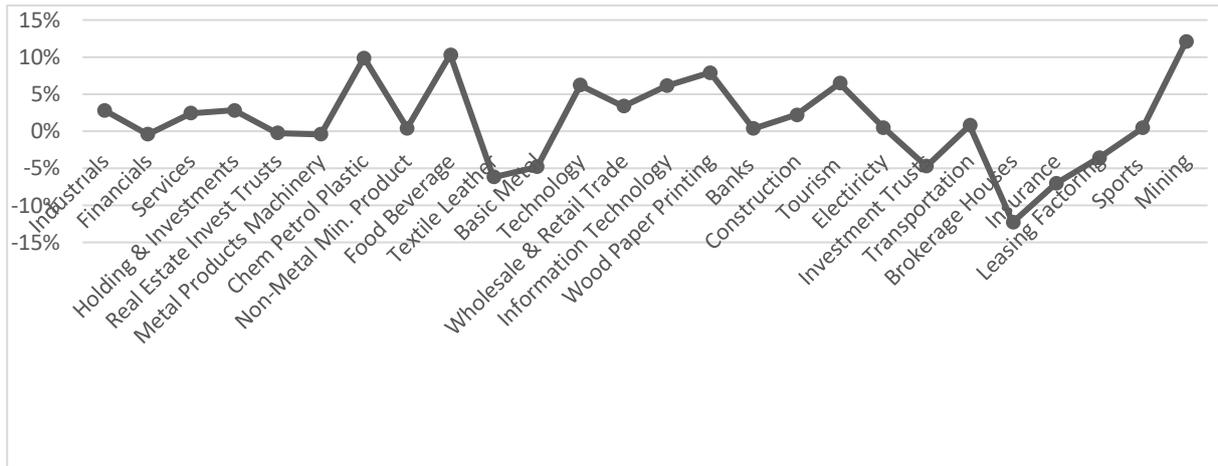
In Table 9 and Graph 7, the highest loss in CAAR 10 days after the event day (11/03/2020) is seen in the Sports index as approximately 8.5% negative return. The abnormal returns of all 4 companies in the Sports index are negative. This is followed by the Tourism (-24%), and Textile Leather (-23%) indices respectively. Besides, positive returns are observed in the Chemical Oil Plastic, Food Beverage, Banks and Mining sectors during the event period. However, the values of these four sectors are not statistically significant.

Table 10: CAAR (0...20)

Indices	CAAR	pos: neg	t-test time-series	t-test cross-sectional	patell z	boehmer et al.	corrado rank	sign test
Industrials	0.0283	89:79	28.101 (0.005)** *	22.851 (0.0223)* *	33.040 (0.001)** *	25.428 (0.011)** *	0.7037 (0.4816)	26.308 (0.0085)**
Financials	-0.004	53:51	-0.2748 (0.7835)	-0.2477 (0.8044)	-0.0915 (0.9271)	-0.0667 (0.9468)	0.5313 (0.5952)	16.846 (0.0921)*
Services	0.0244	42:24	14.303 (0.1526)	12.859 (0.1985)	20.963 (0.0361)* *	17.141 (0.0865)*	0.8678 (0.3855)	32.490 (0.0012)**
Holding & Investments	0.028	24:15	11.930 (0.2329)	10.160 (0.3097)	22.613 (0.0237)* *	17.136 (0.0866)*	0.7377 (0.4607)	22.018 (0.0277)* *
Real Estate Invest Trusts	-0.0026	16:17	-0.1059 (0.9157)	-0.0932 (0.9257)	-0.0754 (0.9399)	-0.0654 (0.9479)	0.9561 (0.339)	0.6282 (0.5299)
Metal Products Machinery	-0.0042	13:17	-0.1801 (0.8571)	-0.1566 (0.8756)	-0.3723 (0.7096)	-0.3102 (0.7564)	0.6197 (0.5355)	0.0851 (0.9322)
Chem. Petrol Plastic	0.099	23:05	48.814 (0.0000)* **	21.863 (0.0288)* *	51.631 (0.0000)* **	26.168 (0.0089)* **	12.794 (0.2008)	41.730 (0.0000)* **
Non-Metal Min. Product	0.004	14:12	0.1668 (0.8675)	0.2453 (0.8062)	0.3787 (0.7049)	0.444 (0.6571)	0.5802 (0.5618)	12.537 (0.21)
Food Beverage	0.1033	16:06	37.845 (0.0002)* **	32.277 (0.0012)* **	38.341 (0.0001)* **	31.593 (0.0016)* **	0.5995 (0.5489)	26.913 (0.0071)* **
Textile Leather	-0.0617	5:15	-19.243 (0.0543)* *	-32.463 (0.0012)* **	-20.777 (0.0377)* *	-31.591 (0.0016)* **	0.1199 (0.9046)	-15.980 (0.11)*

Basic Metal	- 0.048 2	3:16	-15.609 (0.1185)*	-21.102 (0.0348)* *	-14.475 (0.1478)	-17.622 (0.078)*	- 0.1761 (0.860 2)	-23.122 (0.0208)* *
Technology	0.062	13:6	16.741 (0.0941)*	24.636 (0.0138)* *	17.131 (0.0867)*	23.834 (0.0172)* *	0.8532 (0.393 6)	27.349 (0.0062)* **
Wholesale & Retail Trade	0.033 7	10:07	1.0285 (0.3037)	1.0544 (0.2917)	1.9122 (0.0558)*	1.3539 (0.1758)	0.004 (0.996 8)	1.3834 (0.1666)
Information Technology	0.061 3	11:07	1.5615 (0.1184)	2.2778 (0.0227)* *	1.5069 (0.1318)	2.0754 (0.0379)* *	0.7434 (0.457 3)	2.5193 (0.0118)* **
Wood Paper Printing	0.078 9	10:05	1.9703 (0.0488)* *	2.2622 (0.0237)* *	2.1199 (0.034)**	2.3071 (0.0211)* *	0.9487 (0.342 8)	1.8672 (0.0619)*
Banks	0.003 7	5:09	0.0978 (0.9221)	0.125 (0.9005)	-0.617 (0.5373)	-0.6948 (0.4872)	- 0.4464 (0.655 3)	-0.1392 (0.8893)
Construction	0.022 1	6:03	0.5134 (0.6076)	0.4771 (0.6333)	0.8766 (0.3807)	0.7884 (0.4304)	0.6654 (0.505 8)	1.3111 (0.1898)
Tourism	0.064 6	6:03	1.3339 (0.1822)	0.6127 (0.5401)	1.5055 (0.1322)	0.7993 (0.4241)	1.23 (0.218 7)	1.5069 (0.1318)
Electricity	0.004 7	6:02	0.0904 (0.928)	0.1188 (0.9055)	0.0111 (0.9911)	0.01 (0.992)	1.3805 (0.167 4)	1.5671 (0.1171)
Investment Trusts	- 0.047 1	5:04	-0.847 (0.397)	-0.4082 (0.6832)	-0.5407 (0.5887)	-0.2774 (0.7815)	0.926 (0.354 4)	0.8652 (0.3869)
Transportati on	0.008	5:03	0.1678 (0.8668)	0.2303 (0.8178)	0.0265 (0.9788)	0.0241 (0.9807)	0.9275 (0.353 7)	1.1509 (0.2498)
Brokerage Houses	- 0.123	2:03	-1.4612 (0.144)	-0.9104 (0.3626)	-0.8422 (0.3997)	-0.6471 (0.5176)	- 0.8013 (0.422 9)	-0.0514 (0.959)
Insurance	- 0.070 6	2:04	-1.6653 (0.0959)*	-0.7718 (0.4402)	-4.2785 (0.0000)* **	-1.607 (0.108)*	- 1.3069 (0.191 3)	-0.4734 (0.6359)
Leasing Factoring	- 0.035 6	4:03	-0.5312 (0.5953)	-0.3507 (0.7258)	0.1293 (0.8972)	0.1062 (0.9154)	0.5074 (0.611 9)	0.8264 (0.4086)
Sports	0.004 3	3:01	0.0545 (0.9565)	0.056 (0.9554)	0.0992 (0.921)	0.1005 (0.9199)	0.5269 (0.598 3)	1.349 (0.1773)
Mining	0.120 9	3:01	2.1473 (0.0318)* *	2.3976 (0.0165)* *	2.0375 (0.0416)* *	2.5175 (0.0118)* **	0.7713 (0.440 6)	1.0969 (0.2727)

*,**,*** shows statistical significance at the level of 10%, 5% and 1 respectively.



Graph 8: CAAR (0...20)

In Table 10 and Graph 8, the highest loss in CAAR 20 days after the event day (11/03/2020) is seen in the Brokerage Houses index as approximately 12 % negative return. This is followed by the Insurance (-%7), and Textile Leather (%-6) indices respectively. According to CAAR values 20 days after the event day, only the values of Industrials, Chem. Petrol Plastic, Textile Leather, Technology, Wood Paper Printing, Mining sector are statistically significant.

Conclusion

This study examines the impact of the COVID-19 outbreak, which originates in China and spreads to the World, on the financial markets of Turkey. The event study method is used and the day of the event is considered as March 11, 2020, the day on which the pandemic is declared by WHO. 26 sectors of BIST are examined. By comparing the sectors' cumulative average abnormal returns, it is aimed to reveal that which sectors the pandemic affects more. For this purpose, CAAR values are calculated for each index for estimation periods (-20...+20), (-10...+10), (-5...+5), (-2...+2), (-1...+1), (0...0), (0...+10), (0...+20).

When the event periods are examined respectively;

In (-20... +20), the highest loss is experienced in the Textile Leather sector, while positive CAAR value is observed in the sports and mining sector. In (-10... +10), the sports sector loses 60%, followed by the Tourism, Textile Leather, and Transportation sectors. A positive CAAR isn't observed in any sector during this period. In (-5... +5), the sports sector suffers the highest loss with 48% CAAR value. The Banks sector is the only sector that achieves a positive CAAR value. In (-2... +2) Sports sector has the highest negative CAAR value. In this period, the Insurance sector achieves the highest positive CAAR value. Finally in (-1... +1) the loss of the Sports sector is 33%. All sectors have a negative CAAR value in this period.

On the event day March 11, 2020, while the Sports, Tourism, Investment Trust sectors receive negative CAAR value, Food Beverage, Wholesale and Retail sectors receive positive CAAR value. In (0... +10), while Sports, Tourism, Textile leather sectors have negative CAAR values, Food Beverage, Chem... Petrol Plastic, Banks, and Mining sectors have positive CAAR value. In (0... +20), the highest negative CAAR values are obtained in the Brokerage Houses and Insurance sectors, while the highest positive CAAR value is in the Mining and Food Beverage sectors.

Consequently, while negative CAAR values occur in most of the estimation periods examined, different positive CAAR values in terms of sectors are observed in some periods. Relations between countries have been temporarily suspended due to the pandemic, and the impact of pandemic has been felt more in sectors such as international transportation, airline,

and tourism. For example, Turkish Airlines Company operating in the airline industry has a negative abnormal return of 11% and 13% respectively on the day of the event and the day after the event day, Petrokent Tourism Company operating in the tourism sector has 14%, and 12% negative abnormal return on the day of the event and the day after the event day, respectively. However, positive CAAR values are realized in some sectors in this period. For example, in the period of 20 days after the day of the event, Food Beverage shows a rapid recovery with a positive return of 10% and differs from other sectors. Chem... Petrol Plastic sector, which meets the demand of disinfectant, achieves a rapid recovery with a positive CAAR performance of approximately 10%. Similarly, Mining, Industrials, and Wood Paper Printing sectors also differs positively from other sectors in terms of CAAR values.

Results vary by sector in different estimation periods. However, in general, it is seen that the indices of sports, tourism, and textile sectors are the sectors most negatively affected by pandemics. COVID-19 is an epidemic where the vaccine has not yet been developed, permanent treatment methods cannot be developed, and currently maintaining its negative impact on humans. For this reason, uncertainty about the future affects the cash flow expectations of the sectors, especially for luxury consumption. There is a great uncertainty as to when the suspended sports competitions will start again, whether it will be as demanded as before, and whether domestic and foreign tourists will benefit from hospitality services or not. Therefore, investors' investments in these sectors have slowed down. On the other hand, the fact that a positive CAAR is seen in the food, chemistry, and banking sectors stems from the fact that these sectors are sectors for fundamental consumption. Faced with extraordinary events, people will act with the motive to meet their basic needs first. For this reason, cash flows in these sectors will continue rapidly and these sectors will be more attractive for investors.

Each sector is an important part of the real and financial sectors. The revival of the investors' demand in the face of the developments experienced depends on the creation of an environment of confidence. Although it is not known when the process will be terminated, if the perception that all safety importance is taken most strictly and that human health will always be a priority, the disrupted cash flows will be revived. This will encourage investors to invest in these sectors again.

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