PANDEMIC OUTBREAK, INVESTOR SENTIMENT AND STOCK MARKET REACTION: EVIDENCE FROM THE FRONTIER MARKET, SRI LANKA

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Any remaining errors are mine.

ABSTRACT

This study examines the impact of COVID-19 pandemic, the resulting investor sentiment in determining stock returns of different sector portfolios, namely, healthcare, telecommunication, banking, insurance, and hotel companies in the Colombo Stock Exchange (CSE), Sri Lanka in the year 2020. The empirical work is drawn on two widely used event study and regression-based econometric analysis. Firstly, the event study methodology focuses on the impact on sector portfolio returns after the World Health Organisation (WHO) declared COVID-19 as a global pandemic on 11th March 2020. Statistically significant positive cumulative average abnormal returns (CARs) are observed surrounding the event day. The most striking phenomenon is positive and persisting CARs perceived after a long Island-wide lockdown curfew, which imposed with effect from 16th March 2020, is lifted on 11th May 2020. CSE investors are likely to be more sensitive to local events than to global news, and persisting CARs indicate market inefficiency. A second-stage regression-based methodology is adopted to evaluate the impact of pandemic related news and to identify the influence of investor sentiment on sector portfolio returns and its persisting effects. Results reveal an initial negative sentiment effect on portfolio stock returns, followed by a positive sentiment thereafter. Initial negative effect is relatively robust on banks and hotel sector stock returns. A positive sentiment might emanate from over-reaction to the subsequent rebound with the removal of lockdown curfew and the Government's COVID-relief moratorium packages offered to businesses. Results indicate that CSE investors are likely to react with investment decisions based on psychological bias or sentiment, signifying irrational investor behaviour in CSE. This study provides current findings of investor sentiment, provoked by COVID-19 pandemic, on different sector portfolio returns in the frontier market, CSE, Sri Lanka.

Keywords: COVID-19 Pandemic, Frontier Market, Investor Sentiment, Market Efficiency

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
AAR	Average Abnormal Returns
ASPI	All Share Price Index
CAPM	Capital Asset Pricing Model
CAR	Cumulative Average Abnormal Returns
CSE	Colombo Stock Exchange
EMH	Efficient Market Hypothesis
FGI	Fear Gauge Indicator
MM	Market Model
OLS	Ordinary Least Squares
PRNs	Pandemic Related News
WHO	World Health Organization

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 Background and Introduction

COVID-19 has created a radical uncertainty to financial markets which we had never experienced before, by a dangerous infectious disease to this magnitude. It affected almost everything, and several unprecedented measures were introduced all over the world to control the spread of the virus. Hanna and Yiping (2004) estimate the total cost of the SARS virus outbreak at about 0.5% of GDP in China, but the COVID-19's global impact and economic losses are far severe, where the global healthcare cost, loss of worker productivity and cost of increased community anxiety are difficult to quantify. On the other hand, large distressing events can positively stimulate some groups of investors.

A vast array of empirical findings in asset pricing and behavioural finance literature documents the prevalence of a significant relation between stock market returns and investor sentiment using a variety of sentiment variables; temperature (Cao and Wei, 2005), international soccer results (Edmans et al., 2007; Curatola et al., 2016), aviation disasters (Kaplanski and Levy, 2010), high media pessimism (Tetlock, 2007), local weather conditions (Saunders, 1993) and morning sunshine (Hirshleifer and Shumway, 2003). In general, fear-sentiment drives negative stock returns, whilst positive-emotions are likely to increase investors' enthusiasm to take risks (Baker and Wurgler, 2006).

Cao and Wei (2005) find that stock returns and temperature are negatively correlated; Curatola et al. (2016) reveal evidence of a significant sport sentiment effect on sectoral stock returns in the U.S.; Edmans et al. (2007) find next-day significant abnormal stock returns after a loss in the Soccer World Cup elimination stage; Kaplanski and Levy (2010) document a significant negative event effect of aviation disasters on stock prices; Donadelli et al. (2017) examine how investor sentiment, provoked by news alerts on dangerous infectious disease, is factored in portfolios of pharmaceutical companies' stocks in the U.S. Sun et al. (2021) augment the work of Donadelli et al. (2017) to investigate the impact of COVID-19 on

different stock markets and the effect of individual investor sentiment on medical stock portfolio returns. Mishra and Mishra (2020) investigate the impact of investor sentiment triggered from COVID-19 on major stock markets in Asia. Baker and Wurgler (2006) define investor sentiment as the tendency by investors to speculate about future cash flows and investment risk that is not factually justified based on available information. Certain events may lead to erroneous beliefs and preferences of investors which may transform to a positive or a negative investor sentiment that leads to irrational investment decisions. Sunders (1993) finds that investor psychology systematically influences stock prices and argues for including behavioural variables in asset pricing models.

In spite of an overall negative sentiment due to disease risk of COVID-19, it can lead to new revenue channels for healthcare, telecommunication and insurance companies. A pandemic outbreak of COVID-19 magnitude demands higher R&D investment in healthcare, or an increase in demand for hygiene measures and immune medicine, which are considered new business opportunities and increase in income levels for healthcare companies. Due to the increased health risk, insurance companies are likely to expand their income levels from new health and life insurance policies. On the other hand, travel restrictions to control the spread of the pandemic induce remote working arrangements connected via internet based solutions and online meetings, and online shopping resulting new business opportunities and increased revenue channels for telecommunication companies. The same might act as a harmful force to hotel sector companies when people are confined to their houses limiting mobility. When consumption and investment activities are contracted, banking sector is directly impacted due to loss of income.

Following the Pandemic Related News (PRNs), a positive investor sentiment is expected in the stock returns of healthcare, telecommunication and insurance companies, and a negative investor sentiment in the stock returns of banking and hotel sector companies. A positive sentiment may be inspired by optimistic beliefs about new product development by healthcare, telecommunication and insurance companies in the aftermath of disease outbreak anticipating an increase in the cash

inflows due to potential new business opportunities. A negative investor sentiment may be triggered by pessimistic beliefs about loss of revenue for banks and hotel sector companies due to the contraction of economic activities.

The focus of this paper is COVID-19 pandemic outbreak, and the effect of investor sentiment elicits from pandemic fear, on a variety of sector portfolio stock returns in Sri Lanka using an event study and a regression-based econometric analysis. In this study, it is hypothesised that PRNs might have a positive and relatively persisting effect on healthcare, telecommunication and insurance companies' stocks, but a negative and persisting effect on banking and hotel sector stocks. PRNs are defined as news information related to COVID-19 pandemic outbreak which potentially impacts the investment decisions of CSE investors. A "Fear Gauge Indicator" (FGI) is used as a proxy for investor fear sentiment provoked from pandemic risk, which is expected to exert a significant effect on portfolio stock returns in the regression model.

The World Health Organisation (WHO) declares COVID-19 as a global pandemic on the 11th March 2020. The impact of this news event on stock returns in CSE, Sri Lanka on the immediately following day, 12th March 2020, is focused for the event study in this paper. A dangerous infectious disease like COVID-19, which is deemed to have large negative consequences on the economy and the society, can generate certain sector-specific positive investor sentiment. This means, on one side, the event is seemingly good news to certain sectors, such as, healthcare, telecommunication and insurance companies with avenues for new revenue opportunities, whilst the event is likely to be a bad news for banks and hotel sector companies.

An event study is used to measure the economic impact of a specific event on firm value by examining security return over an event window compared to the expected rate of return on the security (MacKinlay, 1997). When financial markets are efficient, the effects of an event are likely to reflect immediately in security prices. Event study method is widely applied in economics and finance research to measure abnormal returns on a specific class of stocks from an unanticipated corporate event and announcement of macroeconomic variables (McWilliams and Siegel, 1997;

MacKinlay, 1997). Event study methodology is used to obtain an indication on the level of stock market efficiency from the extent of abnormal returns caused by the event (Kothari and Warner, 2004). Precise specification of a normal performance model, an estimation window and an event window with appropriate lengths are important in an event study analysis to accurately estimate abnormal returns from a consequential event.

1.2 Problem Statement

COVID-19's devastating impact is everywhere in the economy as it creates enormous uncertainty leading to numerous dilemmas. This research intends investigating if COVID-19 pandemic outbreak significantly impacts on the stock market in Sri Lanka, and market adjustments are in conformity with the underlying fundamentals of the Efficient Market Hypothesis. It further explores which business sector portfolio returns are significantly impacted and in what degree; and finally if investor sentiment, drawn out from COVID-19 pandemic event, is a significant force behind determining stock price movements, and the extent to which such investor sentiment is divergent, sector specific and persistent over time.

1.3 Research Questions

Following research questions are addressed in this study.

What is the extent to which COVID-19 pandemic outbreak impacts on stock returns?

How influential the investors' COVID-19-induced fear mood is, in driving negative sector portfolio returns?

Does the outbreak of COVID-19 disease inspire a positive sector-specific investor sentiment on portfolio returns?

What is the level of persistence of investors' optimistic or pessimistic sentiment about the future stock performance over time?

1.4 Hypotheses

Following hypotheses are constructed in testing the impact of PRNs and the effect of investor sentiment on stock returns in CSE using five different sector portfolios, namely, healthcare, telecommunication, insurance, banking and hotel sector companies in Sri Lanka.

Hypothesis	**Description**
Null-hypothesis	COVID-19 pandemic has no impact on stock returns indicating zero abnormal returns.
Alternative Hypothesis 1	COVID-19 pandemic leads to radical uncertainty, pessimism among investors, generating a fear sentiment which will negatively affect the portfolio returns.
Alternative Hypothesis 2	COVID-19 pandemic inspires a positive sentiment effect on particular sector portfolio returns.
Alternative Hypothesis 3	The investor sentiment, provoked from COVID-19 pandemic, has a persistent effect on the portfolio returns over time.

1.5 Research Objectives and Approach

The overall objective of this research is to investigate the stock market's reaction in the context of the frontier market, Sri Lanka in response to COVID-19 pandemic and the effects of investor sentiment elicit from the outbreak.

Research objectives are defined as follows;

The first objective is to explore if COVID-19 pandemic outbreak leads to significant abnormal stock returns.

Secondly it intends to assess the level of influence of COVID-19-induced fear-mood of investors on generating negative sector portfolio returns.

Third objective is to identify any positive effect of COVID-19-induced investor-sentiment on particular sector portfolio returns.

Finally, it aims to determine if the effects of investor-sentiment (optimistic or pessimistic) on portfolio returns continue persistently over time.

Equally-weighted five sector investment portfolios are constructed, using 10 healthcare firms' stocks, 02 telecommunication firms' stocks, 09 insurance companies' stocks, 11 banks' stocks and 36 hotel companies' stocks traded in the Colombo Stock Exchange. This empirical work is drawn on event study and regression-based econometric analyses to examine the effects of investor sentiment on stock returns in CSE following the PRNs.

A first-stage event study approach is used to assess the impact of declaration of COVID-19 as a global pandemic by the WHO on CSE stock returns. Cumulative abnormal returns are computed on sector portfolios in the event window and the ex-post expected rates of return are estimated using the parameter estimates of the Market Model (MM). Market Model is more appropriate to estimate expected stock returns in Sri Lanka over other asset pricing models as the market portfolio return is the main determining factor of stock returns in Sri Lanka (Anuradha, 2008; Nimal and Fernando, 2013). Abnormal returns reflect the difference between the ex-post expected rate of return of a stock and its observed rate of return in the event window (MacKinlay, 1997).

A second-stage regression-based methodology is adopted to evaluate the impact of PRNs and to identify the effect of investor sentiment on sector portfolio returns throughout the study period from 1st April 2019 to 30th June 2021. A novel mood variable of investor Fear Gauge Indicator (FGI), constructed by reference to the continuously compounded daily growth rate of COVID-19 cases in Sri Lanka, is used as a proxy for investor fear sentiment in the regression analysis. The WHO's COVID-19 related news declarations, local government lockdown orders, especial media releases in relation to COVID-19, reported new Coronavirus variants in Sri Lanka and other related news about COVID-19 outbreak during the study period, as detailed in Annexure 1(a), are considered as PRNs in the regression model. This intends assessing the effect of PRNs and the consequential positive or negative investor sentiment, provoked by COVID-19 pandemic, on sector portfolio returns and capture any persisting sentiment effect.

1.6 Significance of the Study

Researches of this nature are vital to understand the effect of pandemic, anywhere in the world since people are still perplexed by the enormity of it. Studies on COVID-19's impact on global capital markets are prolific in the event study and behavioural finance literature, but investigations of its implications in the frontier market, CSE is somewhat scarce. The main contribution derives from employing event and sentiment variables (PRNs and FGI) in Sri Lankan context, to explore the effect of investors' pandemic-tempted fear mood on portfolio stock returns representing five key business sectors in CSE, namely, healthcare, telecommunication, insurance, banking, and hotel sector companies.

As per the author's knowledge, the effect of investor sentiment, provoked by COVID-19 pandemic outbreak, on sector portfolio returns has not been investigated in the context of frontier market, Sri Lanka. Moreover, the study contributes to the literature with an evaluation of the balance between two complementary effects of COVID-19 outbreak; the disease fear of pandemic, which is likely to generate a

pessimistic sentiment in stock returns, and a positive sentiment effect on sector-specific portfolio returns.

1.7 Limitations of the Study

COVID-19 pandemic is a new phenomenon, the consequences and implications of the event are complicated and confounding, which leads to different preferences and erroneous beliefs of investors about stock prices. As such, measuring the event's real impact on firm value and stock returns, and gauging the influence of investor sentiment are challenging due to its confounding nature in an empirical scope. The proxy used for investor sentiment might not be representing all sentiment-related features of both individual and institutional investors.

Moreover, controlling for all exogenous macroeconomic factors and the possible endogeneity of variables is enigmatic given the event's compounding implications on the economy and the society. The accuracy of the normal performance model deployed to estimate expected rate of return is not tested in this study as it assumes the expected rate of return is accurately measured by the Market Model in estimating abnormal returns. Given the nature of the event under study, PRNs are seemingly dynamic and persistent, even a precise event window is highly likely to be confounded, which might stand as a limitation to accurately disentangle the real abnormal return caused by the event. A regression-based econometric analysis is used with appropriate control variables to address this.

1.8 Structure of the Thesis

The thesis is in six sections of which this is the first that presents an introduction to the study. Section 2 presents a review of literature on neoclassical asset pricing and emergence of behavioural finance and event studies. Section 3 describes the data collection process and reports descriptive statistics. Section 4 outlines the research

design and methodology and formulates main hypotheses. Section 5 presents empirical results and a discussion. Section 6 concludes the paper highlighting policy implications and potential areas for future research.

2.0 LITERATURE REVIEW

2.1 Efficient Market Hypothesis and Stock Prices

Fama (1970), the father of iconic Efficient Markets Hypothesis (EMH), hypothesises that stock prices always fully reflect available information as markets are efficient at incorporating all known information about the value of an asset. This assumes that consecutive price changes are self-occurring as prices follow random walk, which indicates market efficiency. If there is any mispricing rational arbitragers immediately react and drive the stock prices to its true intrinsic value. As such, in an efficient market, it is expected that no one is offered a chance to make abnormal returns over and above the risk-adjusted return, unless it is by chance (Arnold, 2013). There are 3 stages of informational efficiency; weak form efficiency (reflects all past information), semi-strong form efficiency (reflects all publicly available information) and strong form efficiency (reflects all private information including insider information). If a market in semi-strong form is efficient, as soon as new information come in, the stock prices should immediately react to reflect the current information. However if it under-reacts or over-reacts to the publicly available information, it is assumed that the market is not semi-strong form efficient. Advocates of EMH argue that even if anomalous patterns evolve due to slight deviations or a chance (Fama, 1998), they are self-destructive once they are discovered and publicised to the market. Hence, such anomalies do not allow for consistent abnormal returns to investors.

The scholarly dominance of EMH in the last few decades is seriously challenged amid its failure to fully explain cross sectional variation in stock returns and perceived anomalous pricing patterns. In this context, behavioural asset pricing is emerged as a new breed of asset pricing model in explaining stock return variations. Behaviouralists assert psychological and behavioural elements as the force behind stock-price determination, and they hypothesise that stock prices are driven by investors' psychological influences. Moreover, this new breed of economists starts to believe that stock prices are predictable and hence abnormal returns persist. Shiller

(1981) challenges the EMH's predominant underpinning and demonstrated that stock prices are much more volatile than the stock's intrinsic value would suggest. Shiller (2003) argues that most stock market volatilities are unexplained by rational fundamental causes, as they evolve consequent to investor psychology about stock prices. Shiller's view attracts more credence in providing logical explanations for market bubbles and crashes which are mainly driven by excessive optimism and pessimism of investors' irrational behaviour. Proponents of EMH argue that most market volatilities are fundamental adjustments to changes in the market environment, but are misinterpreted by psychological contagion effects of investors leading to irrational price movements. Malkiel (2003) ascribes that the stock market crash in 1987 is a classic example for this when the market environment clearly indicates that prices should downward adjust due to sharp increase in interest rates and increase in risk perceptions. Capelle-Blancard and Desroziers (2020) assess the impact of COVID-19, the consequential lockdowns and the governments' policy measures on the sensitivity of stock market reactions during the crisis, and find that a majority of the stock returns variations is not explained by the fundamentals.

Proponents of Efficient Market Hypothesis allot the observed market anomalies (Basu, 1977; 1983; Banz, 1981; Bhandari, 1988; Jegadeesh and Titman, 1993; Lakonishok et al., 1994; Lo and MacKinlay, 1999) to a bad model problem, and mis-specified asset pricing model used for measuring expected stock returns (Fama, 1998). Accordingly, the Capital Asset Pricing Model (CAPM) (Sharpe, 1964; Lintner, 1965; Black, 1972) with single beta as a measure of systematic risk is later augmented in numerous empirical studies (Fama and French 1993; 2015; Cahart, 1997). Alternatively, a breed of behavioural asset pricing models is emerged to provide a psychology-based explanation to perceived market anomalies. Under-reaction and short-term momentum effect (Ball and Brown, 1968; Jones et al., 1985; Poterba and Summers, 1988; Jegadeesh and Titman, 1993; Lo and MacKinlay, 1999), long-run return reversal (De Bondt and Thaler, 1985; Chopra et al., 1992; Arnold and Baker, 2007), seasonal effects (French, 1980; Lakonishok and Smidt, 1988; Haugen and Lakonishok, 1988; Ariel, 1990), value stocks anomaly (Basu, 1977; 1983; Lakonishok et al., 1994), and firm size effect (Reinganum, 1981; 1992;

Banz, 1981; Keim, 1983; Banz and Breen, 1986) are among prominent anomalies conferred in the empirical literature.

Basu (1977; 1983) finds strong evidence of Price-Earnings anomaly as he observes a predictable patter of stock returns by reference to Price-Earnings (P/E) ratio of stocks and constitutes the price-ratio hypothesis. Empirical work of Reinganum's (1981); Banz's (1981); Banz and Breens' (1986) suggest the dominance of firm-size effect over the Earning to Price (E/P) effect. Jaffe et al. (1989) find that firm-size and E/P ratio jointly explain stock returns extensively. Lakonishok et al. (1994) find superior performance from value stocks over glamour stocks. Jegadeesh and Titman (1993) detect short-run momentum behaviour of stock prices with a period to period continued pattern of high returns. Lo and MacKinlay (1999); Poterba and Summers (1988) reveal strong under-reaction effect as they observe many consecutive moves towards same direction, leading to short-run positive serial correlation, which led them to conclude that stock prices have some predictive power. Ball and Brown (1968); Jones et al. (1985) too observe short-term delayed response to earnings announcements, constituting evidence of under-reaction. As prices adjust gradually to earnings announcements, predictable price patterns appear resulting excessive returns (Shiller, 2000). Klibanoff et al. (1998) find that when an announcement attracts the attention largely and rich in information, the fund prices can incorporate the content of the announcement faster. Investors' overconfidence about their ability to forecast future stock returns reflects as over-reaction to new information with subsequent correction effects, which is in consistent with the behavioural decision hypothesis of Kahneman and Tversky (1979).

Empirical evidence on long-run return reversal anomaly posits that prior losers rebound and winners fade back due to initial over-reaction and subsequent correction (De Bondt and Thaler, 1985; Chopra et al., 1992; Arnold and Baker, 2007). These findings give rise to a 'contrarian' investment strategy of buying stocks which underperformed for long periods of time and keeping away from those stocks that have largely excelled over the last several years. Fama (1998) argues that long-run return reversal is a result of interest rates reversing to mean. Few calendar anomalies

are discussed in the literature; turn-of-the-month effect (Lakonishok and Smidt, 1988); holiday effect (Ariel, 1990); January effect (Haugen and Lakonishok, 1988). French (1980) finds three times higher Monday returns compared to other four days for the week, but argues that the moment these seasonal effects are identified and publicised they seem to be self-destructive, hence not dependable from period to period, and these seasonal anomalies do not offer sizable returns above the risk-adjusted return given the higher transaction cost involved in exploiting them.

Reinganum (1992) finds evidence that investors can earn excessive returns by investing in small market cap stocks. Keim's (1983) study reveals that small-cap stocks in the United States produce higher annual return than from large-cap stocks, which is later validated in a study by Fama and French (1993). Banz (1981) finds that small-cap shares tend to deliver higher returns than those of larger companies and constitutes evidence that Capital Asset Pricing Model (CAPM) is mis-specified. Barberis and Shleifer (2000) give an explanation to Banz's findings from their 'style investing model' explaining as switchers' effect in favour of small-cap stocks which tends to divert funds to small-cap stocks causing price increases which then attracts more switchers towards small-cap stocks continuously. Empirical results on small-cap anomaly run contrary to EMH if one accepts that CAPM beta as the comprehensive risk measure that explains cross sectional variation in stock returns. Empirical evidence on market anomalies leads to a joint-hypothesis dilemma of either stock market inefficiencies or misspecification of CAPM (Banz, 1981; Basu, 1977; 1983; DeBondt and Thaler, 1985; DeLong et al., 1990; and Shleifer and Vishny, 1997; Rathnasekara, 2017). This results in a new asset pricing model of Fama and French (1993) three-factor model including additional two factors based on proportions of excess returns on portfolios formed on size feature and price-to-book-value ratio as appropriate measures of risk, as further augmented by Carhart (1997) introducing a momentum factor making a four factor model, which again expanded by Fama and French (2015) with two more additional variables, for profitability and investment aspects, introduced to their former Fama and French (1993) three-factor model to constitute Fama and French (2015) five-factor model.

2.2 Behavioural Finance and Stock Prices

Nanayakkara et al. (2019) review the advancement of behavioural asset pricing. Neoclassical asset pricing is based on rational beliefs and preferences, which use fundamental facts through Bayesian updating (Celik, 2012) and principles of maximised expected utility theory (Morgenstern, 1944). Behavioural finance, in contrast, is based on psychological biases and heuristics, resulting from investors' erroneous beliefs and preferences. Erroneous beliefs occur in two possible ways; by wrongly used right information (Barberis et al., 1998; Shefrin, 2009) or correctly used erroneous information (Barberis and Thaler, 2003). Erroneous beliefs reflect as investor sentiment in financial markets which leads to irrational investment decisions (DeLong et al., 1990; Baker and Wurgler, 2006; Cao and Wei, 2005; Curatola et al., 2016; Kaplanski and Levy, 2010; Cen and Liyan-Yang, 2013; Brown and Cliff, 2004; Donadelli et al., 2017; Sun et al., 2021). Prospect theory of Kahneman and Tversky (1979) shows how decisions are made in the real world by comparing outcomes with an initial reference point, rather than judging them on an absolute scale.

Neoclassical asset pricing models on their own fail to explain stock return variations by reference to true intrinsic value of stocks. Hence, the scholarly dominance of neoclassical asset pricing, which is based on market efficiency and rational investor behaviour, is challenged by the emergence of behavioural finance, which hypothesises that investors' decisions are driven by human psychology which is not always fully rational (Barberis and Thaler, 2003). People tend to use emotional judgments to make decisions ignoring information that may lead to errors in investment decisions (Marewski at el., 2010; Shefrin, 2002). Behavioural finance literature identifies a vast array of psychological decision biases and heuristics (Tversky and Kahneman, 1974; Hirshleifer, 2001). As such, behavioural asset pricing models attempt to capture specific biases of investor psychology in explaining cross sectional variation of stock returns (Daniel et al., 1997; Barberis et al., 1998). Behavioural models proposed by Barberis et al. (1998) and Daniel et al.

(1997) explain how investors over-react to certain events and under-react to others based on their judgment biases.

Barberis et al. (1998) develop a behavioural asset pricing model based on two judgment biases; the representativeness bias and conservatism. The model demonstrates that one regime of investors misreads increase in earnings as a mean-reverting mechanism and under-reacts to the change in earnings as they sluggish to realise that the company has entered a growth phase. The other regime of investors incorrectly extrapolates an earnings change of the same sign creating an over-reaction effect. The first regime of investors is inspired by short-run momentum effect in stock returns and delayed responses of stock prices to earnings announcements. Daniel et al. (1997), in their behavioural model, explain market under-reaction and over-reaction anomalies based on two investor biases; overconfidence and self-attribution, which lead to momentum effects causing over-reaction to price information.

Behavioural asset pricing models are developed on the key underlying assumptions that investors are not always fully rational and there are limits to arbitrage. As such, the investment decisions are made subject to psychological biases provoked from irrational beliefs and preferences (Nanayakkara et al., 2019). Acts of rational arbitrageurs are not assertive enough of bringing the stock prices to their true fundamental values given the high unpredictability persists in markets which are dominated by noise traders (Black, 1986; Shleifer and Vishny, 1997). The noise trader theory of Black (1986) suggests that irrational investors trade on noisy signals that are unrelated to fundamentals, making security prices deviate from their true intrinsic values (Baker and Wurgler, 2007). This assumes that investor sentiment reflects noise traders, and leads to investment decisions not supported by fundamentals, exhibits poor market timing, that follows trends, resulting over-reaction or under-reaction to good or bad news (Ramiah et al., 2015). Noise traders help increase the liquidity level of the market due to excess volatility created by noise (Black, 1986). Baker and Stein (2004) find high market liquidity as an indicator of sentiment, dominated by irrational investors, and suggest to use as an

indirect proxy in constructing a composite sentiment index (Brown and Cliff, 2004; Baker and Wurgler, 2006).

Mehra and Sah (2002) and Nofsinger (2005) analyse how moods and feelings translate to emotional decision making in financial markets. Chung et al. (2012), and Beaumount et al. (2008) define investor sentiment as investor error leading to excessive optimism or pessimism about future cash flows and risks of a firm. As such, investor sentiment represents the irrational investors' erroneous beliefs on rules of thumb about future cash flows (Shleifer and Summers, 1990; Brown and Cliff, 2004). Behavioural literature discusses two types of sentiment measures; direct and indirect or explicit and implicit (Chung et al., 2012). Direct or explicit measures attempt to capture the mood of the market directly through surveys, whereas indirect or implicit measures are based on constructed proxy measures or composite indices from objectively observable data, such as closed-end fund discount (Lee et al., 1991); share turnover (Brown and Cliff, 2004); equity shares in new issues (Baker and Wurgler, 2000; Neal and Wheatley, 1998); dividend premium (Baker and Wurgler, 2000); time varying market liquidity (Baker and Stein, 2004; Baker and Wurgler, 2000) and the number and average first day returns on IPOs (Baker Wurgler, 2006).

Investor sentiment is difficult to measure precisely (Nanayakkara et al., 2019), but a vital element in asset pricing and behavioural models in explaining cross-sectional variations in stock prices (Bondt et al., 2008). Baker and Stein (2004) find high market liquidity as a sentiment indicator of the dominance of irrational investors, where the managers tend to time the market for seasoned equity offerings. Naseem et al. (2021) create an investor sentiment index based on principle component analysis (PCA) for Shanghai stock market, Nikkei, and Dow Jones using a variety of proxy variables which include change in daily confirmed COVID cases and change in daily confirmed deaths. Sun et al. (2021) too construct investor sentiment indices, using PCA techniques, for different types of investors.

Neal and Wheatley (1998); Baker and Wurgler (2007); Baker and Stein (2004) use indirect measures of investor sentiment whilst, Brown and Cliff (2004) uses both indirect and direct measures. Given the difficulty in selecting the best proxies that

measure investor sentiment appropriately, literature suggests composite sentiment indices that compact the effects of different proxy measures. The composite sentiment index developed by Baker and Wurgler (2006) includes six underlying proxies of sentiment, and the composite index of Brown and Cliff (2004) is based on eleven indirect measures of sentiment. Cook et al. (2006) capture investor sentiment in U.S. markets using a number of news headlines in financial or economic periodicals. Trading volume (Baker & Stein, 2004), dividend premium (Lee et al., 1991), bond yield spread (Nayak, 2010) and prices in the pre-IPO (Cornelli et al., 2006) are successful in empirical work. Higher trading volume may indicate an exaggerated level of investor enthusiasm. Higher IPO period reflects greater demand for new equity shares (Brown and Cliff, 2005) indicating an upward sentiment. Feldman (2010) suggests a perceived loss index, as a new sentiment measure, appropriate in revealing stock market bubbles and crashes. Jiang and Li (2013) calculate a Google Search Volume Index (SVI) and use it as a direct measure of investor attention.

Some of the proxy variables for investor sentiment may be impractical to use in the frontier market Sri Lanka, for instance, closed-end fund discount (Baker & Wurgler, 2007), debt issues to equity issues and put-call option ratio are inappropriate in Sri Lankan context due to its under-developed debt and derivative markets. Nanayakkara et al. (2019) propose direct and indirect measures of investor sentiment appropriate to Sri Lankan context, and identify three available direct measures that can possibly be used to signify the investor sentiment and recommend six indirect proxy measures for constructing a composite sentiment index.

In the midst of perceived empirical anomalies, which are predominantly driven by investors' psychological biases and heuristics, behavioural variables are required to encompass in asset pricing models to capture investor sentiment. Behavioural finance is an embedded discipline of the mainstream finance, and neoclassical asset pricing with such behavioural variables embedded together might better explain cross sectional variations in stock returns (Subrahmanyam, 2007).

2.3 Event Studies

Primarily, the event study methodology is developed, as a test of semi-strong form market efficiency in measuring the effects of an unanticipated event on stock prices (Kothari and Warner, 2004). McWilliams and Siegel (1997) affirm that abnormal returns, estimated in reference to parameter estimates from a normal performance model, are assumed to reflect the stock market's reaction in response to new information from an unanticipated event. The first notable event analysis of Dolley (1933) scrutinizes the price impacts of stock splits, and finds evidence of consequent increases and decreases of share prices. Seminal studies in this space are carried out by Ball and Brown (1968) and Fama et al. (1969). Empirical studies suggest efficient adjustments of stock prices, within few minutes of releasing announcements, to reflect the information content of announcements in stock prices (Dann et al., 1977; Mitchell and Netter, 1989). A significant negative war sentiment effect is observed by Kaplanski and Levy (2012) during the 1973 Arab–Israeli War. A major breakthrough in cancer research tempts an enthusiastic public attention on stock prices (Huberman and Regev, 2001). Donadelli et al. (2017) examine how pharmaceutical companies' stock portfolios in the United States react to disease-related news on dangerous infectious diseases and document a positive and significant sentiment effect among investors of pharmaceutical companies' stocks in response to disease-related news. Sun et al. (2021), augmenting the empirical work of Donadelli et al. (2017), explore the influence of investor sentiment, provoked by COVID-19 outbreak and macroeconomic-related news, on medical stock portfolios in China, Hongkong, Korea, Japan, and U.S., and find a significant and positive sentiment effect on the medical portfolios, constituting evidence of optimistic investor attention on the medical industry.

An event window should be in an appropriate length to capture the significant effect of the event (McWilliams and Siegel, 1997) and as short as possible to control for confounding effects (Fama, 1991). Meznar et al. (1994) find confounding events during a 3-day event window immediately surrounding the event. Salinger (1992) subtracts the impact of confounding events inside the event window. Davidson and

Worrell (1988) use a relatively long event window to analyse the effects of firms being found guilty of illegal acts. McGuire et al. (1988) study the effects of appointments of top managers to cabinet positions using a 51-day window. Systematically non-zero abnormal returns that continue persistently after a particular event are inconsistent with the underlying principles of the efficient market hypothesis (Brown and Warner, 1980). Jayakody (2017) finds that depending on the nature of the terrorist attack, different industries experience the impact of the attack in a heterogeneous manner. In long-horizon tests, compared to short-horizon tests, abnormal price performance is highly sensitive to appropriate adjustment for risk (Brown and Warner, 1985).

There has been a considerable response from the scientific cohort through empirical investigations of COVID-19 pandemic's impact on many aspects of the society, especially on stock market performance. Delatte and Guillaume (2020) find that the pre-2020 fiscal situation, the stability of the banking sector and healthcare capacity mitigate the impact of the pandemic. Haddad et al. (2020) notice a recovery of the U.S. debt market from COVID-19 crisis once the Fed implemented quantitative easing techniques. Baker et al. (2020) show the unprecedented impact of COVID-19 pandemic on US stock markets by comparing market volatility during COVID-19 crisis with that of previous epidemics and large historical financial crashes. Gormsen and Koijen (2020) find that changes in investors' expectations and discount rates mainly affect the drop in stock prices during COVID-19. Giglio et al. (2020) explore and find that retail investors turn more pessimistic in the short run, during February, March and April 2020, compared to long run.

In an analysis on daily abnormal stock returns during January to March 2020, Ramelli and Wagner (2020) reveal strong differences between industries and within industries. Ding et al. (2020) find that firms with stronger pre-2020 financial standings are resilient to COVID-19 pandemic and reported relatively less negative weekly returns. Fahlenbrach et al. (2020) find worse stock returns in firms with less financial flexibility during early periods of COVID-19 outbreak in the U.S., but they benefit more from monetary stimulus on 24th March 2020. Heyden and Heyden

(2020) show that shareholders react negatively to the news of the first COVID-19 related deaths, than to the first cases, but positively to the announcement of expansive monetary policy. Asharaf (2020) suggests that stock markets reactions are more sensitive to the growth in confirmed cases of COVID-19 than those of deaths, but the effects are short-term. Ru et al. (2020) show a strong response by countries, those previously hit by the 2003-SARS epidemic, to COVID-19. Gerding et al. (2020) show a stronger stock price reaction in response to COVID-19 in countries with higher debt-to-GDP ratio.

3.0 DATA COLLECTION

3.1 Description of Data

The World Health Organization (WHO) declares COVID-19 to be a pandemic on 11th March 2020, when it is clear that the illness is spreading quickly across countries or continents (www.who.int). COVID-19 cases are first reported in China in December 2019, and the first case from Sri Lanka is reported on 27th January 2020. Consequent to these events, the Government of Sri Lanka imposes an Island–wide lockdown curfew with effect from 16th March 2020 to control the spread of the outbreak. The main event point for this study is chosen as, 11th March 2020; the day on which COVID-19 is declared as a global pandemic by the WHO. It is expected that the effect of this declaration event on 11th March 2020 to reflect on CSE on the day immediately following the declaration news.

Island-wide lockdown curfew, which imposed with effect from 16th March 2020, is lifted on 11th May 2020. The CSE does not operate its trading activities during this lockdown period from 16th March 2020 to 11th May 2020 except for one day, 20th March 2020. As such, after COVID-19 is declared as a global pandemic by the WHO on 11th March 2020, two major events occurred in Sri Lanka; imposing Island-wide lockdown curfew on 16th March 2020, and lifting the same on 11th May 2020. These two events fell inside the post event window as elaborated in Figure 4.1. Declaration of COVID-19 as a pandemic on 11th March 2020, and imposing Island-wide lockdown curfew on 16th March 2020 are considered as bad news to financial markets, whilst lifting the Island-wide lockdown curfew on 11th May 2020, after a long lockdown period of 56 days, is considered as a positive stimulating news to financial markets. The Government's COVID-relief moratorium packages to businesses further stimulate the rebound.

It can be assumed that the effects of the rebound either negate the extent of the negative effects of the declaration news on 11th March 2020 or surpass the negative effects. As such, the expected negative abnormal returns that might have prevailed consequent to the declaration event on 11th March 2020 might have been outweighed

to some extent or surpassed by the positive abnormal returns inspired from the stimulating events on 11th May 2020.

For regression-based econometric analysis, PRNs are defined as WHO's COVID-19 related news declarations, local government lockdown orders, especial media releases in relation to COVID-19, reported new Coronavirus variants and other COVID-19 related news which are extracted from various internet based sources and media and press releases. Share price data for this study are collected from the Data Library in Colombo Stock Exchange (CSE) and published Annual Reports of companies that are listed in the CSE. CSE is a frontier market, licensed by the Securities and Exchange Commission of Sri Lanka for securities listed for public transactions in Sri Lanka. Approximately 300 companies representing nearly 20 industry groups are listed in the CSE. Equally-weighted sector portfolios are formed using 11 companies representing the healthcare sector, 02 companies representing the telecommunication sector, 09 companies representing the insurance sector, 11 banks representing the banking sector, and 36 companies representing the hotel sector. Daily stock price data from 1st April 2019 to 30th June 2021 are collated and continuously compounded daily percentage return on each of above equally-weighted portfolio classes are computed.

The study examines the impact of PRNs and the effect of investor sentiment on portfolio returns of five business sector stocks listed in the CSE, using a first-stage event study methodology followed by a regression-based econometric analysis. The impact on the S&P SL 20 Index is also reported as a benchmark portfolio. COVID-19 pandemic is likely to be a good profitable opportunity for healthcare, telecommunication and insurance companies on one side, but likely to be a bad event for banks and hotel sector companies. Companies in the healthcare sector are expected to increase their profitability with excessive demand for medicine and hygiene products. Telecommunication companies are likely to be more demanded for internet-based solutions to facilitate remote working arrangements and excessive usage of internet. Owing to the swelling health related concerns and disease risk from the pandemic, insurance companies are likely to be sought for increased health

and life insurance policies. Banks are likely to be hit by moratorium reliefs of deferred debt repayments and interest subsidies recommended by the Central Bank. When economic activities are contracted, banks' income levels are inevitably reduced. Hotel sector companies are directly affected owing to travel restrictions. Stock return behaviour of these business sectors intends providing a reasonable comparative framework for testing the impact of the pandemic event and its related sentiment effect on firm value of different business sectors. All-Share-Price-Index (ASPI) in the Colombo Stock Exchange is used as a proxy for the market portfolio. Continuously compounded daily growth rate of COVID-19 cases in Sri Lanka is used as a proxy for investor fear sentiment. Figure 3.2 elaborates a quantitative depiction of the FGI that represents COVID-19-induced investor fear sentiment and performance of CSE stock indices. Figure 3.1 outlines how erroneous beliefs and preferences of investors, triggered from pandemic related news (PRNs), cascade to investor sentiment leading to irrational decision making.

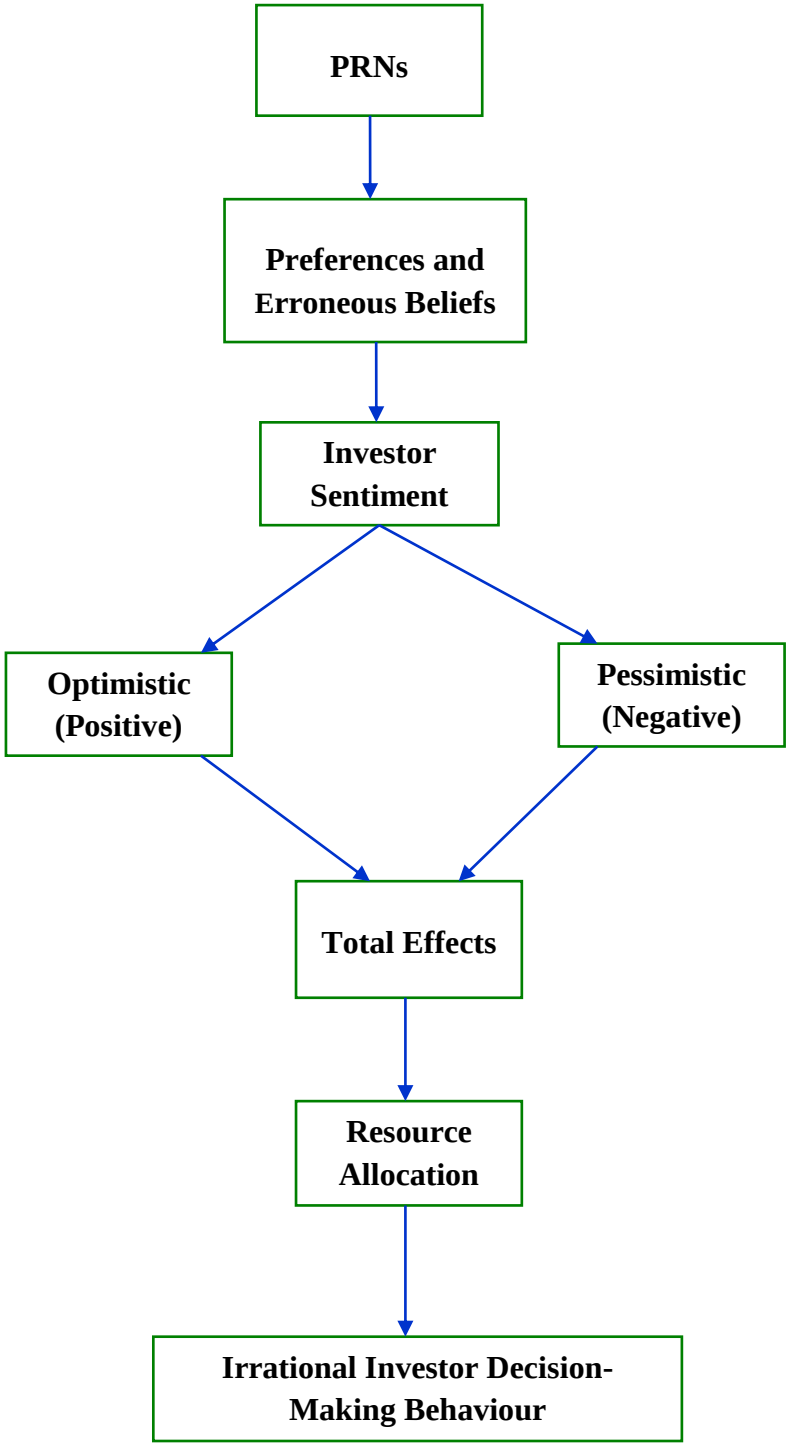

Figure 3.1: Investor Sentiment and Irrational Behaviour

(Source: Sun et al., 2021 and augmented based on author's interpretation)

3.2 Descriptive Statistics

Trading-day-closing prices of stocks are extracted from the Colombo Stock Exchange from 1st April 2019 to 30th June 2021, which gives a 27-month period with 507 trading days. Specifically, equally-weighted five benchmark sector portfolios representing five different industry groups are constructed as listed in Annexure 2. The portfolio cross-sections include 10 healthcare sector companies, 02 telecommunication sector companies, 09 insurance sector companies, 11 banks, and 36 hotel sector companies that are listed in CSE. Continuously compounded daily percentage returns [*Log(Present Trading-Day Closing Share Price / Previous Trading-Day Closing Share Price)*] on the aforementioned portfolios are computed and Table 3.1 presents descriptive statistics. Figure 3.3 and 3.4 show sector portfolio performance and daily returns during the study period.

Over the full sample period from 1st April 2019 to 30th June 2021, the mean return on the healthcare, telecommunication and S&P SL 20 Index are 0.078%, 0.069%, and 0.059% respectively, which are noticeably higher than the mean of the remaining portfolios. The mean return on the hotel portfolio is 0.013% and the bank portfolio has a mean return of -0.023%. The highest median of 0.061% records on the healthcare portfolio, whilst the S&P SL 20 Index has the second largest median. Telecommunication portfolio has the largest difference between mean and median. The bank portfolio has the highest variation range between the maximum and the minimum returns (8.052% and -13.027%, respectively) and the insurance portfolio has the lowest (4.005% and -6.312%, respectively). The highest distinctive risk, as indicated by the standard deviation (1.686%), records on the healthcare portfolio, whereas the S&P SL 20 Index bears the least risk to invest (1.167%). Moreover, portfolio returns are negatively skewed, with an exception of the telecommunication and healthcare portfolios. The negative skewness indicates higher likelihood of large negative returns than large positive returns. Furthermore, all five portfolios classes and the S&P SL 20 Index report values greater than zero for coefficient of excess kurtosis. A high value of excess kurtosis gives rise to the perceived non-normality of returns on all five sector portfolios and the S&P SL 20 Index, as measured by the Jarque–Bera test statistic.

Table 3.1: Descriptive Statistics

	Telecom.	**Banks**	**Healthcare**	**Insurance**	**Hotels**	**S&P SL 20**
Mean Return	0.000691	-0.000233	0.000776	0.000320	0.000131	0.000587
Median Return	0.000179	-6.99E-05	0.000607	0.000429	-6.11E-05	0.000563
Maximum Return	0.088405	0.080523	0.123503	0.040052	0.077949	0.067467
Minimum Return	-0.097031	-0.130274	-0.083756	-0.063117	-0.082493	-0.076025
Std. Dev.	0.016435	0.016405	0.016863	0.011677	0.014028	0.011670
Skewness	0.006811	-1.691669	0.772097	-0.703075	-0.226087	-0.551031
Excess Kurtosis	10.23078	19.71720	11.09380	6.965052	10.86089	10.69930
Jarque-Bera	1102.327	6133.393	1420.119	372.4143	1296.793	1275.411
p-values	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	0.349873	-0.117939	0.389681	0.161742	0.065870	0.296882
Sum Sq. Dev.	0.136410	0.135900	0.142463	0.068719	0.098591	0.068779
Observations	506	506	502	505	502	506

Notes: Table 3.1 reports descriptive statistics of continuously compounded daily percentage return on equally-weighted five sector portfolio classes and S&P SL 20 Index.

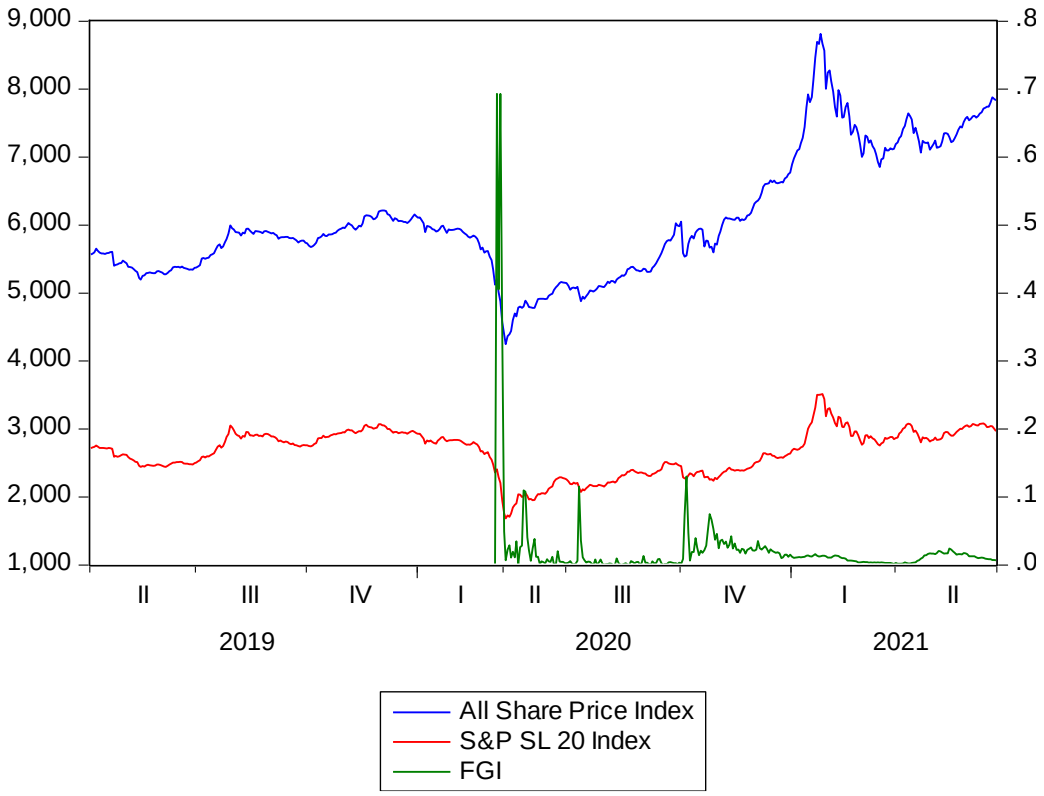

Figure 3.2: FGI for Investor Sentiment triggered from COVID-19 pandemic and Stock Index Performance

Notes: Figure 3.2 shows the level of investor fear sentiment, represented by the FGI, triggered from COVID-19 pandemic outbreak, together with ASPI and S&P SL 20 Index values during the period from 01-Apr-2019 to 30-June-2021.

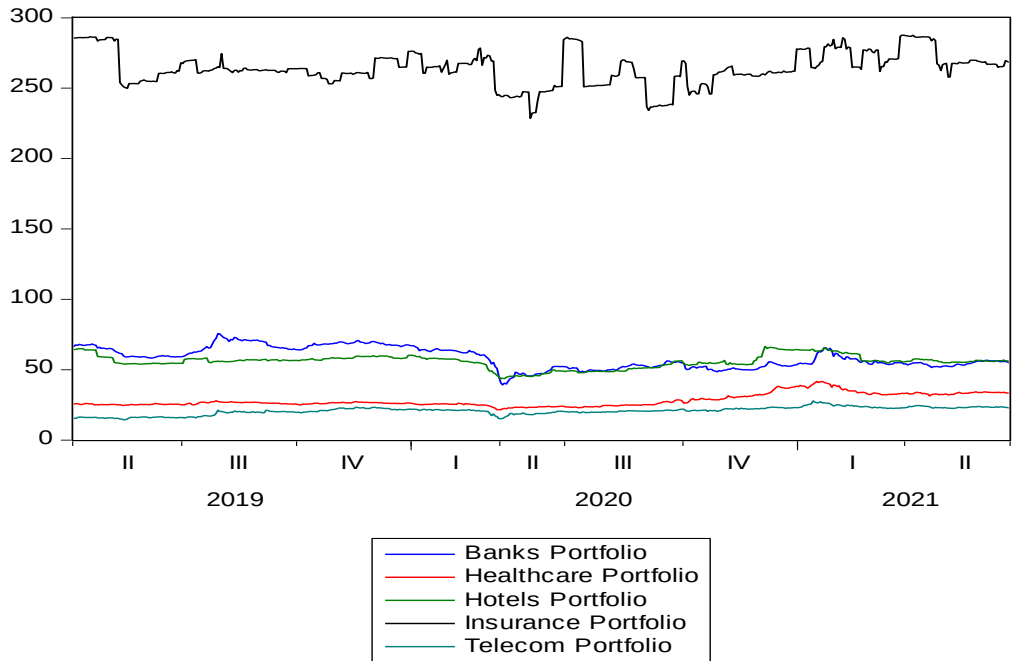

Figure 3.3: Sector Portfolio Performance

Notes: Figure 3.3 shows performance of sector portfolio indices during the period from 01-Apr-2019 to 30-June-2021.

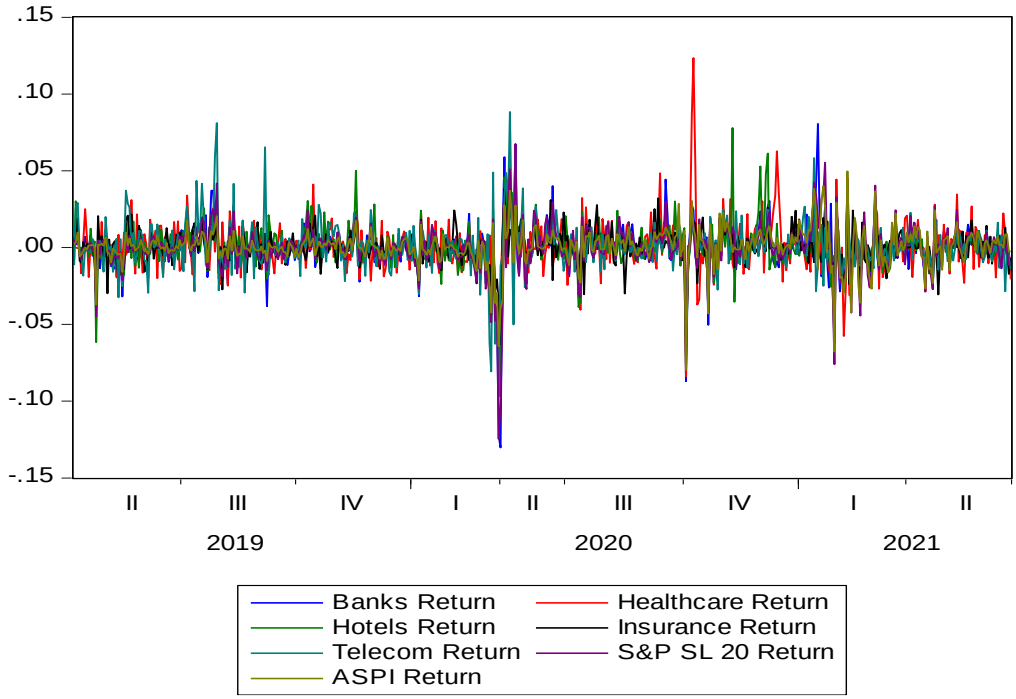

Figure 3.4: Daily Returns on Share Indices and Sector Portfolios

Notes: Figure 3.4 shows daily returns on stock indices and sector portfolios during the period from 01-Apr-2019 to 30-June-2021.

4.0 RESEARCH DESIGN AND METHODOLOGY

4.1 Testing Hypotheses

The testing hypotheses for this research are discussed here. The null-hypothesis (H_0) is developed that PRNs have no impact on stock returns, indicating zero abnormal returns. Alternatively, the pandemic event is likely to emanate a positive sentiment effect and a negative sentiment effect among investors of different sector portfolios. Firstly, a pandemic in this magnitude will lead to radical uncertainty, and negative moods among the stock market investors due to a fear effect exaggerated by media coverage of the outbreak. This may result in a drop in the stock prices. It is assumed that especially banking and hotel sector stocks are likely to be negatively affected. Secondly, the pandemic may create new business opportunities and additional revenue channels and may be perceived as a lucrative investment opportunity. This belief of investors is likely to generate a positive sentiment that drives up stock prices of pharmaceutical, telecommunication and insurance companies. Thirdly, it hypothesises that investors tend to under-react initially to an announcement of the pandemic given the level of complexity and uncertainty of the event, but over-react thereafter. The effects of under-reaction and over-reaction might be persistent over time. The relative attractiveness of the announcement about the event will determine the extent of the under-reaction and over-reaction (Donadelli et al., 2017).

Following hypotheses are constructed in testing the impact of PRNs and the effect of investor sentiment on stock returns in CSE using five different sector portfolios, representing healthcare, telecommunication, insurance, banking and hotel sector companies in Sri Lanka.

Hypothesis	**Description**
Null-hypothesis	COVID-19 pandemic has no impact on stock returns indicating zero abnormal returns.
Alternative Hypothesis 1	COVID-19 pandemic leads to radical uncertainty, pessimism among investors, generating a fear sentiment

	which will negatively affect the portfolio returns.
Alternative Hypothesis 2	COVID-19 pandemic inspires a positive sentiment effect on particular sector portfolio returns.
Alternative Hypothesis 3	The investor sentiment, provoked from COVID-19 pandemic, has a persistent effect on the portfolio returns over time.

The null hypothesis is tested using an event study methodology by reference to the event of declaration of COVID-19 as a global pandemic by the WHO. To test alternative hypotheses, a regression-based methodology is adopted to examine the effect of investor sentiment, elicited from the outbreak, on portfolio returns.

4.2 First-stage Event Study Methodology

To capture the event day effect as the first objective, ex-post abnormal stock returns are measured over the event window. Abnormal returns are computed by the difference between the observed stock return and its ex-post expected rate of return over the length of the event window (MacKinlay, 1997; Donadelli et al., 2017). Parameter estimates for ex-post expected rate of return are derived from a normal performance model (MacKinlay, 1997), which is the Market Model used in this study, using an appropriate estimation window.

Abnormal returns for a given security (Security x), are derived from the below equation (equation 1).

$$AR_{xt} = R_{xt} - E(R_{xt} : X_t) \quad (1)$$

AR_{xt} - Abnormal or unexpected component of return on t-event day

R_{xt} - Observed return on Security x on t-event day

$E(R_{xt} : X_t)$ - expected normal return on Security x, estimated by the Market Model with the conditional parameter that no event occurred, means, COVID-19 is not declared as a global pandemic

Under normal market conditions, it is assumed that R_{xt} and $E(R_{xt} : X_t)$ are equal, in which case, the abnormal return component (AR_{xt}) is equal to zero.

4.2.1 Estimation window and event window

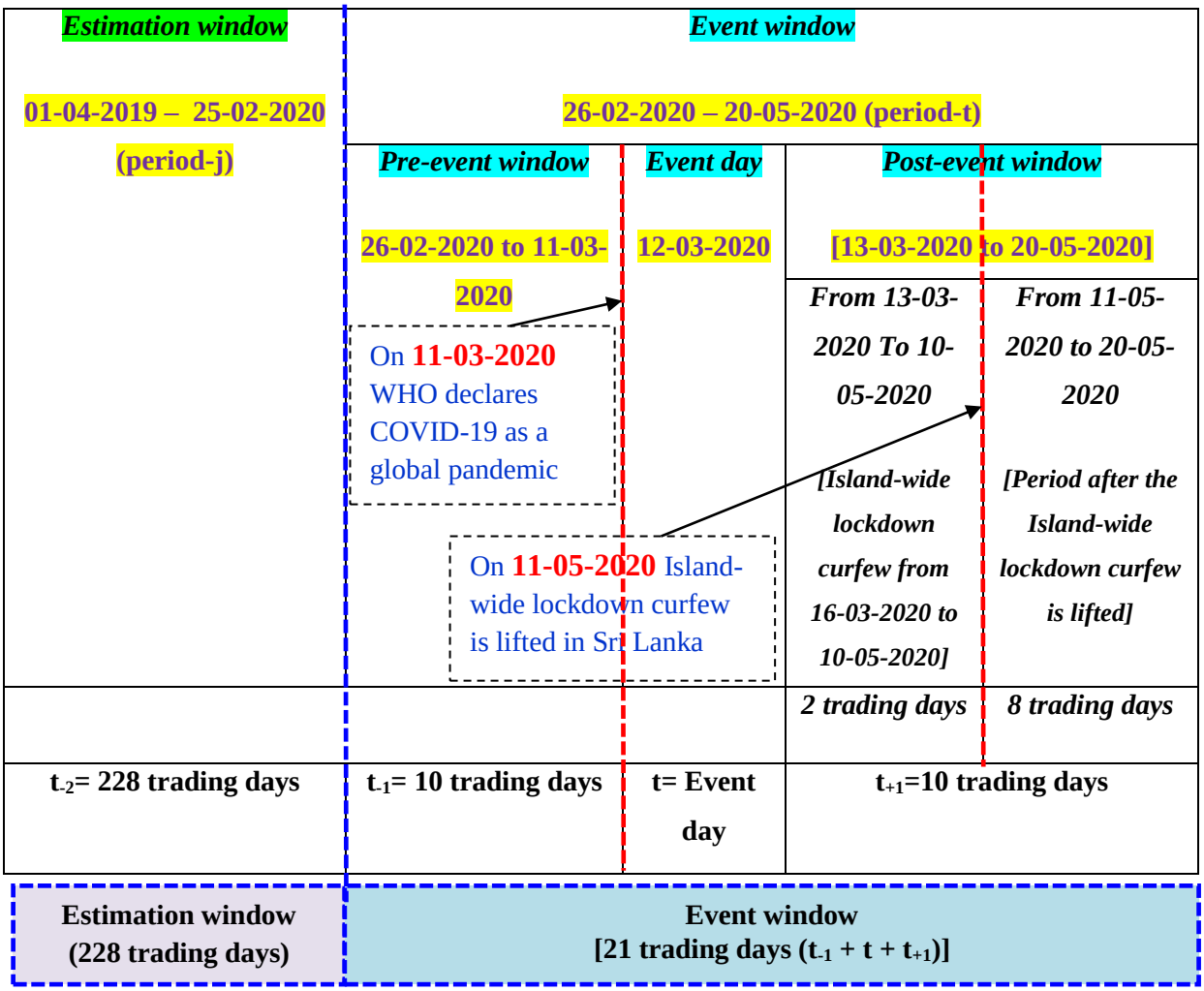

Figure 4.1: The Estimation Window, the Event and the Event Window

The event window and the estimation window are clearly defined to test the event's impact on stock prices, and the event period is clearly separated from the estimation

period to ensure that event effects do not influence on ex-post expected normal returns (MacKinlay, 1997). The starting point of the estimation window is 1st April 2019 and runs up to 25th February 2020. The event window starts on 26th February 2020. The event under study occurs on 11th March 2020, when COVID-19 is declared as a global pandemic by the WHO. The estimation window for the normal performance model is 228-trading days long immediately prior to the event window. MacKinlay (1997) suggests a 120days long estimation window prior to the event as a reasonable length for the normal performance model when daily data are used in an event study. A 10-trading days gap is kept between the event date and the estimation window to precisely capture abnormal returns (Sun et al., 2021), and another 10-trading days after the event day to observe any reversal or persisting effect. This makes up a 21-trading days long event window in a manner to minimise possible confounding effects in the event window. The estimation window is chosen relatively long enough to make it reasonable to assume that the contribution of any sampling errors to the variance of the abnormal returns is zero.

4.2.2 Normal performance model

Literature discusses three types of normal performance models for estimating expected normal returns, namely, mean adjusted returns, market adjusted returns (market model), and market and risk adjusted returns - asset pricing models (Brown and Warner, 1980; MacKinlay, 1997). Donadelli et al. (2017) estimate expected rate of return based on the Fama-French three-factor model (1993). This paper deploys the Market Model (MM) approach to estimate expected stock returns, where the market portfolio return (R_{mj}), is regressed on the Security x return (R_{xj}) in the estimation window (equation 2). Market Model is more appropriate to estimate expected stock returns in Sri Lanka over other asset pricing models as market portfolio return is the main determining factor of stock returns in Sri Lanka (Anuradha, 2008; Nimal and Fernando, 2013).

The null-hypothesis (H_0) assumes that the event has no impact on Security x returns, indicating zero abnormal returns on the event day-t. [$AR_{xt} \sim N(0, \sigma^2(AR_{xt}))$].

Ordinary Least Squares (OLS) estimators of the Market Model are derived from the below equation (equation 2).

$$R_{xj} = \alpha_x + \beta_x(R_{mj}) + \varepsilon_{xj} \quad (2)$$

Under homoscedasticity;

$$E[\varepsilon_{xj}, (R_{mj})] = 0 \qquad Var[\varepsilon_{xj,}(R_{mj})] = E(\varepsilon_{xj}^2) = \sigma^2$$

R_{xj} – Security x returns over j-period

R_{mj} - Market portfolio return over j-period

ε_{xj} – Zero-mean independent error term

j = 1,2,….n number of days in the estimation window

α_x, β_x – Market Model parameter estimates

4.2.3 Abnormal returns in the event window

Abnormal returns in the event window are computed from the below formula (equation 3).

$$AR_{xt} = R_{xt} - [\hat{\alpha}_x + \hat{\beta}_x(R_{mt})] \quad (3)$$

R_{mt} - Market portfolio return in period-t

$\hat{\alpha}_x, \hat{\beta}_x$ - OLS parameter estimates derived from the Market Model (equation 2)

t = 1,2…n days in the event window

Average Abnormal Returns on event day-t (AAR_{xt}) are calculated as follows (equation 4);

$$AAR_{xt} = \frac{1}{N} \sum_{x=1}^{N} AR_{xt} \quad (4)$$

N – Number of companies in the sample

Average Abnormal Returns are aggregated in the event-window (from t_{-1} to t_{+1}) and Cumulative Average Abnormal Returns (CARs) are derived from the below (equation 5).

$$CAR_{(t-1,t+1)} = \sum_{t=t-1}^{t+1} AAR_{xt} \quad (5)$$

Null-hypothesis (H_0) for CAR is drawn as follows;

$$CAR_{(t-1,t+1)} \sim N[0, \sigma^2(CAR_{(t-1,t+1)})]$$

t-statistic (t_x) is established from equation 6, and compared with the assumed t-distribution

$$t_x = \frac{CAR_{(t-1,t+1)} - 0}{S\varepsilon_{CAR}} \quad (6)$$

$S\varepsilon_{CAR}$ - Standard error estimate of average abnormal returns per day is computed from the below formula (equation 7).

$$S\varepsilon_{CAR} = \sigma_{CAR} \Big/ \sqrt{L_t} \quad (7)$$

σ_{CAR} - Standard deviation of CAR

L_t – Length of the event-window

4.3 Second-stage Regression Methodology

Following regression model (equation 8) is used to evaluate the impact of PRNs and to identify the effect of investor fear sentiment, represented by the FGI, on portfolio returns.

$$R_{P,T} = \alpha_{P,T} + \sum_{i=1}^{5} \beta_{1,i} R_{P,T-i} + \beta_2 E_T + \beta_3 FGI_T + \beta_4 DE_T + \beta_5 INF_T + \beta_6 EXR_T + \beta_7 INTR_T + \varepsilon_{P,T} \quad (8)$$

Where;

$R_{P,T}$ – Continuously compounded daily percentage return on stock portfolio P at time-T (dependent variable)

$R_{P,T-i}$ – Lagged dependent variable

E_T – PRNs variable at time-T

FGI_T – Fear Gauge Indicator (proxy for COVID-19-induced fear sentiment) at time-T

DE_T – Other macroeconomic events at time-T

INF_T – Month-to-month percentage change in Inflation rate at time-T

EXR_T - Day-to-day percentage change in US$/LKR Exchange rate at time-T

$INTR_T$ - Week-to-week percentage change in Weekly Average Weighted Prime Lending Rate at time-T

$\alpha_{P,T}$ – Regression intercept

β_1 – Estimated slope coefficient of the lagged dependent variable

β_2 – Estimated slope coefficient of the PRNs variable

β_3 – Estimated slope coefficient of the FGI

β_4 – Estimated slope coefficient of other macroeconomic events

β_5 - Estimated slope coefficient of the month-to-month percentage change in Inflation rate

β_6 - Estimated slope coefficient of the day-to-day percentage change in US$/LKR Exchange rate

β_7 - Estimated slope coefficient of the week-to-week percentage change in Weekly Average Weighted Prime Lending Rate

$\varepsilon_{P,T}$ – Independent error term

Continuously compounded daily portfolio returns ($R_{P,T}$) on healthcare, telecommunication, insurance, banking and hotel sector portfolios are calculated throughout the study period from 1st April 2019 to 30th June 2021. A lagged dependent variable ($R_{P,T-i}$), to ensure that all possible serial correlations have been accounted for, a dummy variable for the PRNs effect (E_T) and another variable for the fear gauge indicator (FGI_T), as a proxy for investor sentiment are used as independent variables in the regression. A control variable, which takes value at 1 for the occurrence of other macroeconomic events as detail in Annexure 1(b) in studied windows, and 0 for otherwise, is used in the regression to control for other exogenous macroeconomic shocks.

The FGI represents the investor fear sentiment, triggered from COVID-19 pandemic, which is formed by reference to continuously compounded day-to-day growth rate of COVID-19 cases in Sri Lanka during the study period from 1st April 2019 to 30th June 2021. It is assumed that the proxy measure reasonably captures the COVID-19 related fear sentiment among CSE investors. Donadelli et al. (2017) used a Volatility Index as a proxy for investor fear sentiment in the U.S. stock market. Sun et al. (2021) used an online financial social platform database in China to represent the individual investor sentiment. The coefficient β_2 captures the effect of PRNs on portfolio rate of return, whilst β_3 captures the investors' fear sentiment effect on portfolio returns. PRNs variable is a dummy variable that takes on value 1, for WHO's news in relation to COVID-19 pandemic, local government lockdown orders, especial media releases in relation to COVID-19, reported new Coronavirus variants in Sri Lanka or other COVID-19 related news as detail in Annexure 1(a), and 0 for otherwise.

Below regression model (equation 9) is also run to capture any possible persisting effects of PRNs and investor sentiment;

$$R_{P,T} = \alpha_{P,T} + \sum_{i=1}^{5} \beta_{1,i} R_{P,T-i} + \sum_{i=1}^{5} \beta_{2,i} E_{T-i} + \sum_{i=1}^{5} \beta_{3,i} FGI_{T-i} + \beta_4 DE_T + \beta_5 INF_T + \beta_6 EXR_T + \beta_7 INTR_T + \varepsilon_{P,T} \quad (9)$$

5.0 EMPIRICAL RESULTS AND DISCUSSION

5.1 First-stage Event Study Results

Figure 5.1 and Table 5.1 depict statistically significant portfolio CARs around the event day and evidence of persisting CARs for many days after the event day. Statistically significant CARs run contrary to the null hypothesis that PRNs have no impact on stock returns, and lead to assessment of the validity of three alternative hypotheses. Findings of significant CARs in this study confirm the results of empirical event analyses of Sun et al., 2021; Mishra and Mishra, 2020; Donadelli et al., 2017 on stock price reaction in response to disease outbreak. However, contrary to the general expectation of significant negative CARs on the immediately following day after COVID-19 is declared as a global pandemic by the WHO, except for telecommunication portfolio, all remaining portfolios produce statistically significant positive CARs. Even the negative CARs on the telecommunication portfolio are not statistically significant.

Results indicate that sector portfolio returns under this study are not negatively sensitive to the declaration of COVID-19 as a global pandemic on 11th March 2020. With effect from 16th March 2020, the Government of Sri Lanka imposes an Island-wide lockdown curfew, which brings everything to a standstill including trading activities in CSE, until the lockdown curfew is lifted on 11th May 2020. Once the curfew is lifted, from 12th May 2020 onwards, significantly positive and persisting CARs are observed on all portfolio classes, except for banking portfolio. The rebound on 11th May 2020 after a long lockdown curfew period and the Government's COVID-relief moratorium packages might have stimulated the investor sentiment optimistically. A similar positive effect of post-COVID rebound is documented by Capelle-Blancard and Desroziers (2020) and Haddad et al. (2020), which is attributed to the substantial intervention by the Government monetary authorities and Central Banks in stimulating economic activities. Evidence supporting the persisting positive CARs from 12th May 2020 onwards, confirming Hypothesis 3, runs contrary to the Efficient Market Hypothesis as perceived

persistence is likely to have been driven by investor sentiment. Findings on persisting CARs are consistent with the results of Sun et al. (2021) and Donadelli et al. (2017). Banking portfolio reports a large negative abnormal return on 11th May 2020 followed by an immediate reversal on the next day, 12th May 2020; the phenomenon too runs contrary to the market efficiency fundamentals.

Overall, CSE seems to have poorly predicted the economic outcomes of COVID-19 pandemic and under-reacted to the declaration of COVID-19 as a global pandemic by the WHO when cases were climbing to millions globally. What remain prominent are the substantial rebound that follows immediately after the lockdown curfew is lifted on 11th May 2020 and the persisting pattern of positive CARs for many days from 12th May 2020 onwards. This results from over-reaction of investors. Under-reaction to the global news of declaration of COVID-19 as a global pandemic by the WHO on 11th March 2020, and over-reaction to the local rebound news of lifting Island-wide lockdown curfew on 11th May 2020 and the Government's COVID-relief moratorium packages, and persisting CARs there-onwards indicate market inefficiency in CSE due to significant sentiment-driven dominance.

Table 5.1 summarises AARs and CARs on each sector portfolio class and the level of statistical significance.

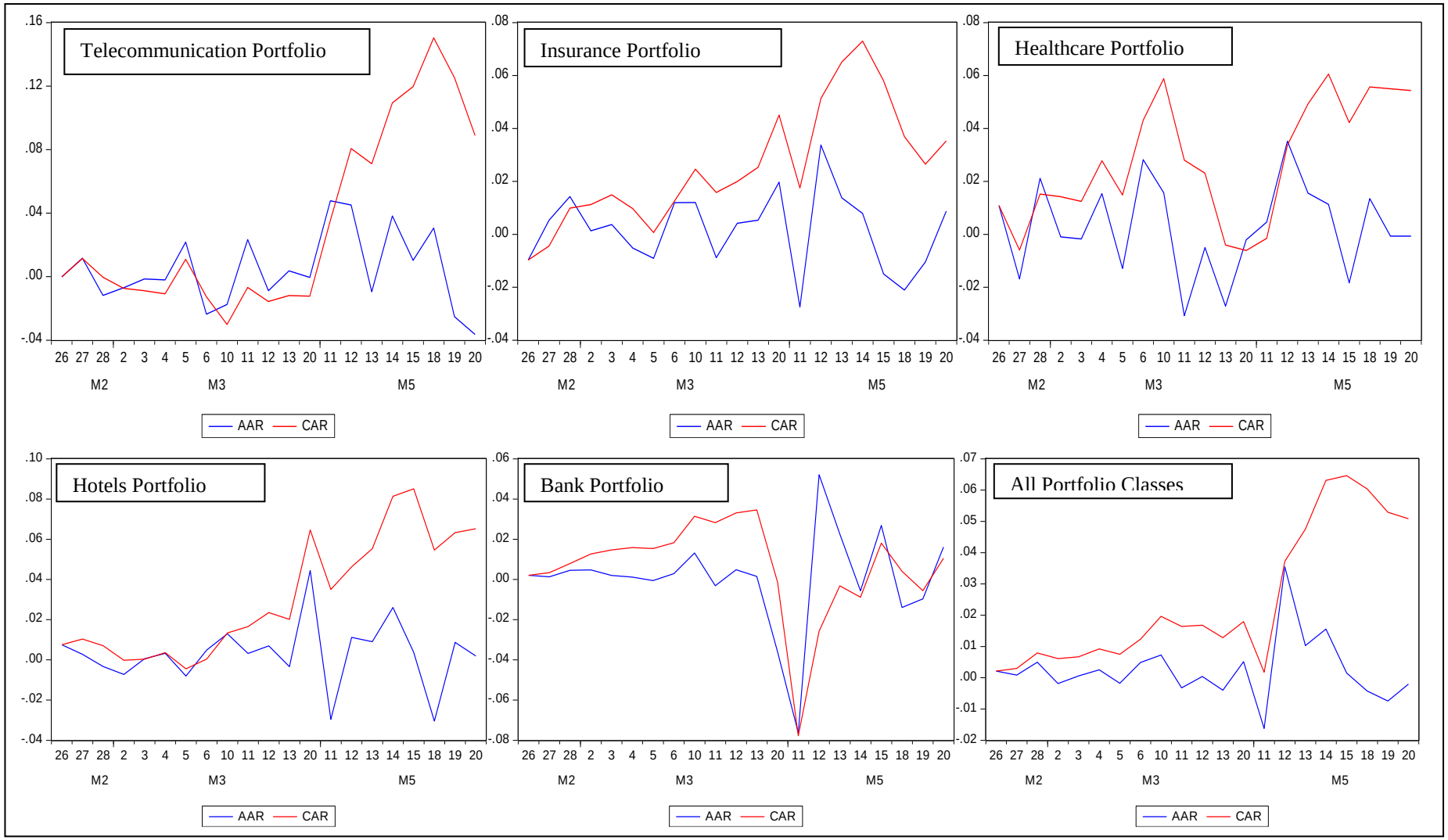

Figure 5.1: AARs and CARs on equally-weighted sector portfolios in the Event Window from 26-Feb-2020 to 20-May-2020

Table 5.1: AARs and CARs on sector portfolio classes in the event window

Date	Days	AAR-Telecom	AAR-Healthcare	AAR-Insurance	AAR-Banks	AAR-Hotels	Total AAR	Total CAR	t-statistic	Significance at the 5%	Level of Significance
26-FEB-20	-10	-0.018%	1.089%	-0.972%	0.207%	0.754%	**0.212%**	**0.212%**	0.4454	Not Significant CAR	Not Significant
27-FEB-20	-9	1.164%	-1.686%	0.533%	0.132%	0.279%	**0.084%**	**0.296%**	0.6229	Not Significant CAR	Not Significant
28-FEB-20	-8	-1.179%	2.115%	1.429%	0.454%	-0.327%	**0.499%**	**0.795%**	1.6708	Not Significant CAR	Not Significant
02-MAR-20	-7	-0.700%	-0.100%	0.133%	0.475%	-0.725%	**-0.183%**	**0.612%**	1.2856	Not Significant CAR	Not Significant
03-MAR-20	-6	-0.147%	-0.176%	0.367%	0.202%	0.054%	**0.060%**	**0.672%**	1.4119	Not Significant CAR	Not Significant
04-MAR-20	-5	-0.205%	1.537%	-0.517%	0.118%	0.324%	**0.251%**	**0.923%**	1.9400	Not Significant CAR	10%
05-MAR-20	-4	2.182%	-1.293%	-0.907%	-0.055%	-0.805%	**-0.176%**	**0.748%**	1.5711	Not Significant CAR	Not Significant
06-MAR-20	-3	-2.361%	2.821%	1.197%	0.291%	0.488%	**0.487%**	**1.235%**	2.5951	Significant CAR	5%
10-MAR-20	-2	-1.749%	1.571%	1.200%	1.316%	1.297%	**0.727%**	**1.962%**	4.1229	Significant CAR	1%
11-MAR-20	-1	2.340%	-3.074%	-0.884%	-0.312%	0.317%	**-0.323%**	**1.639%**	3.4451	Significant CAR	1%
12-MAR-20	0	-0.886%	-0.497%	0.417%	0.483%	0.695%	**0.043%**	**1.682%**	3.5346	Significant CAR	1%
13-MAR-20	1	0.370%	-2.713%	0.535%	0.148%	-0.339%	**-0.400%**	**1.282%**	2.6945	Significant CAR	5%
20-MAR-20	2	-0.042%	-0.209%	1.973%	-3.606%	4.450%	**0.513%**	**1.795%**	3.7729	Significant CAR	1%
11-MAY-20	3	4.783%	0.462%	-2.751%	-7.633%	-2.958%	**-1.619%**	**0.176%**	0.3695	Not Significant CAR	Not Significant
12-MAY-20	4	4.512%	3.520%	3.378%	5.208%	1.122%	**3.548%**	**3.724%**	7.8257	Significant CAR	1%
13-MAY-20	5	-0.949%	1.557%	1.380%	2.257%	0.901%	**1.029%**	**4.753%**	9.9890	Significant CAR	1%
14-MAY-20	6	3.826%	1.131%	0.790%	-0.569%	2.606%	**1.557%**	**6.310%**	13.2607	Significant CAR	1%
15-MAY-20	7	1.030%	-1.834%	-1.500%	2.686%	0.373%	**0.151%**	**6.461%**	13.5783	Significant CAR	1%
18-MAY-20	8	3.069%	1.348%	-2.109%	-1.394%	-3.047%	**-0.427%**	**6.034%**	12.6815	Significant CAR	1%
19-MAY-20	9	-2.515%	-0.071%	-1.042%	-0.967%	0.873%	**-0.744%**	**5.290%**	11.1172	Significant CAR	1%
20-MAY-20	10	-3.641%	-0.069%	0.880%	1.613%	0.193%	**-0.205%**	**5.085%**	10.6867	Significant CAR	1%

Notes: Table 5.1 shows AARs and CARs on equally-weighted five sector portfolio classes in the event window from 26-Feb-2020 to 20-May-2020, t-statistics are reported together with the level of significance.

5.2 Second-stage Regression Results

Regression results examining the effects of PRNs and FGI on the sector portfolio returns are reported in Table 5.2 and Table 5.3.

Table 5.2: Second-stage regression results - regression equation 8

Variable	Telecom	Healthcare	Insurance	Hotels	Banks	S&P SL 20 Index
CONSTANT	0.002331 [0.0022]	0.001920 [0.0135]	0.001137 [0.0389]	0.000857 [0.1579]	0.001203 [0.0943]	0.000869 [0.1130]
PORTFOLIO_RETURN(-1) [$R_{P,T-1}$]	0.033751 [0.4332]	0.110775 [0.1883]	0.012293 [0.8127]	0.123773* [0.0740]	0.232944*** [0.0022]	0.147858*** [0.0010]
PORTFOLIO_RETURN(-2) [$R_{P,T-2}$]	-0.009978 [0.8213]	0.026087 [0.6440]	0.037110 [0.5343]	0.028677 [0.6327]	-0.100728 [0.1433]	0.025259 [0.5793]
PORTFOLIO_RETURN(-3) [$R_{P,T-3}$]	0.020329 [0.6372]	-0.063566 [0.3603]	-0.071750 [0.1893]	0.014621 [0.7989]	0.046434 [0.4996]	0.020196 [0.6572]
PORTFOLIO_RETURN(-4) [$R_{P,T-4}$]	-0.125605*** [0.0036]	-0.156271** [0.0431]	-0.068238 [0.1252]	-0.000488 [0.9931]	-0.054877 [0.4219]	0.111704** [0.0126]
PORTFOLIO_RETURN(-5) [$R_{P,T-5}$]	-0.048336 [0.2665]	0.020224 [0.6917]	0.039223 [0.4232]	0.006883 [0.8944]	-0.006833 [0.9058]	0.023728 [0.5952]
CHANGE_IN_INFLATION [INF_T]	-0.507246 [0.2809]	0.090213 [0.8032]	0.176616 [0.6910]	0.694917 [0.2135]	0.614991 [0.2145]	-0.038989 [0.9089]
CHANGE_IN_USD_LKR_EX_RAT [EXR_T]	0.484540** [0.0424]	0.212420 [0.4433]	0.153559 [0.4032]	0.132364 [0.5140]	0.293349 [0.2740]	0.489857*** [0.0049]
CHANGE_IN_WEEKLY_AWPLR [$INTR_T$]	0.055326 [0.3506]	0.136675* [0.0701]	0.084957 [0.1124]	0.081456 [0.1899]	0.090324 [0.1663]	0.038620 [0.3778]
DUMMY_PRNS [E_T]	-0.006939* [0.0530]	-0.005079 [0.1205]	-0.004485** [0.0266]	-0.007263*** [0.0003]	-0.003797 [0.2296]	-0.003413 [0.1884]
DUMMY_DE [DE_T]	-0.002871 [0.5850]	-0.008078 [0.0072]	7.35E-05 [0.9850]	0.008991 [0.3029]	0.001139 [0.7277]	-0.001361 [0.7207]
FEAR_GAUGE_IND [FGI_T]	-0.100248*** [0.0000]	-0.047881*** [0.0052]	-0.047687*** [0.0002]	-0.058900*** [0.0003	-0.113694*** [0.0003]	-0.033820*** [0.0013]
LOG LIKELIHOOD	1381.668	1345.010	1534.856	1446.798	1408.120	1542.019

Notes: Table 5.2 shows regression results of equation (8) using daily data for the period from 01-April-2019 to 30-June-2021. Results of regressions of continuously compounded daily percentage returns on equally-weighted five sector portfolio classes and the S&P SL 20 Index are reported. E_T represents the PRNs effect variable and FGI_T represents the proxy variable for COVID-19 related investor fear sentiment. DE is a control variable for exogenous macroeconomic events. The log-likelihood values are shown in the last row of Table 5.2. All parameter estimates are tested and corrected for non-stationarity, autocorrelation, and heteroscedasticity and *p*-values are reported in parentheses.

*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level

A negative and significant effect of the fear gauge indicator is obtained from the regression analysis supporting Hypothesis 1. This effect is robust across all five sector portfolio classes and the S&P SL 20 Index. The estimated coefficient β_3 of fear gauge indicator ranges from weakest of -0.033820 (S&P SL 20 Index), -0.047687 (Insurance portfolio), to strongest of -0.113694 (Bank portfolio). As such, the bank portfolio signifies the strongest effect of investor fear gauge indicator, whilst S&P SL 20 Index and insurance portfolio show the weakest FGI effect. Further, coefficient β_2 of PRNs effect is always negative and generally statistically significant on hotels, insurance and telecommunication portfolios, indicating Hypothesis 1. Negative coefficients on FGI and PRNs reflect significant investor pessimism regarding all portfolio investments including S&P SL 20 Index, which has a negative effect on stock returns, thus confirming Hypothesis 1. Results in this study confirm the findings of negative stock returns affected by disease-induced fear sentiment (Donadelli et al., 2017; Sun et al., 2021) and war-induced fear sentiment (Kaplanski and Levy, 2012).

The coefficient estimate of β_2 ranges from -0.0034 (S&P SL 20 Index) to -0.0073 (Hotel portfolio). In the rouse of PRNs, hotels stock returns significantly decrease. COVID-19 pandemic fear emanates a pessimistic sentiment among investors of all portfolio classes, and the negative sentiment is relatively significant on banks and hotel sector stocks. Results suggest that investors should sell banks and hotel sector stocks when COVID-19 is declared as a global pandemic and buy a well-diversified portfolio comparable to S&P SL 20 Index. Contrary to Hypothesis 2, results do not indicate any sector specific positive effects of the fear gauge indicator and the PRNs

on portfolio returns. This is in contrast to the findings by Donadelli et al. (2017) and Sun et al. (2021) which reveal a significant positive effect of investor sentiment on medical portfolios in response to disease related news. Other independent variables used in the regression analysis do not indicate any significant distinct effect on portfolio returns, except for some influence of the lagged effects of portfolio returns.

Table 5.3: Second-stage regression results - regression equation 9 with lagged effects of PRNs and FGI

Variable	Telecom	Healthcare	Insurance	Hotels	Banks	S&P SL 20 Index
CONSTANT	0.001562	0.001897	0.001108	0.000747	0.000742	0.000851
	[0.0533]	[0.0278]	[0.0581]	[0.2509]	[0.3113]	[0.1445]
PORTFOLIO_RETURN(-1) [$R_{P,T-1}$]	0.021335	0.105839	-0.008248	0.078341	0.187677***	0.151361***
	[0.6386]	[0.2283]	[0.8562]	[0.2801]	[0.0033]	[0.0009]
PORTFOLIO_RETURN(-2) [$R_{P,T-2}$]	-0.017059	0.026989	0.037378	0.048254	-0.103241*	0.025612
	[0.7086]	[0.6452]	[0.4179]	[0.2897]	[0.0792]	[0.5794]
PORTFOLIO_RETURN(-3) [$R_{P,T-3}$]	0.076779*	-0.059304	-0.061431	0.033794	0.094479	0.026638
	[0.0909]	[0.4309]	[0.1801]	[0.5327]	[0.1447]	[0.5640]
PORTFOLIO_RETURN(-4) [$R_{P,T-4}$]	-0.108549**	-0.150877*	-0.048882	0.027135	0.007191	0.104588**
	[0.0171]	[0.0644]	[0.2798]	[0.6299]	[0.9082]	[0.0216]
PORTFOLIO_RETURN(-5) [$R_{P,T-5}$]	-0.017367	0.021717	0.040546	0.014823	0.009931	0.033326
	[0.6949]	[0.6745]	[0.3616]	[0.7516]	[0.8250]	[0.4638]
CHANGE_IN_INFLATION [INF_T]	-0.293475	0.147767	0.074380	0.545892	0.488330	0.081565
	[0.5471]	[0.6929]	[0.8357]	[0.2153]	[0.1628]	[0.8200]
CHANGE_IN_USD_LKR_EX_RAT [EXR_T]	0.477455**	0.198630	0.158415	0.154341	0.297077	0.463177***
	[0.0435]	[0.4751]	[0.3645]	[0.4377]	[0.2472]	[0.0081]
CHANGE_IN_WEEKLY_AWPLR [$INTR_T$]	0.058988	0.135322*	0.086848**	0.085034	0.095900	0.038331
	[0.3143]	[0.0753]	[0.0468]	[0.1763]	[0.1365]	[0.3826]
DUMMY_DE [DE_T]	-0.002538	-0.008001**	0.000254	0.008667	0.001653	-0.001085
	[0.6265]	[0.0101]	[0.9472]	[0.3244]	[0.6181]	[0.7768]
FEAR_GAUGE_IND(-1) [FGI_{T-1}]	-0.076222***	-0.053879***	-0.024232*	-0.021437	-0.077181***	-0.030329**
	[0.0002]	[0.0046]	[0.0984]	[0.3836]	[0.0000]	[0.0385]
FEAR_GAUGE_IND(-2) [FGI_{T-2}]	0.001386	-0.007307	-0.039313**	-0.057246**	-0.019864	-0.019655
	[0.9535]	[0.8331]	[0.0212]	[0.0433]	[0.5316]	[0.2456]
FEAR_GAUGE_IND(-3) [FGI_{T-3}]	-0.066722***	0.014599	0.005663	-0.005019	-0.043625	0.008360
	[0.0060]	[0.5836]	[0.7459]	[0.8445]	[0.2087]	[0.6267]
FEAR_GAUGE_IND(-4) [FGI_{T-4}]	0.047348*	0.012053	-0.009542	0.007469	-0.022506	0.032080*
	[0.0543]	[0.6597]	[0.5863]	[0.8541]	[0.6411]	[0.0635]
FEAR_GAUGE_IND(-5) [FGI_{T-5}]	0.047369**	0.004120	0.033302**	0.044527*	0.098892**	-0.019492
	[0.0233]	[0.8156]	[0.0263]	[0.0541]	[0.0190]	[0.1833]

DUMMY_PRNS(-1) [E_{T-1}]	-0.005360 [0.1727]	-0.003302 [0.3263]	-0.004283 [0.1403]	-0.006540*** [0.0012]	-0.002692 [0.4317]	-0.002593 [0.3694]
DUMMY_PRNS(-2) [E_{T-2}]	0.002507 [0.5302]	0.000283 [0.9435]	0.001096 [0.7100]	-9.80E-06 [0.9971]	0.002972 [0.4199]	0.001916 [0.5138]
DUMMY_PRNS(-3) [E_{T-3}]	-0.001238 [0.7639]	-0.001860 [0.5817]	-0.003662 [0.2294]	-0.002946 [0.2935]	-0.006017 [0.1770]	-0.003144 [0.2996]
DUMMY_PRNS(-4) [E_{T-4}]	9.15E-05 [0.9816]	-0.003266 [0.4393]	0.001627 [0.5790]	-0.001522 [0.6134]	0.001547 [0.6803]	-0.000586 [0.8413]
DUMMY_PRNS(-5) [E_{T-5}]	-0.002530 [0.5257]	-0.001802 [0.5949]	-0.002149 [0.4656]	-0.000731 [0.8029]	-0.001893 [0.6727]	-0.000664 [0.8210]
LOG LIKELIHOOD	1391.917	1346.630	1542.652	1458.279	1424.569	1545.606

Notes: Table 5.3 shows regression results of equation (9) using daily data for the period from 01-April-2019 to 30-June-2021. Results of regressions of continuously compounded daily percentage returns on equally-weighted five sector portfolio classes and the S&P SL 20 Index are reported with lagged effects of both PRNs and FGI variables. The log-likelihood values are shown in the last row of Table 5.3. All parameter estimates are tested and corrected for non-stationarity, autocorrelation, and heteroscedasticity and *p*-values are reported in parentheses.

*Significance at the 10% level.
**Significance at the 5% level.
***Significance at the 1% level

Table 5.3 indicates an interesting observation when five-lags of PRNs and FGI are used to capture the persisting effects. Results indicate a negative effect on initial lags of the FGI and a positive effect on subsequent lags of the FGI. The initial negative sentiment is persistent for two-three days, but it is outweighed by a positive effect as time passes by. This might be either due to positive information flown to the stock market or correction of earlier under-reaction. Especially, the removal of lockdown curfew and the Government's COVID-relief moratorium packages are interpreted as stimulating events of a rebound to inspire a positive investor sentiment in the stock market to outweigh the initial negative sentiment. The phenomenon is evidenced in Table 5.3 results by statistically significant negative coefficients on the initial lag effects of the FGI variable and significant positive coefficients on the fourth and fifth lags of the FGI variable, however subject to one exception of the healthcare portfolio, where the subsequent positive lag effects on it are not statistically significant. The coefficients on the fifth lag of the FGI variable of telecommunication, insurance and banks portfolios are positive and significant at the 5% level, whereas the hotel portfolio and the S&P SL 20 Index too constitute the same pattern at the 10% level. Both negative and positive sentiment effects are persistent at significant levels, and consistent with the finding of Kaplanski and Levy (2010), where an announcement usually attracts news captions several days after the event. Findings on persisting sentiment effect support Hypothesis 3, as the effect of investor sentiment remains significant several days after PRNs. Results of this study emphasise that fear gauge indicator always has a significant and persisting effect on stock returns in varying degrees. This indicates that the investor sentiment can be prevalent across various business sectors, and might lead to lucrative trading strategies.

6.0 CONCLUSION

6.1 Conclusion

Motivated by findings in behavioural finance studies that certain events may have strong effects on investor mood (Coronavirus outbreak – Sun et al., 2021; infectious disease - Donadelli et al., 2017; world cup soccer game losses – Edmans et al., 2007; aviation disasters – Kaplanski and Levy, 2010; Arab–Israeli War - Kaplanski and Levy, 2012), the paper investigates if the declaration of COVID-19 as a global pandemic by the WHO on 11th March 2020 impacts on stock returns in Colombo Stock Exchange, and the effect of pandemic-induced investor sentiment in determining stock returns on five different sector portfolios, namely, healthcare, telecommunication, banking, hotels and insurance companies in Sri Lanka. As such, the investigation focuses on estimating abnormal returns derived from the COVID-19 pandemic event, and examining the influence of investor sentiment, and the extent of persistence of its impact on portfolio returns of different industry sectors in CSE.

The literature suggests that COVID-19 emanates an overall pessimistic sentiment among stock market investors all over the world, whilst it positively stimulates stock prices of healthcare and medical stocks through a positive investor sentiment (Sun et al., 2021). Evidence suggests that the initial negative impacts of the disease fear are later negated by stimulus packages offered by the Central Banks (Haddad et al., 2020; Capelle-Blancard and Desroziers, 2020). The study uses traditional event study approach and regression-based econometric analysis to examine the event's impact on portfolio returns and the effect of investor sentiment in determining portfolio returns.

The first-stage event analysis documents evidence of cumulative average abnormal returns (CARs) surrounding the event date. However, contrary to the general expectation of continuing negative abnormal returns given the nature of the event, it is positive and persisting CARs are revealed in the study, especially in the post event window after a long Island-wide lockdown curfew is lifted. Overall, the CSE investors seem to have poorly predicted the economic outcomes of COVID-19

pandemic and under-reacted to the WHO's pandemic declaration news when cases were climbing to millions globally. What remain prominent are the substantial rebound that follows immediately after the lockdown curfew is lifted on 11th May 2020 and the persistence of significant CARs for several days from 12th May 2020 onwards. This results from over-reaction of CSE investors. Results indicate that CSE investors are likely to be more sensitive to local events than to global news. Under-reaction to the global news of declaration of COVID-19 as a global pandemic by the WHO on 11th March 2020, and over-reaction to the local rebound news of lifting Island-wide lockdown curfew on 11th May 2020 and the Government's COVID-relief moratorium packages, and persisting CARs there-onwards indicate market inefficiency in CSE due to significant sentiment-driven dominance.

A second-stage regression based analysis finds statistically significant negative effects of fear gauge indicator (FGI) and pandemic related news (PRNs) on portfolio returns. Evidence suggests an overall negative investor sentiment as indicated by the fear gauge indicator. The negative FGI effect is robust across all five sector portfolio classes and the S&P SL 20 Index. Findings are consistent with empirical results of Donadelli et al. (2017) and Sun et al. (2021), who document an overall negative disease-related sentiment effect. The bank portfolio signifies the strongest negative effect of investor fear gauge indicator, whilst S&P SL 20 Index and insurance portfolio show the weakest FGI effect. Further, the PRNs effect is always negative and generally statistically significant on hotels, insurance and telecommunication portfolios, where the strongest negative PRNs effect is reflected on the hotel portfolio. Results reflect a significant investor pessimism regarding all portfolio investments including the S&P SL 20 Index, which exerts a negative effect on stock returns. COVID-19 pandemic fear emanates a pessimistic sentiment effect among investors of all portfolio classes, and the negative sentiment is relatively strong on banks and hotel sector stocks. Results suggest that investors should sell banks and hotel sector stocks when COVID-19 is declared as a pandemic and buy a well-diversified portfolio comparable to S&P SL 20 Index. However, results do not support the hypothesis of sector-specific positive effect, contrary to the findings of

positive effect on pharmaceutical stock returns documented by Donadelli et al. (2017) and Sun et al. (2021).

When lag effects of the FGI are tested, results indicate that the perceived negative effect of the FGI lasts for initial few days and then transforms to a positive effect afterwards. This might be either due to positive information flown to the stock market or correction of earlier under-reaction. Especially, the removal of lockdown curfew and the Government's COVID-relief moratorium packages are interpreted as stimulating events of a rebound to inspire a positive investor sentiment in the stock market to outweigh the initial negative sentiment. However, evidence of this study suggests that both negative and positive sentiment effects prevail for several days, which are in accordance with the persisting behaviour detected by Donadelli et al. (2017).

Amid radical uncertainty of COVID-19 pandemic, rational trading is unlikely to occur, mainly due to uncertainty surrounding the future cash inflows of companies and their resource and capacity constraints to engage in large-scale investments in exploit of new business opportunities created by the outbreak. As a result, stock prices should not respond positively to pandemic news. The initial negative sentiment drawn by fear and anxiety due to pandemic appears to have a significant effect on portfolio returns, but it appears to have been outweighed by subsequent rebound events. CSE investors are relatively more sensitive to local events than to global news and are likely to react with investment decisions based on psychological bias or sentiment. Persisting CARs surrounding the event day and prevalence of significant sentiment effect in determining stock returns indicate market inefficiency. This indicates the dominance of investor psychological effects in CSE on stock price movements.

The main contribution of this study derives from employing event and novel mood variables in Sri Lankan context to provide current findings on pandemic-induced investor sentiment in the frontier market, CSE.

6.2 Policy Implications

Findings of this study are therefore of paramount importance and practical usefulness for institutional and individual investors, financial analysts, fund managers and policy makers. Investor sentiment is a dominant factor in the frontier market, Sri Lanka, which determines stock price movements. Market inefficiency and anomalous pricing patters offer a range of exploitable investment and trading strategies creating business opportunities for financial analysts and fund managers who give advice to investors on which stocks to buy and which to sell and also on market timing for new equity issues that can benefit from increased market valuation.

Anomalous pricing indicates that the prices are not fundamentally the true intrinsic value of stocks. When prices are not the true fundamental values of underlying stocks, stock markets are prone to instant crashes and bubbles. Policy level regulatory intervention is imperative to control irrational behaviour in CSE to avoid extreme volatilities in stock prices.

Long-run Benefits of Research Outcomes

The main contribution of this study derives from employing event and novel mood variables in Sri Lankan context to provide current findings on pandemic-induced investor sentiment in the frontier market, CSE.

Results indicate that a considerable sentiment-driven contagion effect prevails in the Colombo Stock Exchange, Sri Lanka. Investors' irrational exuberance drives the stock prices away from their true intrinsic value. This results in price-to-price-feedback-trading as many investors are drawn into the market in a kind of bandwagon effect. Extreme volatilities make the stock market investments highly unsuitable and hamper its resilience to exogenous shocks like COVID-19 pandemic. Stock markets should be informational efficient to create a level playing field to all investors. When new information arrives to the market, stock prices should immediately adjust to reflect new information. When prices underreact or overreact,

switchers and momentum traders are quickly attracted into lucrative style classes with anomalous pricing creating short run momentum effects.

Investors should be rationale in their investment decisions and should not be persuaded by noise and feedback trading. Results of this study suggest that rationale investors should hold a well-diversified portfolio comparable to S&P SL 20 Index when COVID-19 is declared as a global pandemic due to the confounding nature and the level of uncertainty of the event.

6.3 Direction for Future Research

Estimating expected stock returns using a contemporary asset pricing model, such as Fama-French (2015) five-factor model, might be a potential area for a future research. It is also appropriate to deploy alternative econometric techniques to obtain parameter estimates to compare results between different econometric models. Given the nature of the event being studied, the econometric modelling can be further improved using an appropriate instrumental variable to control for confounding and measurement errors.

It might be a potential area for a future investigation to carry out a regional analysis of investor sentiment effect on portfolio returns, and also to test the spill-over effect of investor sentiment to other sectors of the economy and even to other countries in the region. Finally, constructing a proxy for aggregate investor sentiment in Sri Lankan context, such as a composite sentiment index capturing the effects of divergent investor sentiment in a wider form, would remain for a future empirical study.

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Annexure 1

a. COVID-19 Pandemic Related News (PRNs) – *source* *www.who.int*, *www.epid.gov.lk*

Date	Topic	News
01-DEC-19	News from China	The first reported case of a new Coronavirus
31-DEC-19	WHO News	WHO's Country Office in China apprehends a media statement on cases of 'viral pneumonia' in Wuhan, China
04-JAN-20	WHO News	Reports that there is a cluster of pneumonia cases in Wuhan, Hubei province in China
05-JAN-20	WHO News	First Disease Outbreak News Report by WHO on their public, web-based platform
07-JAN-20	News from China	Diagnoses as "Novel Corona Virus"
09-JAN-20	WHO News	WHO reports that the outbreak is caused by a novel coronavirus.
11-JAN-20	WHO News	Receipt of the genetic sequences for the novel coronavirus from China First death case in China from the novel coronavirus
12-JAN-20	WHO News	The new coronavirus is named 2019-nCoV
13-JAN-20	WHO News	Thailand reports its first recorded case of novel coronavirus – the first case outside of China
13-JAN-20	WHO News	WHO declares it as a Public Health Emergency of International Concern (PHEIC)
15-JAN-20	WHO News	Japan informs of a confirmed case of a novel coronavirus - the second confirmed case outside of China WHO urges that additional cases in other countries are probable
16-JAN-20	WHO News	First epidemiological alert on the novel coronavirus is issued by the WHO Regional office for the Americas, with recommendations on infection prevention and control measures
19-JAN-20	WHO News	Evidence of limited human-to-human transmission - reported by the WHO Western Pacific Regional Office (WHO/WPRO)
21-JAN-20	WHO News	WHO/WPRO confirms that there is at least some human-to-human transmission. The first confirmed case of the novel coronavirus is reported in the USA
23-JAN-20	Chinese Government Order	Wuhan City in China Lockdown
24-JAN-20	WHO News	Three cases of novel coronavirus from France - the first confirmed cases in the WHO European region
25-JAN-20	WHO News	A public statement outlining the importance of being ready for detecting cases, testing samples and healthcare management.
26-JAN-20	WHO News	WHO's first free online course on the novel coronavirus on WHO learning platform
27-JAN-20	Media Release on COVID-19 cases in Sri Lanka	The first coronavirus patient, a Chinese tourist, is reported in Sri Lanka

27-JAN-20	WHO News	A press release urging on countries' readiness for the quick detection of cases and prevention of further spread.
10-FEB-20	China's Health Commission Statement	The numbers of death in coronavirus are more than SARS
11-FEB-20	WHO News	The novel coronavirus is named as COVID-19
12-FEB-20	WHO Statement	Operational Planning Guidelines to Support Country Preparedness and Response
19-FEB-20	Media Release on COVID-19 cases in Sri Lanka	The first COVID-19 patient in Sri Lanka, a Chinese tourist, is discharged from the hospital
24-FEB-20	WHO Statement	A press conference to convey main findings on the Joint Mission on COVID-19 by WHO-China, urging the need of implementing measures to contain the spread of the COVID-19 virus
07-MAR-20	WHO News	The number of confirmed COVID-19 cases exceeding 100 000 globally
11-MAR-20	**WHO News**	**WHO declares COVID-19 as a global pandemic**
13-MAR-20	WHO Statement	The DG's statement of caution that Europe is becoming the epicenter of the pandemic
16-MAR-20	Sri Lankan Government Order	First Island-wide pandemic lockdown curfew is imposed in Sri Lanka
04-APR-20	WHO News	Over 1 million confirmed cases of COVID-19 worldwide
13-APR-20	WHO News	WHO reports that work is underway to speed up the development of a vaccine against COVID-19
11-MAY-20	Sri Lankan Government Order	Island-wide lockdown curfew is lifted.
16-OCT-20	Media Release on COVID-19 cases in Sri Lanka	Reports a COVID-19 Brandix cluster in Minuwangoda, Sri Lanka and district level lockdowns are effected
22-JAN-21	Vaccine approved to use in Sri Lanka by NMRA	Covishield Oxford/AstraZeneca formulation Vaccine is approved to use in Sri Lanka
04-MAR-21	Vaccine approved to use in Sri Lanka by NMRA	Sputnik V Vaccine is approved to use in Sri Lanka
08-MAY-21	Vaccine approved to use in Sri Lanka by NMRA	Sinopharm Vaccine is approved to use in Sri Lanka
08-MAY-21	Vaccine approved to use in Sri Lanka by NMRA	Pfizer Vaccine is approved to use in Sri Lanka
21-MAY-21	Sri Lankan Government Order	Second Island-wide pandemic lockdown curfew is imposed in Sri Lanka
21-JUN-21	Sri Lankan Government Order	Second Island-wide lockdown curfew is lifted

b. Macro Economic News (DE) – *source www.cbsl.gov.lk*

Date	Topic	News
17-APR-19	CBSL Circular	Withdrawal of measures to curtail imports of motor vehicles and non-essential consumer goods in Sri Lanka
21-APR-19	Media News	A series of terrorist attacks in Sri Lanka on the Easter Sunday (21st April 2021)
08-MAY-19	CBSL Circular	Debt moratorium to the Tourism sector
19-MAR-20	CBSL Circular	Measures to curtail imports and foreign currency investments
24-MAR-20	CBSL Circular	Relief measures to assist COVID-19 affected businesses and individuals
27-MAR-20	CBSL Circular	Rs 50 Billion, six-month refinancing facility to support COVID-19 hit businesses and individuals
08-MAY-20	CBSL Circular	Concessions granted to tourism industry
26-AUG-20	CBSL Circular	Extension of Debt Moratorium for COVID-19 affected businesses and individuals in the tourism industry
09-NOV-20	CBSL Circular	Debt Moratorium for COVID-19 affected businesses and individuals
19-MAR-21	CBSL Circular	Extension of Debt Moratorium for COVID-19 affected businesses and individuals in the tourism industry
25-MAY-21	CBSL Circular	Concessions for COVID-19 affected businesses and individuals
28-JUN-21	Statement from the CBSL Governor on Forex Crisis in Sri Lanka	Shortage of foreign currency reserves in Sri Lanka
29-JUN-21	Media Release on Forex Crisis in Sri Lanka	Dropping Sri Lanka's foreign exchange reserves to alarming levels

Annexure 2: Sector Portfolios

1. Healthcare portfolio

No.	*Name*	*Market Cap of Voting Shares as at 30-06-2021(Rs Millions)*
1	Asiri Surgical PLC	7,451
2	Asiri Hospitals PLC	32,647
3	Durdans Hospital PLC	2,629
4	E B Creasy & Co PLC	6,339
5	Hemas Holdings PLC	48,678
6	Lanka Hospitals PLC	10,068
7	Muller & Phipps (Ceylon) PLC	311
8	Nawaloka Hospitals PLC	8,034
9	Singhe Hospitals PLC	992
10	Sunshine Holdings PLC	11,261

2. Telecommunication portfolio

No.	*Name*	*Market Cap of Voting Shares as at 30-06-2021(Rs Millions)*
1	Dialog Axiata PLC	98,407
2	Sri Lanka Telecom PLC	60,282

3. Insurance portfolio

No.	*Name*	*Market Cap of Voting Shares as at 30-06-2021(Rs Millions)*
1	Softlogic Life Insurance PLC	11,550
2	Arpico Insurance PLC	1,477
3	Amana Takaful PLC	1,602
4	Amana Takaful Life PLC	435
5	Ceylinco Insurance PLC	39,000
6	HNB Assurance PLC	7,800
7	Janashakthi Insurance PLC	6,433
8	People’s Insurance PLC	6,600
9	Union Assurance PLC	16,618

4. Banks portfolio

No.	*Name*	*Market Cap of Voting Shares as at 30-06-2021(Rs Millions)*
1	Amana Bank PLC	8,064
2	Commercial Bank of Ceylon PLC	98,953
3	DFCC Bank PLC	21,187
4	Hatton National Bank PLC	56,395
5	NDB Bank PLC	28,641
6	Nations Trust Bank PLC	14,071
7	Pan Asia Bank PLC	7,214
8	Sampath Bank PLC	60,194

9	SDB Bank PLC	4,606
10	Seylan Bank PLC	13,002
11	Union Bank of Colombo PLC	12,136

5. Hotel portfolio

No.	*Name*	*Market Cap of Voting Shares as at 30-06-2021(Rs Millions)*
1	Asian Hotels and Properties PLC	16,471
2	Aitken Spence Hotels Holdings PLC	9,685
3	Anilana Hotels PLC	1,409
4	Browns Beach Hotel PLC	1,179
5	Beruwala Resorts PLC	480
6	Bansei Royal Resorts Hikkaduwa PLC	419
7	Ceylon Hotels Corporation PLC	1,890
8	Hikkaduwa Beach Resort PLC	1,567
9	Waskaduwa Beach Resort PLC	1,680
10	Hayleys Leisure PLC	1,998
11	Eden Hotel Lanka PLC	5,280
12	Galadari Hotels (Lanka) PLC	4,257
13	Hotel Sigiriya PLC	352
14	Hunas Falls Hotels PLC	896
15	Jetwing Symphony PLC	4,721
16	The Kandy Hotels Company PLC	2,830
17	John Keells Hotels PLC	13,251
18	The Lighthouse Hotel PLC	1,509
19	Marawila Resorts PLC	410
20	Mahaweli Reach Hotels PLC	626
21	The Nuwara Eliya Hotels Company PLC	2,160
22	Palm Garden Hotels PLC	1,194
23	Pegasus Hotels of Ceylon PLC	851
24	Renuka Hotels PLC	2,639
25	Citrus Leisure PLC	2,271
26	Renuka City Hotel PLC	1,596
27	Ramboda Falls PLC	344
28	The Fortress Resorts PLC	1,087
29	Royal Palms Beach Hotels PLC	765
30	The Kingsbury PLC	5,434
31	Serendib Hotels PLC	1,065
32	Sigiriya Village Hotels PLC	337
33	Dolphin Hotels PLC	800
34	Taj Lanka Hotels PLC	1,773
35	Tangerine Beach Hotels PLC	780
36	Trans Asia Hotels PLC	11,100

Annexure 3: Regression Diagnostic

Following regression diagnostic procedures are carried out in attaining best linear unbiased estimators.

Criteria	**Test values**
Significance of parameter estimates	Statistical significance based on Probability level <0.01(1%), <0.05(5%), <0.1(10%)
Normality	Ho: Residuals follow a normal distribution Ha: Residuals do not follow a normal distribution If *p*-values of Jarque-Bera statistics are above 5%, it indicates normal distribution of residuals and accepts the null hypothesis (Ho). Outliers are carefully observed and removed appropriately, to correct for non-normality.
Autocorrelation	Ho: No serial correlation (all $\rho = 0$) Ha: Serial correlation (at least one $\rho \neq 0$) The accepted range in Durbin-Watson Test ~1.5-2.5 to accept no autocorrelation (Ho is accepted) If autocorrelation exists, appropriate AR(p), MA(q), ARMA(p,q) models are used to correct for such autocorrelation
Heteroscedasticity	Ho: Homoscedasticity (σ^2) Ha: Heteroscedasticity (σ_i^2) Probability of chi-square of LM statistics [$n.R^2$] to be more than 5% in Breusch-Pagan-Godfrey test to satisfy the Homoscedasticity If Heteroscedasticity exists, White's robust standard errors are reported.
Non-Stationarity	Unit root test using Augmented Dickey-Fuller (ADF) test The level and 1st differencing probability values in ADF test to be less than 5%, for series to be stationary Ho: Unit root exists (Non-Stationary) Ha: Unit roof does not exist (Stationary) If probability is <5%, reject Ho.