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Outbreak of epidemic diseases and stock returns: an event study of emerging economy

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ABSTRACT

The massive contagion diseases such as COVID-19 amongst others, has affected nearly all the economies and business concerns that leads to substantial decline in the cashflows and returns dynamics. Considering the same, this paper intends to investigate the impact of outbreak of epidemic diseases on the stock return (observed through cumulative average abnormal return (CAAR)) for the listed banks in Pakistan from 2011 to 2020. Event study method was employed and five days pre and ten days post event of each disease were observed as an event window. The results confirm that none of the epidemic disease outbreak significantly determines the CAAR for all listed banks, except COVID-19 and Dengue Fever during the event day. There is a negative and significant impact of COVID-19 on the stock returns for all the banks in Pakistan from the event day to day eight except day seven. More specifically, COVID-19 is found to be a significant indicator for the stock returns of private banks. However, in case of public listed banks, only the outbreak of HIV cases possesses significant and positive impact on CAAR at the day of event. These findings would guide all stakeholders such as investors, financial analysts, regulators, and chief risk officers specifically in banks to make strategic decisions while analyzing the relationship between epidemic outbreaks and stock returns.

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KEYWORDS
Epidemic diseases; bank's return; stock market; event study; CAAR

1. Introduction

The term Coronavirus (COVID-19) is entitled both with an epidemic and pandemic as it has affected large number of people in the communities, populations and regions. Its outbreak has exposed a range of vulnerabilities for various economies and

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sectors while creating a set of new challenges too. Meanwhile, due to drastic outbreak of COVID-19, financial markets like other sectors remain turbulent because of the massive shut down in the economic activities in United States, Europe, Asia and other regions (Khan et al., 2021; Razzaq et al., 2020; Yu et al., 2021). Although several responses were observed from the central banks in both developed and developing economies to control the harmful effect of COVID-19, however, global stock markets have been continued to shrink. On March 23, 2020, the New York Stock Exchange (NYSE) has been reported to close its trading floor and advised the traders and market makers to work remotely (Sherman, 2020). To prevent a panic-trading as a result of recent turmoil, four times market-wide circuit breakers were trigged during the month of March 2020 (World Economic Forum, 2020). Meanwhile, the reported losses to various financial markets are still an ongoing phenomenon. It is pragmatic that S&P fell about 9.5 percent, Nasdaq 9.4 percent, and an estimated loss of £160.4bn in Financial Times Stock Exchange 100 Index (FTSE 100) of United Kingdom (UK) as reported by (BBC, 2020). Similarly, the Nikkei 225, Nikkei Jasdaq, Hong Kong Stock Exchange, and Shanghai Stock Exchange were found with a downturn of 3.6 percent, 3.4 percent, 3.6 percent, and 1.6 percent due to the spread of COVID-19 (Catherine, 2020). Meanwhile, the economy of Pakistan has also observed a significant decline in the KSE100 index. From February 26, 2020 to March 25, an enormous downturn was observed from 38,858.45 to 28,109.57 points due to uneven market situation as reported because of epidemic outbreaks (PSX, 2020).

Like any other sector, banking firms are playing a significant role in the financial strength of any economy. A dramatic shift in the economic activities is observed due to advancement in the banking and financial sector (An et al., 2021b; Buchak et al., 2018; He et al., 2021). However, various events and news breaks have affected the banks in different regions. These events are in the form of terrorism (Ghani, 2016; Teichmann, 2019), outbreak of war (Sakr-Tierney, 2017; Tortella, 2017), natural disasters (Cortés & Strahan, 2017; Hosono et al., 2016) and several epidemic diseases (Lu et al., 2015; Yang et al., 1999). Such events have provided enough evidence to empirically examine the financial health, performance measures, and market shares of banks with other firms too (An et al., 2021a). For instance, Nasdaq Bank Index was observed with a continuous decline in the last two months from 3887.94 (February 05, 2020) to 2136.63 (March 23, 2020) because of COVID-19 (Bloomberg, 2020a). Meanwhile, declining trend in the stock price of HSBC (i.e., 595.10 GBX on January 02, 2020 to 466.55 GBX on March 27, 2020) was also pragmatic (Hargreaves Lansdown, 2020). This symmetry in the financial crisis for the stock index of listed banks is also observed in the Asian economies too. TOPIX Banks Index has observed 149.89 points on January 6, 2020 which was later declined to 106.98 on 23 March 2020 because of recent epidemic (Bloomberg, 2020b). Similarly, the banking firms as listed in FTSE China A 600 Index have also observed with the declining trend because of this uneven market threats from COVID-19. For Pakistan, it is observed that since the outbreak of COVID-19, there is a sudden decline in the performance and market measures of the listed banks. On 15th January 2020, Pakistan was exposed with the outbreak of this epidemic and experienced a dramatic decline in the stock price of listed banks which continues for most of the listed commercial banks

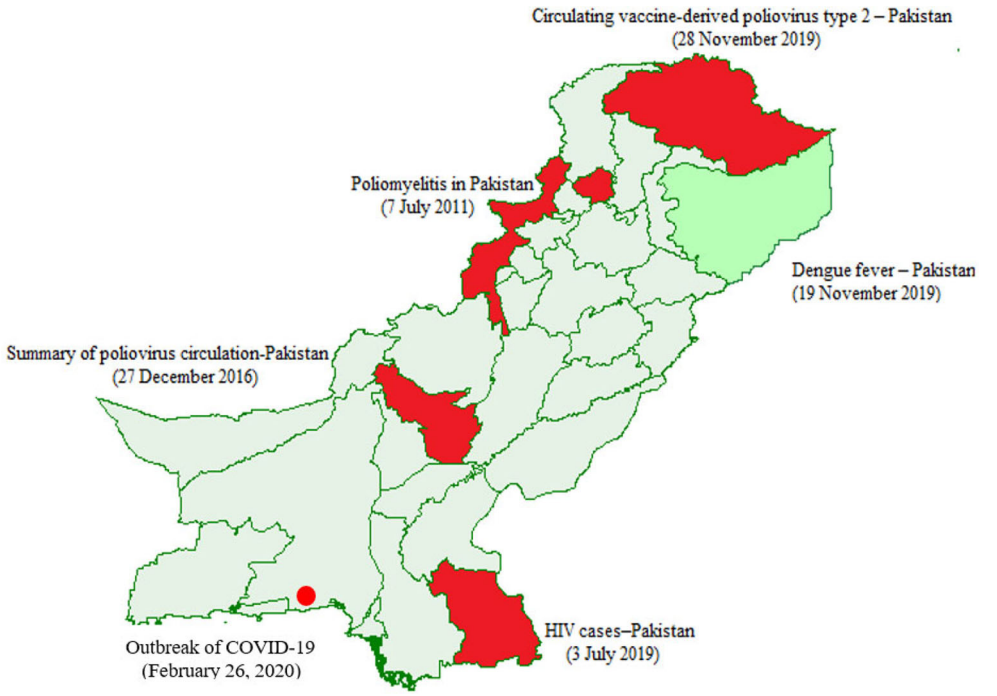

Figure 1. Disease outbreaks in Pakistan. Source: Data from World Health Organization (WHO), Map developed by the Authors.

until 25 March 2020 (KSE, 2020). Besides, the past record of economy reveals that over the last ten years, Pakistan has experienced variety of the epidemic outbreaks with their momentous influence on the stock's performance of the banks. However, literature work is entirely missing while examining the influence of epidemic outbreaks specifically on the stock returns of Pakistani banking sector. This would justify a reasonable research gap which is under observation in the present study analysis.

As per the above discussion, the key objective of this study is to examine the trends in stock return for the listed banking firms of Pakistan during different epidemic disease outbreaks from 2011 to 2020. More specifically, this study considers five events which are related to outbreaks of diseases in Pakistan and their individual impact on the stock return of overall, public sector, and private sector banks. For addressing the stated objective, event study methods (ESM) are applied by measuring the abnormal returns, average abnormal returns, cumulative average returns, and cumulative average abnormal returns during the specified time period. Through this approach, present study is reasonably expected to contribute to the existing literature in multiple ways. Firstly, this research considers the financial sector of Pakistan specifically the banking sectors while taking the sample from public sector, private sector, Islamic and conventional ones. Secondly, event study approach is applied for investigating the trends in stock returns of local banks dur to outbreak of COVID-19. Thirdly, Most of the earlier studies have contributed from the context of developed economies like (Mirza et al., 2020a, 2020b; Rizvi et al., 2020a, 2020b; Yarovaya et al., 2020, 2021). Therefore, our perspective of investigating the trends in stock return is

Table 1. Details of epidemic disease outbreaks during 2011–2020 in Pakistan.

Main disease	Year of outbreak	Event day as reported by WHO	Targeted regions
COVID-19	2020	02/26/2020	Karachi, Punjab, Sindh provinces
Circulating vaccine-derived poliovirus type 2—Pakistan	2019	11/28/2019	Gilgit-Baltistan, Khyber Pakhtunkhwa (KP), Metropolitan Corporation Islamabad
Dengue fever—Pakistan	2019	11/19/2019	Peshawar, Khyber Pakhtunkhwa (KP)
HIV cases–Pakistan	2019	7/3/2019	Larkana district, Sindh
Summary of poliovirus circulation in 2016—Pakistan	2016	12/27/2016	Quetta, Balochistan
Poliomyelitis in Pakistan	2011	7/7/2011	Khyber Agency, Federally Administered Tribal Areas (FATA)

Source: Health Care Commission of Pakistan.

entirely from the developing economies like Pakistan. Such effort would help the policy makers, financial experts, and specifically the risk officers in the banks to strategically analyze the banks' position during such uneven situations. Figure 1 shows five epidemic disease outbreaks in different regions of Pakistan (i.e., Regional information is provided under Table 1) during 2011 to 2020. It is found that the most recent outbreak in the country history is entitled as COVID-19 whose first case was diagnosed on February 26, 2020.

2. Review of literature

The field of event study has been emerged over time. The very first contribution for the event study was provided by Dolley (1933) who have examined the stock splits and related trends. Among others, the contribution provided by (Aktas et al., 2007; Binder, 1998; Corrado, 2011; Kritzman, 1994) is accepted as a cornerstone. It is found that ESM is employed to various fields like finance (MacKinlay, 1997), accounting (Johannesen & Larsen, 2016), and many others (Hartman et al., 2019; Li et al., 2017; Val et al., 2018). More specifically, some others have put their focus for examining the trends in the stock returns for both local and multinational organizations. However, the topics like merger and acquisition (Adnan et al., 2016; Sorescu et al., 2017), banking crisis (Miyajima & Yafeh, 2007), and diversification versus specializations (Culligan et al., 2000; Lepetit et al., 2004) are widely reviewed in the literature keeping the event study as base method of analysis. A set of the business and market related events are also observed in the recent and past decade. For instance, Staikouras (2009) examines the global sample of financial intermediaries for the bank-insurance joint ventures with their impact on the abnormal returns. Meanwhile, the factors like bank size, profitability, and functional diversification are found to be significant determinant for the abnormal return over different intervals. Research contribution by Sufian and Majid (2007) explores the event window with data envelopment analysis (DEA) for investigating the influence of mergers and acquisition on the group efficiency of banking sector of Singapore. Authors found that there is a higher mean overall efficiency for the banking group of Singapore through merger. Additionally, through Tobit regression, they suggest that bank efficiency is positively determined by the profitability. French (2018) explores the patterns of the

market returns as forecasted through event occurrence. Considering the six nations from both developed and developing economies during the time of 2007 to 2016, overall 64 events were observed. It is claimed that market return is influenced by the investor's sentiment. Besides, study findings provide some significant information about the rapidity of price adjustment to new information.

Smith et al. (2019) analyze the multisectoral impact of infectious disease. They believed that endemic infectious disease events have laid a wider range of socioeconomic consequences. Additionally, the multisectoral impact is also examined through discussing the health sector, agriculture sector, and food animal production system, tourism and travel, and environmental impacts. Additionally, some other impacts in the form of lost jobs, lost education, creasing poverty and food insecurity were also discussed by the authors. In recent year, Kim et al. (2020) observes the restaurant industry of USA for examining the impact of epidemic disease outbreak on the financial performance during 2004–2016. Three firms related characteristics (i.e., brand reliability, service types, and advertising effect) were observed for the firms' value. It is found that epidemic disease outbreaks have their significant but negative influence on the restaurant industry. However, the stated three firm's characteristics are also found as core risk reduction factors.

Rizvi et al. (2020a) examine the association between COVID-19 and asset management for investigating the trends in performance and investment styles in European Union (EU). For this purpose, they have considered the time duration between January and May 2020 and divided the spread of pandemic under three different phases. It is observed that Social Entrepreneurship funds are positively linked with all three phases, while subcategories plunged into negative zone. Mirza et al. (2020a) investigate the linkage between price reaction, volatility timing, and performance of funds during COVID-19. It is observed that most of the investment funds during the period of January and June 2020 shows stressed performance whereas social entrepreneurship funds endured resilience as well. Yarovaya et al. (2021) investigate the impact of human capital efficiency on the performance of equity funds during the outbreak of COVID-19. Overall data for 799 open-ended equity funds across five EU economies was collected. The findings suggest that during the outbreak of COVID-19, equity funds that were ranked higher in HCE outperformed their counterparts. Mirza et al. (2020b) examine the impact of COVID-19 on the corporate solvency and policy responses among EU member states. Key highlights of their study reveal that there is a decline of market capital during the outbreak of COVID-19 which has further increased the default likelihood. However, tax deferral is observed as sufficient while giving a moderate deterioration in the economic profile of selected economies.

Yarovaya et al. (2020) analyze the risk adjusted performance for the Islamic as well as conventional equity funds during COVID-19 pandemic. They observed that during such outbreak Islamic equity funds are showing some differential in terms of risk-adjusted performance, volatility timing, and investment styles comparatively to the conventional counterparts. Rizvi et al. (2020b) assess the impact of COVID-19 pandemic on the value of non-financial firms in 10 EU states while applying stress testing method taking a sample of 5342 listed firms. Firstly, they have estimated the input sensitivities of free cash flow and residual income models along with the

random effect estimation. Secondly, based on the input sensitivities, they have computed the model driven ex post valuation. Thirdly, multiple stress scenarios are also observed that may emanate from COVID-19. Their study finding shows that there is a significant amount of loss in terms of valuation across different sectors dur to decline in the sales.

Sharif et al. (2020) examine the relationship between COVID-19 outbreak, geopolitical risk, oil prices and economic uncertainty for the economy of US. For this purpose, they have applied wavelet-based approach while showing the association between the different time period and investment horizons. It is found that there is a greater effect of COVID-19 on the US geopolitical risk along with the economic uncertainty as well. Yousfi et al. (2021) have tested the effect of COVID-19 pandemic on the US stock market through comparative assessment between first and second waves. The study highlights confirm that there is a presence of volatility spillover between the Chinese and US stock market during the outbreak of COVID-19. Additionally, a persistent link is observed between the US returns and uncertainty during the first and second waves of COVID-19.

Although a substantial contribution is made by the earlier research through ESM, however, it is observed that the gap for investigating the influence of epidemic disease outbreaks and their influence on the financial market role players like banks is very little covered. Therefore, our study has contributed to the present literature in several ways. First, we explore the five epidemic disease outbreaks in Pakistani economy in recent decade which is missing in the earlier literature. Second, as stock market and their players are highly vulnerable to such events, our study has provided a good empirical finding covering the pre and post event discussion too. Thirdly, our study splits the sample of listed banks into public and private sector to observed whether the outbreak of five epidemic diseases have their significant influence on the stock return or not.

3. Research methodology

Our study has primarily observed the epidemic diseases which were outbreak in Pakistan during 2011–2019. After investigating from the web sources of world health organization (WHO), five disease outbreaks were found between the targeted time duration. The event was considered during a particular day when the news is outbreak and same is reported on the official web page of WHO. Meanwhile, the event day was observed as the time when the outbreak of selected epidemic diseases was released on the media. The data for the event day and news outbreak was collected from the WHO and similar was reported on the media too. For the better understanding, Table 1 shows the details about the main diseases, their year of outbreak, event days, and targeted regions in Pakistan.

For the measurement of return factors, our study has focused on the stock return (daily) for the listed banks and market return information (KSE100 index) during the study period. The data for 20 listed banks was collected from official web sources of Pakistan Stock Exchange during 2011 to 2020 on daily basis. For measuring the market return, market price on daily basis for KSE100 index was collected over the

similar time frame. To examine the influence of outbreak of each epidemic in the Pakistan during the study period on return patterns, the announcement date of each disease is observed as an event. However, no specification is mentioned whether these events have their positive or negative influence on the return patterns of selected banking firms in Pakistan. The traditional ESM approach of Fama et al. (1969) indicates the calculation of cumulative average abnormal returns (CAAR) for the selected firms. In this regard, three major steps were examined in the literature and similar approach is followed.

In the very first step, daily abnormal return (AR) for each of the listed banks was calculated in the days as surrounded by the announcement of a particular event being studies. Various methods are further provided in the literature of event study for the calculation of AR based on the various benchmarks like market return, net of the market return, net of the characteristics matched portfolio return or acquiring the most cited model of capital assets pricing or CAPM. Under present research, we have applied the statistical market model in order to anticipate the expected returns. Each value of expected return was compared to the actual returns to find the patterns of abnormal returns for the selected banks during the study period. The relationship between the stock return and market return can be expressed through Eq. (1).

$$E(Ri,t) = \alpha + \beta 1 \quad \times E(RM,t) \tag{1}$$

The above equation is quite similar to the single factor CAPM except that the value of intercept is taken to be constant instead of using the risk-free rate of return (Rf). However, for estimating the parameters in the above equation, ordinary least square regression approach is widely used. For our data, we used the daily data for the returns based on the estimation window of 200 days which further specifies the 40 days before the event and 40 days after the outbreak of the event. The time duration of -5 and $+10$ is assumed as window period in the present study. After the estimated value of both of the parameters for Eq. (1), predicted returns for the event window were calculated while using the market returns of KSE100 index. The value of abnormal return (AR) for each of the selected banking firms was collected while taking the difference between the actual returns and predicted return. Equation (2) indicates the calculation of AR in the present study.

$$ARi,t = Ri,t \; - \; E(Ri,t) \tag{2}$$

In the second step, average abnormal return (AAR) was calculated against each day in the event window. This approach has provided an aggregated value of abnormal return for all the listed banks over time *t*. this approach helps to eliminate the peculiarities in the measurement due to particular banking firms. Equation (3) shows the measurement of AAR.

$$AARt = \frac{1}{N}\sum_{i=1}^{N} ARi,t \tag{3}$$

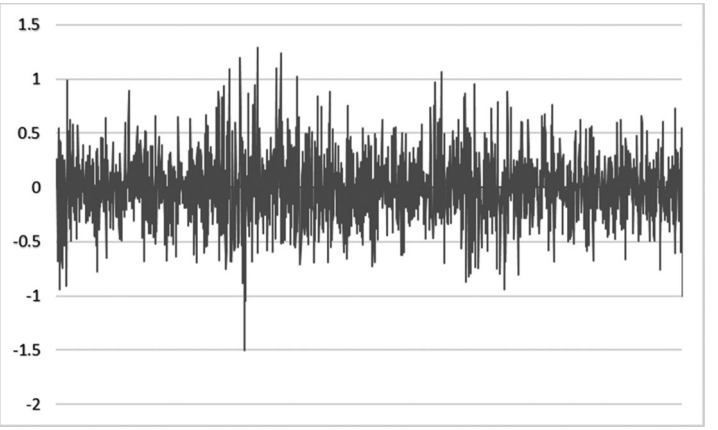

Figure 2. CAAR for all listed banks (overall).
Source: authors estimations and drawing.

In the third step, cumulative average abnormal return (CAAR) was calculated through finding the summation of average abnormal return (AAR) over the targeted days (T) in the event window for overall times *t*. It is believed that CAAR is among the significant statistical approaches in addition to AAR as it provides the sense of aggregate effect of AR. Figures 2–4 are providing the trends in CAAR for the overall listed banks, public banks and private banks during 2004 to 2020.

4. Results and discussion

4.1. Results

Table 2 provides findings for the impact of epidemic disease outbreak on the CAAR for all the listed banks of Pakistan during 2011–2020. One of the key contributions of our study is to examine whether the influence of outbreaks of epidemic diseases have their impact on the CAAR 5 days before the event ($t-5$) to event day (0), and 10 days after the event (t10) to event day (0). Meanwhile, our results have repeated this approach in the form of 0 to $t-4$, 0 to $t-3$, 0 to $t-2$, 0 to $t-1$, 0 to t1, 0 to t2, 0 to t3, 0 to t4, 0 to t5, 0 to t6, 0 to t7, 0 to t8, 0 to t9, and finally 0 to t10. It is observed that on the event day of CVDP, positive but insignificant influence on the CAAR for all the listed banks was observed (C0 = 0.0930, *t*-value = 0.333). However, on $t-4$ and $t-5$, the influence of CVDP on CAAR is highly significant at 5 percent. This would imply that four and five days before the outbreak of CVDP, overall significant and adverse impact on CAAR of listed banks was observed. Whereas $t-1$, $t-2$, and $t-3$ have shown a negative but insignificant result. Meanwhile, the influence of CVDP on the CAAR of selected banks in the very first day after the event is negative and significant which means that stock return of the listed banks has observed with a negative tendency due to the outbreak of CVDP. This trend continues to observe until the 10th day after the event (C10), except in t2 where the influence of CVDP is negatively insignificant. Authors like Mazur, Dang, and Vega (2021) have examined the trends in stock returns due to outbreak of COVID-19. It is

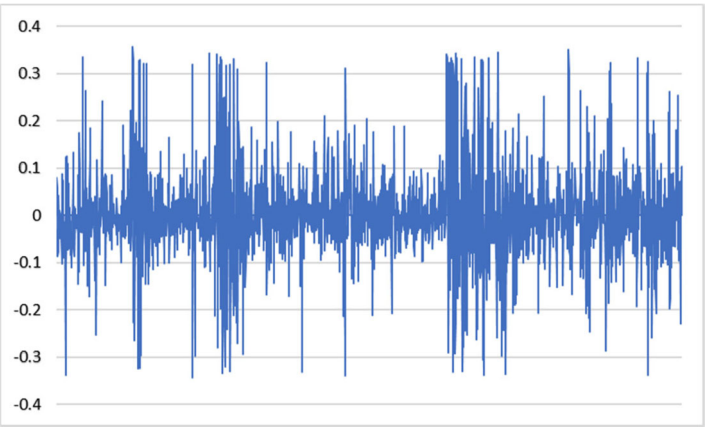

Figure 3. CAAR for all public banks (overall).
Source: authors estimations and drawing.

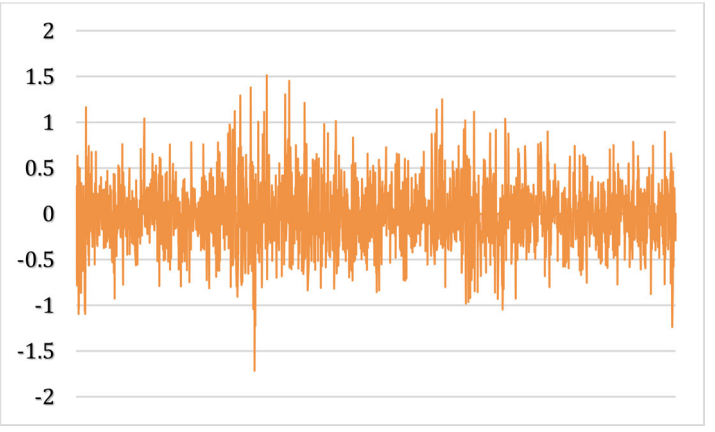

Figure 4. CAAR for all private banks (overall).
Source: authors estimations and drawing.

observed that various sectors like natural gas, health, and software have shown their positive returns while the sectors like real estate, hospitality and entertainment have shown a dramatic decline in the returns values. Salisu and Vo (2020) consider the health-related news in order to predict the stock returns. The results of their study reveal that health-news index outperforms the benchmark historical average model confirm the fact that health news searches are playing their role as a good predictor of stock returns since the outbreak of COVID-19.

Through DFP, event day is showing a positive and highly significant impact on CAAR. This shows that the outbreak of DFP has its positive impact on the stock return of listed banks. Similarly, all the five days before the news outbreak of DFP, highly significant and positive impact was recorded (t-statistics for C0 to $C-5$ is above threshold level of 1.96). Additionally, from C1 to C3, CAAR is also reporting positive and significant results. The third event under this study was reported through HIV cases in Pakistan. Table 2 shows that on event day for HIV cases in Pakistan

Table 2. Impact of epidemic on Cumulative average abnormal return (all banks).

Window	CAAR-code	CVDP	T-value	DFP	T-statistics	HIV cases	T-statistics	PV	T-value	Poliomyelitis	T-score	COVID-19	T-score
0 to $t-5$	C − 5	−0.6128**	−2.19	0.87336***	6.99	−0.4679**	−3.69	2.4903***	19.93	−0.1975	−1.58	−0.625	−1.61
0 to $t-4$	C − 4	−0.6098**	−2.18	0.5122***	4.10	−0.1340	−1.07	2.0677***	16.55	−0.0374	−0.30	−2.014***	−2.30
0 to $t-3$	C − 3	−0.4928	−1.76	0.8259***	6.61	−0.1382	−1.10	1.2899***	10.32	−0.2366*	−1.89	−0.352*	−1.90
0 to $t-2$	C − 2	−0.2724	−0.975	0.6422***	5.14	0.0501	0.40	0.4539***	3.63	−0.2171	−1.74	−0.5471	−1.156
0 to $t-1$	C − 1	−0.0854	−0.305	0.5161***	4.13	0.0621	0.49	0.3311***	2.65	−0.2633**	−2.11	−0.0214	−0.119
0	C_O	0.0930	0.333	0.6043***	4.83	0.0827	0.66	−0.0498	−0.40	−0.0462	−0.37	−.685	−1.07
0 to t1	C1	−0.2559**	−2.04	0.6013***	4.81	−0.3992***	−3.16	0.3347***	2.68	−0.1454	−1.16	−0.214***	−3.16
0 to t2	C2	−0.3114	−1.11	0.4843***	3.87	−0.1824	−1.16	1.2529***	10.03	0.0975	0.78	−0.6230***	3.874
0 to t3	C3	−0.6148**	−2.20	0.2639**	2.11	0.4394***	3.44	0.6349***	5.08	−0.0905	−0.72	−0.254	−0.625
0 to t4	C4	−0.6364**	−2.27	0.1700	1.36	0.0624	0.04	−1.0950***	−8.77	−0.3194***	−2.56	−.201***	−4.56
0 to t5	C5	−0.7026**	−2.51	−0.0085	−0.680	−0.3708***	−2.96	−1.0498***	−8.40	−0.3378***	−2.70	−0.241***	−4.70
0 to t6	C6	−0.9623***	−3.44	0.0845	0.676	−0.4712***	−3.77	−0.1218	−0.98	0.2603**	2.08	−0.6325***	3.08
0 to t7	C7	−1.1630***	−4.16	−0.1714	−1.37	−0.1672	−1.33	0.6119***	4.90	0.0654	0.52	0.2014	0.52
0 to t8	C8	−1.2083***	−4.32	−0.2268	−1.18	0.0235	0.188	1.0800***	8.65	0.2252*	1.80	0.3680*	1.80
0 to t9	C9	−1.3386***	−4.79	−0.5303**	−4.24	0.0376	0.301	1.0795***	8.64	0.1345	1.08	0.3575	1.08
0 to t10	C10	−1.3594***	−4.86	−0.5518**	−4.14	0.0620***	4.96	0.4856***	3.89	−0.0022	−0.02	0.68	−0.587

Note: CAAR = cumulative average abnormal return, CVDP = circulating vaccine-derived poliovirus type 2–Pakistan, DFP = dengue fever in Pakistan, PV = poliovirus circulation in 2016—Pakistan, 0 = event day, $t-1$ to $t-5$ = day one to day five before the event, t1 to t10 = day one to tenth day after the event, C0 = cumulative return for the event day, C − 1 to C − 5 = cumulative return day one to fifth day before the event, C1 to C10 = cumulative return for the day one to tenth day after the event accordingly, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$ indicating level of significance.

Source: authors estimations and drawing.

(C0), positive but insignificant impact on CAAR is observed. Similarly, C − 1 to C − 4 have also reported an insignificant impact from HIV cases, however, C − 5 is showing a negative and significant result (CAAR = −.4617, *t*-value = −3.69). For the days after this event, C3 and C10 have reported positive and significant results, whereas C1, C5, and C6 show an adverse impact after the outbreak of HIV cases in Pakistan. The fourth event is entitled as the outbreak of polio virus where the event day is showing an insignificant impact (i.e., C0 = −0.0498, *t*-value = −0.40). For all the five days after the outbreak of polio various news, we have observed a positive and highly significant trend for the CAAR of listed banks. Furthermore, C1 to C10, positive and significant trend for C2, C3, and C7–C10, and negatively significant for C4 and C5 was found. The next event is named as Poliomyelitis in Pakistan. It is observed that C0 is showing a negatively insignificant result, however, the day before poliomyelitis, CAAR for the local banks in Pakistan is negative and highly significant (C − 1 = −.2633, *t*-value = 2.11). Meanwhile, the impact of poliomyelitis in the three subsequent days of the event was found to be insignificant. After the event day, the relative value of CAAR against C4, C5, and C6 is negatively significant, showing an adverse impact of poliomyelitis. However, C8 has presented positive impact from poliomyelitis. In addition, the findings under Table 2 for all the banks as observed through CAAR indicate that five days before the outbreak of COVID-19, negative but insignificant impact is observed, whereas three days and four days before that outbreak in Pakistan, all the listed banks have shown a significant and negative trend in CAAR. However, one day before this outbreak, the stock return is found be negatively insignificant. The results further claim that on the event day, insignificant impact on the banks' return was observed. Furthermore, from the event day to day eight except day seven, there is a negative and significant impact of COVID-19 on the stock returns for all the banks in Pakistan.

Various studies have been found while exploring the impact of disease outbreak on different economies and stock returns. For example, Narayan et al. (2021) investigate the effect of government responses in G7 economies against COVID-19 on the stock market return. It is observed that factors like travel bans, economic stimulus packages and lockdowns have their positive impact on the stock returns. However, the factor like lockdowns is the most effective while cushioning the effect of COVID-19. Narayan et al. (2020) try to investigate the linkage between local currency and stock returns for the economy of Japan. They found that e unravel that the depreciation of the Yen vis-à-vis the US dollar led to gains in Japanese stock returns. Kim et al. (2020) have observed the impact of epidemic diseases outbreak on financial performance of restaurants in USA. For this purpose, they have considered nine events during 2004–2016. It is found that there is a negative impact of epidemic disease outbreaks on the performance dynamics of restaurant industry.

Meanwhile, Table 3 indicates that at none of the disease outbreak has shown its significant impact on stock returns for the private banks in Pakistan. However, the impact from selected disease before and after the outbreak is showing mixed trend. More specifically, COVID-19 is found to be a significant indicator for the stock returns of private banks from t4 to t8 as shown in Table 3. Lastly, our results have covered the sample for the private listed banks (Table 4) while exploring the influence

Table 3. Impact of epidemic on Cumulative average abnormal return (public sector).

Window	CAAR-code	CVDP	T-value	DFP	T-value	HIV cases	T-value	PV	T-value	Poliomyelitis	T-value	COVID-19	T-value
0 to $t-5$	C − 5	−0.1570	−1.26	−0.5751***	−4.60	1.2744***	10.20	0.2321	1.86	0.9956***	7.97	−0.214***	3.122
0 to $t-4$	C − 4	−0.0075	−0.06	−0.8638***	−6.91	1.0295***	8.24	0.2560**	2.05	0.8130***	6.51	−0.204	1.0214
0 to $t-3$	C − 3	−0.2261	−1.81	−0.8107***	−6.49	0.9534***	7.63	−0.7390***	−5.92	0.4434***	3.55	−0.874***	3.015
0 to $t-2$	C − 2	−0.1515	−1.21	−0.4720***	−3.78	−0.0152	−0.12	−0.6889***	−5.51	−0.1129	−0.90	−0.305	−1.45
0 to $t-1$	C − 1	−0.0908	−0.73	−0.2628**	−2.10	0.0942	0.75	0.1844	1.48	−0.0261	−0.21	−0.025***	−2.571
0	C_O	0.0607	0.49	0.0045	0.04	0.3678***	2.94	−0.0517	−0.41	0.1077	0.86	−0.257	−1.0214
0 to t1	C1	0.0423	0.34	−0.0335	−0.27	0.6178***	4.94	−0.0548	−0.44	−0.0214	−0.17	−0.2017	3.2104
0 to t2	C2	0.1085	0.87	−0.1830	−1.46	0.3307***	2.65	−1.0450***	−8.36	−0.0106	−0.08	−0.8471	0.258
0 to t3	C3	0.4342***	3.48	0.0356	0.28	−0.0890	−0.71	−1.6106***	−12.89	−0.0316	−0.25	−.6521	−1.025
0 to t4	C4	0.2568**	2.06	−0.0390	−0.31	0.6202***	4.96	−1.1176***	−8.95	−0.1102	−0.88	0.885***	3.254
0 to t5	C5	0.0965	0.77	−0.1905	−1.52	0.7032***	5.63	−1.9507***	−15.61	−0.0720	−0.58	0.2145***	3.968
0 to t6	C6	−0.2286	−1.83	−0.1298	−1.04	0.6885***	5.51	−1.8177***	−14.55	−0.0938	−0.75	0.3258***	4.0259
0 to t7	C7	−0.2598**	−2.08	−0.1483	−1.19	0.3708***	2.97	−1.9150***	−15.33	−0.0837	−0.67	0.8258	0.1308
0 to t8	C8	−0.2137	−1.71	−0.0820	−0.66	0.4120***	3.30	−1.3875***	−11.11	0.0015	0.01	0.3652**	2.014
0 to t9	C9	−0.1914	−1.53	0.2437*	1.95	0.3247***	2.60	−0.5639***	−4.51	0.0107	0.09	0.9157	1.625
0 to t10	C10	−0.2128	−1.70	0.0663	0.53	0.5726***	4.58	−0.7705***	−6.17	−0.0212	−0.17	0.2750	0.2017

Note: CAAR = cumulative average abnormal return, CVDP = circulating vaccine-derived poliovirus type 2–Pakistan, DFP = dengue fever in Pakistan, PV = poliovirus circulation in 2016—Pakistan, 0 = event day, $t-1$ to $t-5$ = day one to day five before the event, t1 to t10 = day one to tenth day after the event, C0 = cumulative return for the event day, C − 1 to C − 5 = cumulative return day one to fifth day before the event, C1 to C10 = cumulative return for the day one to tenth day after the event accordingly, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$ indicating level of significance.

Source: authors estimations and drawing.

of epidemic outbreaks and their influence on the return patterns. Through CVDP and DFP, insignificant impact on CAAR was observed during the event day and similar is observed through HIV cases, PV, and poliomyelitis, respectively. It means that none of the epidemic disease outbreak have shown their significant influence on the CAAR for the private banks during 2004 to 2019. However, before and after the break of these epidemics, findings are mixed. For example, one day before the event of CVDP, CAAR for private banks are negatively and significantly affected and similar is found the day after the event (C1 = −4.1491). Accordingly, CAAR from 0 to sixth day (C6), highly significant and negative impact through CVDP was found. Meanwhile, influence from DFD before the event was significantly positive for C − 2, C − 3, and C − 5. This means that second, third, and fifth day before the event of DFD were statistically significant. On the other hand, C4 to C10 after this event, highly significant and negative effect was recorded. Meanwhile, the findings under Table 4 have also depicted the impact of COVID-19 on the stock returns for the private listed banks of Pakistan. The results confirm that from the COVID-19, there is a significant and negative effect of COVID-19 on the stock return of private banks on $t-4$, and $t-5$, respectively. Similarly, the impact of COVID-19 on the stock return of private banks is found as significantly negative on $t-1$, and $t-2$, respectively. However, no impact on the event day was observed. Furthermore, one day after this outbreak the private banks return is observed as significant and negative, and similar trend is found from C4 to C5, and C8-C10.

For HIV cases, private banks in Pakistan are also vulnerable, except on the outbreak of other diseases. It is found that $t-3$, $t-4$, and $t-5$ are negatively determining the CAAR, whereas C5 to C10 show a highly significant and negative results. This means that the stock returns for the private banks are exposed towards HIV cases relatively before the second day and after the fourth day. Through PV, our results are again providing no evidence for the significant impact on CAAR for the private banks on the event day. Whereas, for C − 2 to C − 5, highly significant and positive influence from PV, and similar for C1 to C10, except C5 and C6. Finally, the outbreak of poliomyelitis indicates negative impact from C − 1 to C − 5 on CAAR except on the event day. Similarly, subsequent day of poliomyelitis breakup, fourth and fifth day have also provided the adverse effect on CAAR for privately owned banks in Pakistan. However, C8 to C10, results are positively significant at 5 percent.

Figures 5–7 provide the trend in average abnormal return (AAR) for the overall listed banks, public banks, and private banks against each of the epidemic disease outbreak (i.e., AAR-1 = Poliomyelitis in Pakistan to AAR-5 Circulating vaccine-derived poliovirus type 2—Pakistan) respectively.

4.2. Discussion

Our study has examined the outbreak of five epidemic diseases in determining the patterns of the stock return for listed banks of Pakistan. For this purpose, both before and after the outbreak of each event, cumulative returns along with the relative *t*-statistics were provided. It is found that among the five selected diseases, the outbreak of DFP has provided significant evidence to impact on the CAAR for all the listed banks during the

Table 4. Impact of epidemic on Cumulative average abnormal return (private sector).

Window	CAAR-code	CVDP	T-value	DFP	T-value	HIV cases	T-value	PV	T-value	Poliomyelitis	T-value	COVID-19	T-value
0 to $t-5$	$C-5$	−6.6828	−0.0104	5.9082***	5.4547	−9.5867***	−8.8508	6.7707***	6.2510	−7.4309***	−6.86	−6.621***	−4.57
0 to $t-4$	$C-4$	−6.6715	−1.5899	0.4192	0.3870	−3.4501***	−3.1852	6.0718***	5.6057	−5.6864***	−5.25	−4.258***	−5.28
0 to $t-3$	$C-3$	−4.9494	−0.6880	5.3848***	4.9714	−3.4416***	−3.1774	4.4905***	4.1458	−2.1149*	−1.95	−1.114	−0.95
0 to $t-2$	$C-2$	−4.2042	−1.3178	2.1077*	1.9459	0.9253	0.8543	2.7653**	2.5530	−5.5418***	−5.12	−7.257***	−6.06
0 to $t-1$	$C-1$	−2.7768***	−2.4976	−0.1194	−0.1102	1.0249	0.9462	0.2610	0.2410	−5.2395***	−4.84	−4.028***	−3.84
0	C_O	−0.0715	−0.0660	1.0250	0.9463	1.1223	1.0362	−1.2332	−1.1386	−1.0308	−0.95	−1.030	−0.85
0 to t1	C1	−4.1491***	−3.7646	1.0137	0.9359	−7.7264***	−7.1333	6.5096***	6.0099	−2.8858***	−2.66	−4.828***	−3.98
0 to t2	C2	−5.1022	−0.8799	−0.7084	−0.6540	−2.1245	−1.9615	7.8801***	7.2753	−0.9469	−0.87	−0.542	−0.27
0 to t3	C3	−6.2829	−1.0901	−1.4536	−1.3420	0.7373	0.6807	4.2018***	3.8792	−1.7792	−1.64	−0.212	−1.25
0 to t4	C4	−6.4504	−0.1546	−2.8810***	−2.6598	−1.2909	−1.1918	2.5350**	2.3404	−8.0889***	−7.47	−7.485***	−6.17
0 to t5	C5	−7.3500	−0.8306	−5.5862***	−5.1575	−6.7309***	−6.2143	−1.7234	−1.5911	−6.6845***	−6.17	−5.621***	−6.34
0 to t6	C6	−10.1798***	−2.6125	−5.6578***	−5.2235	−9.8418***	−9.0863	0.4372	0.4037	−1.4564	−1.34	−1.054	−1.05
0 to t7	C7	−10.3597	−0.1661	−9.7353***	−8.9881	−9.4081***	−8.6860	2.2158**	2.0458	1.3923	1.29	1.258	1.08
0 to t8	C8	−11.1304	−0.7115	−10.6884***	−9.8680	−9.1413***	−8.4397	4.0032***	3.6959	5.8103***	5.36	6.181***	4.36
0 to t9	C9	−11.2377	−0.0991	−11.8692***	−10.9581	−8.6836***	−8.0171	5.3770***	4.9643	2.6789**	2.47	3.520**	2.15
0 to t10	C10	−11.5484	−0.2869	−12.0366***	−11.1127	1.8668***	3.7235	3.3643***	3.1061	2.6673**	2.46	5.623***	3.46

Note: CAAR = cumulative average abnormal return, CVDP = circulating vaccine-derived poliovirus type 2–Pakistan, DFP = dengue fever in Pakistan, PV = poliovirus circulation in 2016—Pakistan, COVID-19 = COVID-19 outbreak, 0 = event day, $t-1$ to $t-5$ = day one to day five before the event, t1 to t10 = day one to tenth day after the event, C0 = cumulative return for the event day, $C-1$ to $C-5$ = cumulative return day one to fifth day before the event, C1 to C10 = cumulative return for the day one to tenth day after the event accordingly, ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$ indicating level of significant.
Source: authors estimations and drawing.

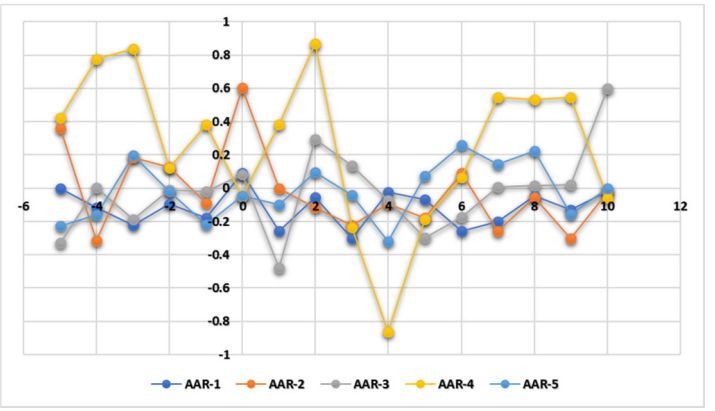

Figure 5. Average abnormal return for all listed banks against all five disease outbreaks (AAR1-AAR5).
Source: authors estimations and drawing.

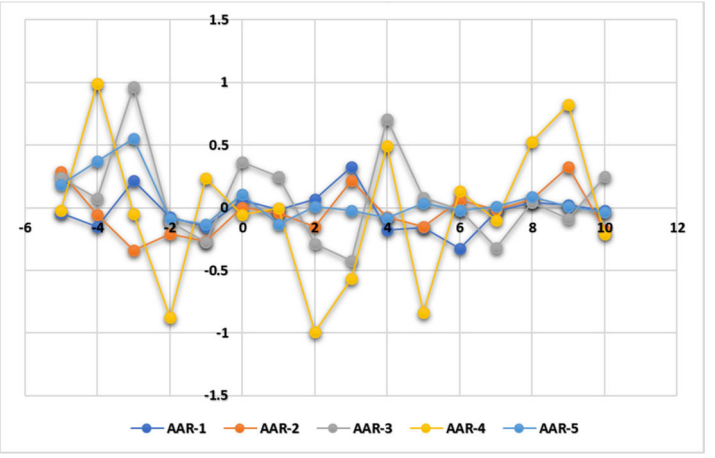

Figure 6. Average abnormal return for public banks against all five disease outbreaks (AAR1-AAR5).
Source: authors estimations and drawing.

event day. Whereas there is no evidence for the influence of remaining diseases regarding their influence on the CAAR of listed banks during the day of event. In case of public listed banks, outbreak of HIV cases is showing a positive impact during the event day, while other epidemics are showing insignificant results. For private banks, event day of all the diseases has shown insignificant results for the CAAR. The practical perspective of outbreak of each event specifically before and subsequent days in each event has highlighted the significance of some managerial suggestions for stock returns. For instance, the findings for the subsequent days of CVDP outbreak are showing an immediate and consistent negative impact on the overall sample of listed banks.

In case of DFP, the outcomes are reflecting highly positive impact on the CAAR from the first day before the event to fifth day which reflects a good trend. The potential reason for this positive influence of before the outbreak of DFP might be the consistent

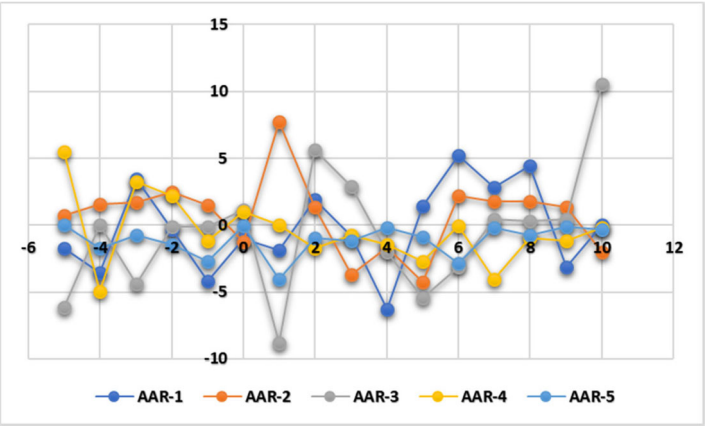

Figure 7. Average abnormal return for private banks against all five disease outbreaks (AAR1-AAR5). Source: authors estimations and drawing.

growth in the overall stock market, where all indexes were found to towards progress by the last quarter of 2019. Such overall positive trend in the local stock market of Pakistan had created an overall positive impression in the second month of the last quarter in 2019, irrespective of the earlier five days of DFP epidemic. From the result of CAAR through HIV cases, our study has shown consistent negative results immediately after the outbreak till C6. This result would justify the claim that HIV cases in Pakistan were increasing with the alarming rate since the 1987, hence declare as concentrated epidemic with the new reported cases of 21,000 in 2017; two years before the outbreak of HIV in 2019 as reported under present study. For the results of PV, our results have shown constantly positive outcomes from $C-1$ to $C-5$, but negative from C4 to C5, and again positive from C7 to C10. More specifically, this overall mix trend of PV in determining the CAAR for the overall listed banks infers that positive trends are comparatively more than the negative ones. Meanwhile, based on the findings for the poliomyelitis during 2011, the day before event has reported an adverse effect on CAAR and similar was observed after the fourth and fifth day of event.

Based on the above findings and discussions, banking firms are highly suggested to develop the relative strategies to significantly cope with the uneven market risks like epidemic diseases. Although, there are certain guidelines as provided by the State Bank of Pakistan (SBP) to tackle the risk factors like those which are market based. However, no evidence is found dealing with the mitigating of those risks dynamics which are uneven in the market and may be widespread at any time. In addition, it is suggested that banking firms need to communicate the proposed policy for dealing with the disease epidemics specifically for their investors so that their confident would remain stable over the investments in the banks.

5. Conclusion

5.1. Conclusion, limitations and future direction

Current study has provided some interesting findings while exploring the outbreak of the diseases with their influence on the stock return of both public and private listed

banks in Pakistan. However, some limitations also exist. Firstly, our study includes only five epidemic diseases during the recent decade. However, various bacterial, viral, venereal, endocrine, and blood diseases were deliberately excluded. Secondly, the outbreak of stated diseases was observed only for the listed commercial banks while other sectors and listed firms in the local market was not observed. Additionally, overall financial market comprises of developed finance institutions, investment banks, leasing companies, exchange companies, housing finance, and venture capitals. However, these firms were also not observed in our research. Thirdly, the stated five diseases of our study may also consider as among the core risk factors for the stock return of banking firms. However, the role of the risk managers or the risk committee is also missing in our research who can play their significant role in lowering the potential impact of such outbreaks on stock's return. Therefore, in the upcoming studies it can be a significant approach to explore the role of risk committee or similar other committee in the banks for exploring the relationship between epidemic diseases and stock return of local banks. Fourthly, the geographical limitation of our study specifies the coverage of only the Pakistani context. While other nearby economies like India, China, and Japan may also observe for the outbreak of several diseases in the recent decade. Future studies need to address the above stated limitations to investigate whether the outbreak of diseases in the neighboring regions have some significant outcomes or not.

5.2. Policy recommendations

In terms of policy recommendations, this study provides the following key highlights

I. The regulatory authorities in banks should make some strategic policies to control the effect of such epidemic diseases through risk diversification strategies. For this purpose, both portfolio diversification and portfolio specialization can provide some meaningful results.
II. Regulatory authorities should instruct the banking officials and risk experts to regularly review the stock market trends based on such events to enhance their understanding and decision-making capabilities regarding the risk aversion strategies confronted by stock returns of banks.
III. Some policies to control both the systematic and non-systematic risk titles should also be communicated well throughout the banks so that stability in the stock returns would be observed.

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