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Test of Semi-Strong Form of Market Efficiency in M&A Announcement by US Technology Companies

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SEMINAR ON ACCOUNTING AND FINANCE

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Summary

Purpose – this study sought to discern the reaction of the stock market to Merger and acquisition (M&A) announcements of US technology firms in an effort to test the semi-strong form of the efficient market hypothesis (EMH). The focus was on M&A announcements made in 2021, which is an attempt to incorporate the influence of the current crisis caused by the COVID-19 pandemic.

Methodology – the study sought to use three models, namely the constant return model, market-adjusted model and the capital asset pricing model (CAPM) to fulfill this aim. A sample of 20 M&A announcements were the focus of the research with a keen focus on the acquirer's stock performance before, during and after the event of interest (i.e., the M&A announcement). The sampled stocks were primarily from 2021. A t-test was used to examine whether the cumulative abnormal returns (CARs) and the buy and hold abnormal returns (BHARs) are statistically significant.

Results – the study's findings revealed that the abnormal returns (i.e., CARs and BHARs) were primarily not statistically significant. Only two of the stocks (averagely) showed statistically significant abnormal returns out

of a sample of 20 securities, which led to the deduction that the US technology market was in the semi-strong form of efficiency.

Conclusion – the US technology market is in the semi-strong form of EMH. The implication of this conclusion is that investors have a low chance of garnering abnormal returns from investment portfolios that comprise assets from the technology market.

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Introduction

In all cases, each and every investor anticipates some level of profit to be generated by his/her investment portfolio. Different models, such as the Capital Asset Pricing Model (CAPM), have been used to predict expected profits or returns from an investor's portfolio. CAPM takes the risk-free rate of return, expected market return, and beta into consideration in the determination of an investor's expected returns (Ndekugri & Pesakovic, 2017). Sometimes, however, due to events in capital markets, anomalies occur that result in abnormal returns for investors. Abnormal returns can be defined simply as those that deviate from the expected returns of a particular investment portfolio. Abnormal returns are unusually large profits or losses obtained from an investment, which can either be positive or negative. A positive abnormal return is the excess amount above the expected profits, such that an investor has a positive excess return of 3% if the actual return was 10% and the anticipated amount was 7%. A negative abnormal return is more or less in the opposite direction, such that an investor has a negative abnormal return of 3% if the actual return was 7% and the anticipated amount was 10% from a portfolio.

Anomalies in capital markets are common and they challenge the efficiency market hypothesis (EMH), which is a key finance that stems from the notion that all stocks in capital markets are properly priced and abnormal returns are impossible because mispriced stocks are not in existent. From this standpoint, anomalies can be delineated as situations that cause the performance of a security or a group of securities to deviate from the notion embraced in efficient markets (Guo, Li & John Wei, 2020). As such, anomalies are unusual occurrences in financial markets that arise because of the constant release and rapid dissemination of novel information, which make it impossible for efficient markets to be achieved and even harder to maintain. A well-known anomaly in financial markets involves small firms outperforming larger companies, which has been termed the small-firm effect (Hwang, Gao & Owen, 2013). For example, a conglomerate may need billions of sales to record a 10% growth while a small firm may only need a few millions in sales to record similar rate of growth. Another anomaly is the January effect, which refers to the notion that stocks that floundered in the last quarter of the prior fiscal year tend to outperform the market in January (Perez, 2017).

Some investors often jettison underperforming stocks during the close of a fiscal year so that they can offset capital gains taxes using their losses.

In the context of this study, mergers and acquisitions (M&A) are considered to be anomalies because, upon their announcements, stocks can either be undervalued or overvalued to the extent of causing abnormal returns to occur. Researchers have become concerned with stock performance before and after M&A announcements. For example, Tang and Xu (2016) investigated stock price run-ups prior to M&A announcements that occurred between 1981 and 2011. A third of these events occurred before the M&A announcements were made and were not the product of market anticipation of the M&As, reported insider trading or toehold acquisitions. Instead, the study observed that the pre-announcement run-ups were substantially larger when the attention on insider trading was low, institutional ownership was even lower and the probability of informed trading is heightened (Tang & Xu, 2016). On the same note, Gopalaswamy, Acharya and Malik (2008) sought to study the reactions of stock prices to merger announcements in the Indian capital markets. The findings revealed a rising trend in cumulative abnormal returns for stocks in the pre-announcement period, which suggests the influence of insider information or the market's anticipation for the M&As. Gopalaswamy, Acharya and Malik (2008) also observed that acquiring firms in the Indian market exhibited higher returns than target companies during the announcement period. Davis, Coy and Guillen Solis (2018) elucidated this phenomenon by associating high short interest with overvaluation of the stock prices of M&A target companies. The findings revealed that high short interests increase the likelihood of an acquisition of a target company, which usually occur prior to M&A announcements. The impact of high short interests has been outsized reductions in the target company's share prices, which point to undervaluation.

Even though the research on abnormal returns due to anomalies created by M&A announcements have been proposed and studied in the past, the United States (US) capital market is still understudied in terms of efficiency. What's more, the impacts of M&A announcements by technology companies in recent times have not been exhaustively studied from a financial perspective. The current study, therefore, strives to examine the effects of M&A announcements of US-based technology companies as far the semi-strong form of EMH is concerned. The M&A announcements of focus are those that have occurred after the year 2020, which

represents the onset of the devastating COVID-19 pandemic. According to Evans (2020), the COVID-19 pandemic has caused a profound shift in how people interact as well as how economies function. Reliance on technology has increased significantly, which means that the technology industry has grown significantly since the onset of the COVID-19 crisis. In addition, the technology companies developed rapidly since 21th century, which gradually developed as the representative of the US stock market in some extents. M&A activity is also expected to increase as a result as corporations in the technology sector combine efforts to serve a rapidly expanding market of consumers. While large corporations (e.g., Microsoft) possess the funding and resources to bring new ideas and technology to the market, small and medium-sized companies struggle to compete in the marketplace, a situation that has only exacerbated in the context of the COVID-19 pandemic. It becomes easier to combine efforts with larger corporations to garner the capacity and resources to compete effectively in the market.

As such, the current study strives to use the market returns as the benchmark, which will provide investors with the means to understand the impact of increased M&A activity during COVID-19 pandemic on US capital market. The aim of this research is to use the event study methodology to test the possibility of investors earning above-average (or abnormal) returns in the context of M&A announcements, i.e., the reaction of the stock market in terms of incorporating new information quickly and effectively. The economic turmoil of the 21st century, particularly due to the COVID-19 pandemic, may have precipitated M&A activity in the contemporary technology sector, which makes this study an important starting point for understanding the implications for capital markets. Additionally, the study strives to put the EMH theory to the test in the context of US capital markets with an acute focus on technology companies that participate in M&A activity. The primary aim of this study, therefore, is:

- To test the reaction of the capital market following M&A announcements by US-based technology firms in terms of the semi-strong form of EMH.

Literature Review

Market Efficiency

Efficient market hypothesis (EMH) has been under study for many years now, particularly in the finance arena because risk-weighted returns are expected to be considerably higher in inefficient markets. From this standpoint, a keen understanding of efficiency of stock markets is crucial for both private and institutional investors as well as corporate executives whose decisions and actions impact the perceived value of corporations (or at least their stocks). In this line of thought, EMH has been used as the underlying assumption in multiple conventional financial models. Despite the shift towards behavioural finance theory, EMH remains useful and contributes significantly towards understanding behaviour of stock markets. According to Mishra (2011), an efficient capital market is one in which current prices fully reflect all the available information. In simple terms, capital market efficiency is the extent to which the present price of an asset reflects all current information in the marketplace. Efficiency can also be perceived in terms of new information in the marketplace being incorporated and reflected quickly and accurately in stock prices. In their summary of what an efficient market is, Degutis and Novickytė (2014) identified two key pillars. In efficient markets, (a) all available information is already incorporated within current stock prices and (b) investors cannot earn excess risk-weighted returns. As such, it is impossible for investors to beat the market or earn returns that are greater than market returns (i.e., abnormal returns are impossible).

Strong form of EMH

In this study, focus will be on EMH and its assertions pertaining to an efficient market. Three forms of EMH have been proposed, namely weak, semi-strong and strong EMH. The strong from of EMH contends that asset prices incorporate all the information available in the capital market, which includes historical financial information (weak EMH), all new public information (semi-strong EMH) and even private information about that asset (Degutis & Novickytė, 2014; Sewell, 2012; Ţiţan, 2015). Since asset prices have incorporated all this information, it is impossible for the investor to garner an advantage that can result in abnormal returns (i.e.,

earnings that are greater than market returns). The existence of the strong form of EMH means that asset prices react immediately to new information so that the likelihood of finding undervalued and overvalued stocks are random. Simply put, the market becomes 'unbeatable' so that active investment strategies are unlikely to garner abnormal returns. The basic test for the strong from of EMH is the test for private information, which strive to ascertain whether insider-based trading yields abnormal returns (Leković, 2018). Even so, several studies have come to the conclusion that the strong-form of market efficiency is only theoretical and unrealistic. For example, Sheefeni (2015) studied the Namibian stock market in an effort to verify the existence of the strong form of market efficiency. The findings found no evidence of the strong from but revealed the presence of the weak form of financial efficiency in the Namibian stock market. Also, Bashir et al. (2020), who were studying the emerging stock markets of Pakistan prior to their amalgamation, found that the capital markets were both inefficient in terms of both weak and strong forms of market efficiency. Recent studies seeking to verify the strong form of EMH are not many because the required evidence is premised on unlawful behaviour (Leković, 2018). Investors using private information cannot generate abnormal returns without being at risk of being arrested because, in the United States (US) and a majority of non-European jurisdictions, insider trading is considered illegal. In this context, the current research will not focus on the strong form of EMH in the effort to discern the reactions of capital markets to M&A announcements.

Weak form of EMH

According to Ţiţan (2015), the weak form of EMH refers to the state of the market where all existing historical financial information is incorporated into a financial asset's current prices at any moment. In this regard, investors cannot garner abnormal profits from investing in assets whose prices depict a random walk (i.e., incorporate all existing historical information). The weak form of EMH implies that asset prices in a capital market incorporates only historical information, e.g., past prices of securities, past returns, etc. Since this information is integrated in asset prices, it means that investors cannot garner abnormal returns (Leković, 2018). This outcome is likely because all price expectations are premised on historical information that are already incorporated in current asset prices. Therefore, assessments for the weak form of EMH are referred to as tests for return predictability, which include correlation tests, runs tests, filter rule, moving average rule,

relative strengths tests, and trading range breakout rule, among others (Leković, 2018). The most common assessment approach from the list is correlation tests, which strives to ascertain the existence of linear correlation between current and past returns between securities.

Studies have been carried out to test the weak form of EMH. For example, Nisar & Hanif (2012) attempted to examine whether the random walk hypothesis (RWH) is applicable, i.e., whether weak form of EMH can be found in South-Asia capital markets. Since the weak form contends that investors cannot garner abnormal returns at a given level of risk using technical analysis, Nisar & Hanif (2012) took the position that RWH would be true because returns would exhibit a random walk. The study focused on 4 major stock exchange markets in South Asia, i.e., KSE-100, BSE-SENSEX, CSE-MPI and DSE-GEN, and ran 4 different statistical tests, namely runs tests, serial correlation test, unit root and variance ratio test. From their findings, Nisar & Hanif (2012) found that none of the four stock markets exhibited the random walk, which suggested that the capital markets in South Asia are not in the weak form of efficiency. Similar observations were made by Hamid et al. (2017), who were testing the weak form of market efficiency in capital markets from Asia-Pacific. The study also employed a variety of tests including autocorrelation, Ljung-Box Q-statistic test, runs test, unit root test and variance ratio test, which were used to ascertain the existence of the random walk. With monthly observations from January 2004 to December 2009, Hamid et al. (2017) reached the conclusion that the RWH is inapplicable for all countries in the Asia-Pacific region. These studies' findings imply that investors can garner abnormal returns through arbitrage processes.

The current study is focused on evaluating the reaction of capital markets to M&A announcements. From this standpoint, investigations will go beyond the use of investment strategies that rely solely on technical analysis. It means, therefore, the weak form of EMH will not be applicable for the current undertaking. However, understanding the weak form is crucial for one to being understanding efficiency in the context of capital markets.

Semi-strong Form of EMH

The semi-strong form of EMH, on the other hand, integrates and extends the weak form by propositioning that, at any moment, the prices of financial assets reflect all the information that exists in the

market (Degutis & Novickytė, 2014; Sewell, 2012; Ţiţan, 2015). This information includes all historical prices as well as other historical information, which means that prices change swiftly and without any biases in the endeavour to incorporate any new public information that enters the market. The existence of the semi-strong form of EMH in a capital market means that neither technical nor fundamental analyses can help the investor beat the market (i.e., abnormal returns are curbed). The main method for verifying the existence of the semi-strong form of EMH is through tests of announcements, which are also known as event studies (de Jong & Naumovska, 2015; Leković, 2018). The aim of event studies is to examine and discern whether the value of assets in a capital market occurs before, during and/or after the announcement of important event. Common events of interest include initial public offering (IPO), block trade, mergers and acquisitions (M&As), stock splits, disclosures of company earnings, among others. For example, Blackburn and Bacon (2013) sought to investigate the semi-strong form of EMH by examining the reactions of the stock market to surprise earnings announcements. The study's findings supported the existence of the semi-strong form of efficiency in capital markets, which respond effectively to public information like surprise earnings announcements. Batista et al. (2018) also observed that the Brazilian stock market was efficient in the context of the semi-strong EMH following that the capital market reacted as expected to presidential impeachment events that took place in 2016. The impeachment events occurred in 3 different dates and, upon their examination using autoregressive-moving-average (ARMA) models, all estimated windows were found to be non-statistically significant. Therefore, the null hypothesis, which stated that abnormal returns and CARs were zero (0), was upheld.

Researchers have investigated the existence of the semi-strong form of EMH in capital markets around the world, which provide evidence of inefficiency. Syed and Bajwa (2018), for instance, strove to study the reaction of the stock price in Saudi Arabia following earnings announcements with the aim being to investigate expected returns and abnormal returns around the event date. The findings of the study showed that the Saudi Arabian stock market did not have the semi-strong form of EMH, which was supported by the evidence of significant abnormal returns around the event date. Aleknevičienė et al. (2018) focused on Baltic stock markets, i.e., in Lithuania, Latvia and Estonia, with the aim of testing for the semi-strong form of EMH. With reliance on the event study methodology and Patell's, BMP and cumulative abnormal return (CAR) tests, the study found that the Baltic stock markets were inefficient, especially in thin stock market (i.e., those with

few buyers and sellers). Meier et al. (2020) went to the extent of studying sports betting markets in an effort to discern whether they are in the semi-strong form of efficiency. Simply put, the study attempted to determine whether new information was rapidly and completely integrated into betting prices with a focus on news of ghost matches in top European football leagues due to the COVID-19 pandemic. The findings revealed that bookmakers overestimated the home team's winning probability in the initial period of the ghost games, which led to the deduction that betting markets were not semi-strong-form efficient (at least temporarily).

Capital markets are expected to react to different events. In the context of this study, capital markets are expected to react accordingly to announcement events, particularly M&A announcements. Simões et al. (2012), for example, focused their investigation on the relationship between M&A announcements, presence of abnormal stock returns and market efficiency in capital markets in Argentina, Brazil and Chile. The findings revealed statistically significant abnormal returns on the event date and subsequent days in Argentina and Chile while, in Brazil, abnormal returns were only evident on the event date. In the context of M&A announcements, Brazil emerged as having a more efficient capital market than Argentina and Chile despite not being completely void of abnormal returns. Panda et al. (2011) studied the Indian stock market's reaction to public M&A announcements and found evidence of the semi-strong form of market efficiency during the event period. Eriki and Osifo (2012), on the other hand, examined the reaction of the Nigerian stock market to M&A announcements. The findings supported the semi-strong form of market efficiency, which means that new public information is quickly incorporated into stock prices.

In this study, the focus is on capital markets in the US. Although researchers have studied these capital markets in the past, the technology sector in the US has not been studied comprehensively with respect to company stock behaviour. Von Gersdorff and Bacon (2009) did not focus on any sector in the US economy in particular but sought to test market efficiency with regards to the impacts of M&A announcements as of August, 2007. The study found evidence to support the semi-strong market efficiency in US capital markets. Khanal et al. (2014) examined the impacts of M&A announcements on stock prices of firms in ethanol-based biofuel industry in the US, where abnormal returns were identified following a 60-day event window. On the other hand, other studies on EMH that have focused on US capital markets have directed their focus towards

the banking sector. For example, Chronopoulos et al. (2012) sought to examine whether stock price changes as a result of bank mergers affect operating efficiency and whether prices reflect the changes that arise from premiums paid by acquiring banks. The evidence found abnormal returns during M&A announcement periods as well as post-merger profit efficiency changes. On a similar note, Al-Khasawneh and Essaddam (2012) studied the short-term reaction of pre-classified M&A deals of US banks between 1992-2003. The findings also revealed significant cumulative abnormal returns in the banking market, especially among acquirers. Moffett and Naserbakht (2013) also made a similar observation in the US banking sector. As noted, M&A announcements in the technology sector have not been extensively studied in recent, extant literature focused on the reaction of US capital markets (i.e., EMH-related studies). This situation has created a gap for the current study on the efficiency of the capital market to M&A announcements by firms in the technology industry, which the current study seeks to explore.

Methodology

Research Design

The current study will employ a quantitative design in the endeavour to examine the effects of M&A announcements by technology companies on the US stock markets. A quantitative design means that the research will employ numerical methods in the endeavour to fulfill the aim of the study. The fact that the study is in the discipline of finance and strives to test the EMH theory in the context of US capital markets necessitates the use of a quantitative design, which will require the use of numerical tests. Additionally, the study will use secondary data from Yahoo Finance for the sample of companies that will be examined, which will primarily be quantitative in nature. The current study entails the use of the event study methodology, which is a quantitative design that seeks to investigate the effect of an event on a particular dependent variable (Sorescu et al., 2017). In most cases, similar to the current research, company stock price is usually the dependent variable. The aim of an event study is to discern whether an event causes stock price(s) of firm(s) that make up the sample changed beyond expectation, which would result in abnormal returns.

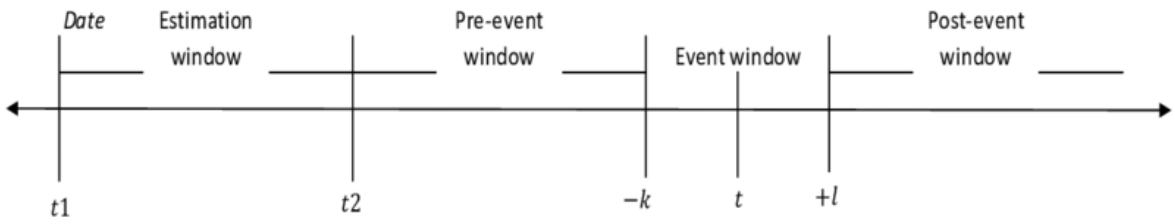


Figure 1: Event timeline that was borrowed from Ergen Keleş and Ülengin (2019)

As shown above, the timeline of this event study will be subdivided into two, namely the event and estimation windows. The event window is premised on the actual returns (or stock prices) during the event, i.e., the M&A announcement, where both normal and abnormal returns are calculated for 10 days before and after the event's occurrence. The aim is to garner insights on whether the event was of material relevance for the firms involved, whether information of the event leaked into the stock market, and whether the market needed more time to incorporate the new information. In contrast, the estimation window (i.e., at least 50 days before the event) will provide the information that will be needed to enable the specification of what the 'normal return' is(i.e,average return, the alpha coefficient,the beta coefficient). As such, it will become easier to determine whether the event (i.e., M&A announcement) results in abnormal returns.

Sample and Sampling Method

The population of interest comprise primarily of US-based companies that operate in the technology industry. In order to avoid the January effect, the current study choose the companies that the event data are during April to July. To combine the effect of the covid-19 crisis , the data during the 2021 will be used. Thus, a key selection criterion for this study will be US-based technology companies that have made an M&A announcement from April 2021to August 2021 , i.e., the said companies have a vision to merge or acquire another company in the technology industry.After the selection ,a sample size of 20 companies will be used in this research. The sampling method employed in this study as far as selecting a sample of 20 from the population of technology companies in the US will be the purposive or judgmental technique. The purposive sampling technique is a subjective approach where the researcher relies on his/her judgment when choosing who to participate in the study as a member of the sample (Taherdoost, 2016). The researcher can choose a 'representative' sample that suit the needs of the study or approach individuals that exhibit certain

characteristics that are deemed valuable for the research. The former approach works best in this study because of the fact that the study will rely on secondary data, which means that the researcher will have to choose a representative sample implicitly.

	Acquirer	**Target**	**Announcement/Event Date**
1	Iron Mountain Inc.	Calcium DC	7 July 2021
2	IBM	BoxBoat Technologies	9 July 2021
3	Sumo Logic	Sensu	2 June 2021
4	JFrog Ltd.	Vdoo Connected Trust Ltd.	29 June 2021
5	Microsoft	Nuance	12 April 2021
6	Thermo Fisher Scientific	Pharmaceutical Product Development (PPD)	15 April 2021
7	Synopsys	Code DX	8 June 2021
8	Hewlett Packard Enterprise (HPE)	Zerto	5 July 2021
9	Ping Identity	SecuredTouch	21 June 2021
10	Cisco Systems	Kenna Security	18 May 2021
11	Splunk	TruStar	18 May 2021
12	Booz Allen Hamilton	Liberty IT Solutions	15 June 2021
13	RingCentral	Kindite	22 March 2021
14	ServiceNow	LightStep	10 May 2021
15	Xerox	Groupe CT	26 April 2021
16	Snap Inc.	WaveOptics	21 May 2021
17	Zscaler	Trustdome	16 April 2021
18	Motorola Solutions	Openpath Security	13 July 2021
19	Unisys	Unify Square	4 June 2021
20	SAIC (Science Applications International Corp.)	Halfaker and Associates	3 June 2021

Table 1: Description of the sample

The Models

The first step of the process will be to determine the return on stocks, which will be dependent on the *market model*. The formula for determining stock returns is shown below:

$$R_t = \frac{P_t}{(P_{t-1})} - 1 \ldots\ldots\ldots\ldots\ldots (i)$$

Where, R_t represents the return on stock for the period t, P_t stands for the stock price for the period t and P_{t-1} represent the stock price for the period (t-1). Therefore, the *market model* is presented using the formula below:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t} \ldots\ldots\ldots\ldots\ldots (ii)$$

Where $R_{i,t}$ stands for the return on security **(i)** for the period t while α_i is the intercept for the equation for that particular security **(i)**. Therefore, β_i is the slope for the equation of security **(i)**, $R_{m,t}$ is the return on the market for period t, and $\varepsilon_{i,t}$ is the error term for the equation.

In the *Market-Adjusted Return Model*, $\alpha_i = 0$ and $\beta_i = 1$ so that the equation (ii) becomes:

$$\varepsilon_{i,t} = R_{m,t} - R_{i,t} \ldots\ldots\ldots\ldots\ldots (iii)$$

The normal and abnormal returns for the current analysis will be determined using the following equation:

$$\in_{it}^{*} = R_{it} - E[R_{it}|X_t] \ldots\ldots\ldots\ldots\ldots (iv)$$

So that $E[R_{it}|X_t]$ represents the normal return for a particular stock, which is the expected return in the case that the event of interest did not occur. X_t, on the other hand, represents conditioning variables while $\in_{it}^{*}$ embodies the abnormal returns (i.e., the difference between the actual return and normal returns).

The *constant mean return model* is among the models to be used in this analysis, where X_t will be treated as a constant. The model is represented by the following formula:

$$R_{it} = \mu_i + \xi_{it} \ldots\ldots\ldots\ldots\ldots (v)$$

So that $E[\xi_{it}] = 0$ and $var\ [\xi_{it}] = \sigma_{\xi}^{2}$. Since the data to be used will be daily stock prices of companies, R_{it} will be represented by nominal returns.

The final model to be incorporated in this analysis is Capital Asset Pricing Model (CAPM), and for purposes of this study, will be premised on the base equation provided by the Market Model. In this model, the focus is on describing the relationship that exists between risk and expected return for a particular financial asset, which is in turn used to price risky securities (Kurek, 2020). The CAPM equation employed in this model is as follows:

$$R_{it} = R_{ft} + \beta_i\left(R_{mt} - R_{ft}\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (vi)$$

Where R_{it} represents the return for security **(i)** during period t. R_{ft} is the risk-free rate during period t while R_{mt} is the return on market portfolio during period t. β_i, on the other hand, represents systematic risk for the particular asset **(i)**.

Estimation of Abnormal Returns

Even though finance literature identifies with several methods for studying and identifying abnormal returns in the stock market, the current study will focus on two key methods, namely cumulated abnormal returns (CARs) and the buy and hold abnormal returns (BHARs). The CARs approach means that the total incremental value of an asset or stock is added to it following new information associated with the event of interest (Sorescu et al., 2017). Therefore, the equation here is shown as:

$$CAR_{it} = \sum_{t-k}^{t+1} AR_{it} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (vii)$$

In this equation, AR_{it} represents the abnormal returns for a particular asset (i) on the event day (t) while *k* and *l* stand for the number of days before and after that particular event respectively. The terms, *k* and *l*, are included in this equation to encompass the window of the event.

The other strategy for discerning abnormal returns is the use of the BHAR principle, which refers to the investment strategy that involves buying stocks and holding on to them for a long period. This principle is

then used to determine abnormal returns by deducting the normal BHARs from the actual return that is realized (scholars). The equation for this approach is captured below:

$$BHAR_{t;t+k}^{i} = \prod_{k}(1 + AR_{i;t+k}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (viii)$$

In this equation, BHAR is exposed as geometric sums as opposed to CARs (which are arithmetic in nature). AR_{it} stands for abnormal returns while *k* and *l* stand for the number of days before and after that particular event respectively.

Analysis

Using the Microsoft Excel software, the analysis of data will involve the use of the t-test, where the abnormal returns obtained using CAR and BHAR approaches will be compared to the normal or expected returns. This inferential statistic will inform the researcher as to whether the abnormal returns calculated are statistically significant, which will be essential in testing the market level of efficiency as far as the semi-strong form is concerned.

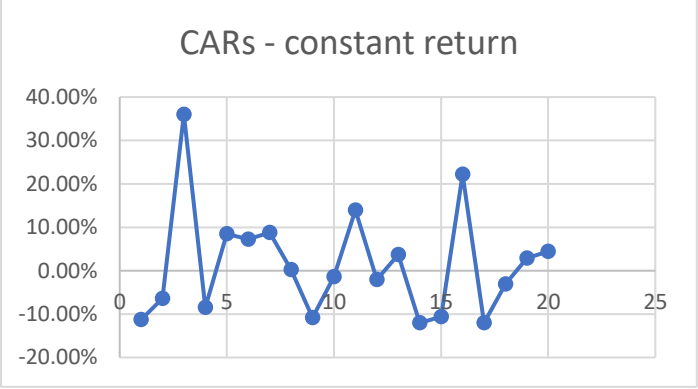
Findings

In this study's analysis, the event study methodology employed three different models in an effort to evaluate the semi-strong EMH. The study focused on evaluating the stock returns for the sampled companies in terms of the event study timeline discussed in the previous chapter, i.e., in the anticipation period, the event day and the adjustment period. Furthermore, the stock returns were examined using the lenses of the three models, namely the constant return model, market-adjusted model and CAPM. The stock returns were aggregated in two ways, i.e., the cumulated abnormal returns (CAR) and buy and hold abnormal returns (BHAR).

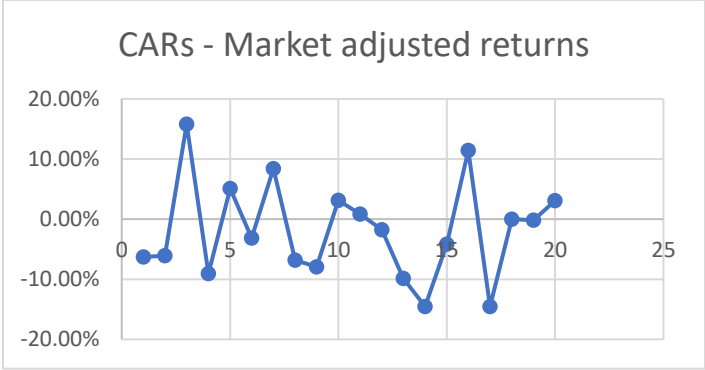
From the findings, the total returns for the 21-day period (i.e., a sum of the 10 days for the anticipation period, a day for the event day and 10 days for adjustment period) emerged as being higher than normal in the context of both CAR and BHAR. In the context of CAR, as shown in the three graphs below representing each of the three models, the stock returns of only few companies can be found around the 0.00%. The situation is

the same for the BHARs used in this study's analysis. In other words, during the anticipation, event and adjustment periods, the stock returns of most of the sampled companies were either above or below expectations as indicated by the six graphs below.

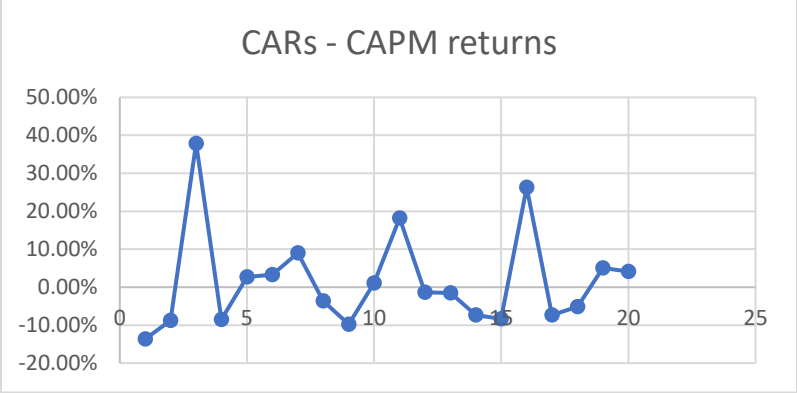
Appendix A captures a summary of the returns of the companies sampled for this study in an effort to evaluate the semi-strong form of EMH, i.e., during the anticipation, event and adjustment period. During the anticipation phase, the findings show that some stock returns went as high as 20% higher than normal, such as Sumo Logic (i.e., 20.13%), while others reported significantly lower returns (e.g., ServiceNow and Zscaler with -11.85% returns). Most of the stocks exhibited an increase in returns during the event day, i.e., during the M&A announcements. For example, Iron Mountain Inc. recorded a 0.41% increase in returns while Snap Inc. reported 6.30% higher returns than normal. In contrast, companies like JFrog Ltd. reported negative returns during the event day (i.e., -3.14%). Appendix A captures other companies that recorded returns that are higher or lower than expectations during the event day. Similarly, during the adjustment period, some stocks went higher and others went lower than expected. This phenomenon can be observed across all the three models as captured in Appendix A and the six graphs below.



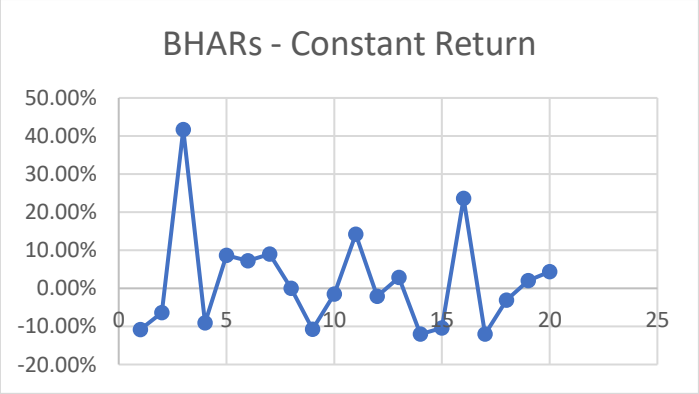
Graph 1: CAR – Constant Returns Model



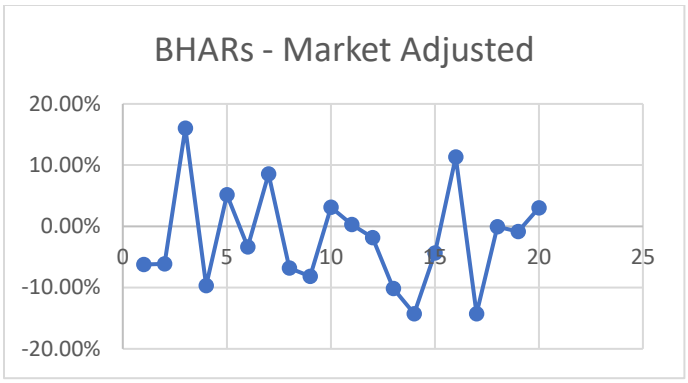
Graph 2: CAR – Market-Adjusted Returns Model



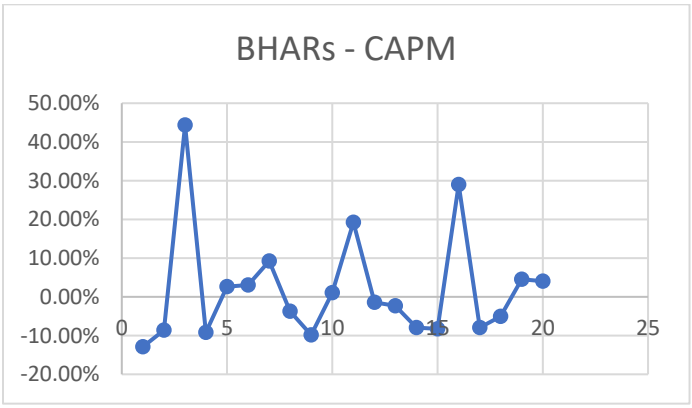
Graph 3: CAR – CAPM Returns



Graph 4: BHAR – Contant Returns Model



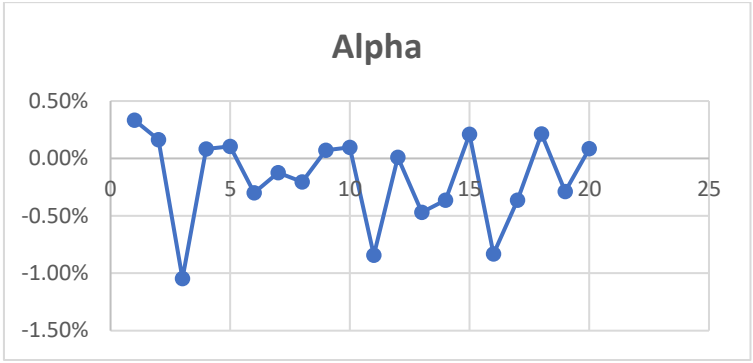
Graph 5: BHAR – Market-Adjusted Returns Model



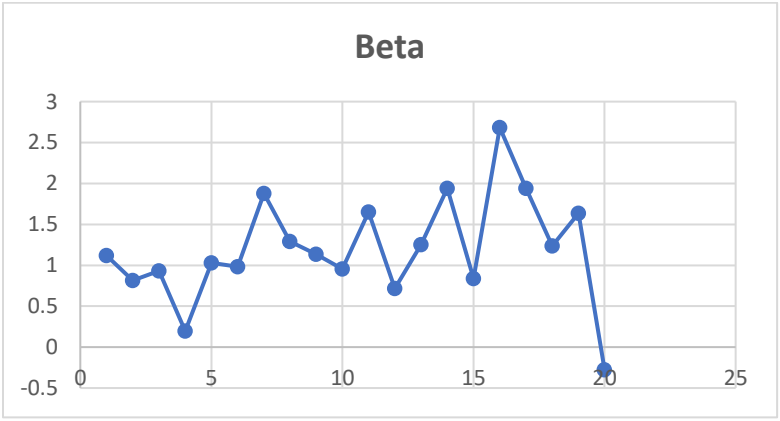
Graph 6: BHAR – CAPM Returns

From the analysis, the alpha (α) and beta (β) for the stock returns were determined and summarized in the table and graphs below. In finance, the alpha is a number that is used to show whether a stock is above or below a particular benchmark index. For example, in this study, the benchmark used was the S&P 500 index. The alpha for all the company stocks used in this study did go above or below the expectations but only few of them reached a distance greater than 0.5% (i.e., $\alpha >= 0.5\%$). In fact, most of the stock recorded alpha values that were lower than 0.5% and closer to zero (0). Since the alpha is considered to be a historical number, i.e., it tracks the performance of stock over a duration to determine how it has performed, values below 1% is evidence that the stocks examined in this study underperformed compared to the S&P 500 index. This finding

suggests that the stocks portfolio was almost tracking perfectly relative to the benchmark used, which is indication that investors did not add or lose a lot as far as their investments are concerned.



Graph 7: The alpha values for the stocks sampled for this research



Graph 8: The beta values for the stocks sampled for this research

In contrast to the alpha, the beta coefficient is a number that is used to reflect the volatility of a stock portfolio relative to the market as a whole, i.e., in this case, the S&P 500 index, which was employed as the benchmark for this financial analysis. The volatility of stock is mostly used by investors as an indicator of the risk involved in investing in a particular stock portfolio. Normally, a beta coefficient that is less than 1 means that the security is less volatile compared to the market while values greater than 1 is a reflection that the or stock portfolio is more volatile relative to the benchmark. In this study, the beta coefficient for almost all stocks was above zero with a majority above 1, which is indication that the performance of the stocks was

more volatile than the market. For example, in the case of stocks of Iron Mountain Inc. and Synopsys, the results showed that they were 11.9% and 87.8% more volatile than the S&P 500 benchmark respectively.

Acquirer	Alpha	Beta
1. Iron Mountain Inc.	0.33%	1.119066
2. IBM	0.16%	0.812607
3. Sumo Logic	-1.05%	0.933277
4. JFrog Ltd.	0.08%	0.19531
5. Microsoft	0.10%	1.029707
6. Thermo Fisher Scientific	-0.30%	0.982539
7. Synopsys	-0.12%	1.877699
8. Hewlett Packard Enterprise (HPE)	-0.21%	1.291628
9. Ping Identity	0.07%	1.135781
10. Cisco Systems	0.10%	0.955286
11. Splunk	-0.84%	1.651323
12. Booz Allen Hamilton	0.01%	0.715284
13. RingCentral	-0.47%	1.252973
14. ServiceNow	-0.36%	1.939537
15. Xerox	0.21%	0.837384
16. Snap Inc.	-0.83%	2.68293
17. Zscaler	-0.36%	1.939537
18. Motorola Solutions	0.21%	1.238337
19. Unisys	-0.29%	1.636926
20. SAIC (Science Applications International Corp.)	0.09%	-0.27541

Table 2: The alpha and beta coefficients of acquirers' stocks

The final part of the analysis was focused on discerning whether the abnormal returns determined during the anticipation, event and adjustment period were statistically significant using a t-test (i.e., p-value <=

5.00%). The analysis captured in the table below shows that, for the constant return model, only the abnormal stock returns of Sumo Logic (i.e., the acquirer of Sensu) were statistically significant (i.e., p-value = 4.99%) when the CAR and BHAR aggregation were used. The market-adjusted model did not yield any statistically significant abnormal returns for any of the stocks in both CAR and BHAR context as shown in the table below. Simply put, the abnormal stock returns did not deviate enough to ensure that investors earned or lost due to investing in the sampled portfolio of securities. The opposite was true for CAPM, where statistically significant abnormal returns were identified in both CARs and BHARs. In the context of CARs, Iron Mountain Inc. and Sumo Logic abnormal stock returns were statistically significant (i.e., p-value <5.00%). Only Sumo Logic was identified as statistically significant (i.e., p-value < 5.00%) out of the stock portfolio.

	CAR		
	Constant Return Model	**Market-Adjusted Model**	**CAPM**
1. Acquirer	**p-value**	**p-value**	**p-value**
2. Iron Mountain Inc.	14.47%	35.82%	4.92%
3. IBM	28.46%	28.23%	11.88%
4. Sumo Logic	4.99%	37.59%	3.72%
5. JFrog Ltd.	60.09%	58.06%	59.79%
6. Microsoft	21.68%	29.09%	57.45%
7. Thermo Fisher Scientific	39.59%	66.95%	65.95%
8. Synopsys	29.35%	20.08%	14.30%
9. Hewlett Packard Enterprise (HPE)	97.13%	24.69%	53.21%
10. Ping Identity	34.56%	47.20%	37.73%
11. Cisco Systems	81.31%	44.00%	78.02%
12. Splunk	26.55%	94.04%	9.72%
13. Booz Allen Hamilton	70.07%	71.24%	77.37%
14. RingCentral	77.44%	40.52%	89.74%
15. ServiceNow	31.57%	16.27%	47.37%
16. Xerox	26.65%	62.47%	33.15%
17. Snap Inc.	22.24%	47.79%	8.25%
18. Zscaler	31.57%	16.27%	47.37%

19. Motorola Solutions	57.52%	99.68%	20.88%
20. Unisys	82.33%	98.77%	65.01%
21. SAIC (Science Applications International Corp.)	67.73%	78.55%	69.75%

Table 3: The p-values of CARs for the sampled stock portfolio

	BHAR		
	Constant Return Model	**Market-Adjusted Model**	**CAPM**
Acquirer	**p-value**	**p-value**	**p-value**
1. Iron Mountain Inc.	15.96%	36.26%	6.22%
2. IBM	28.73%	28.23%	12.71%
3. Sumo Logic	2.41%	36.82%	1.55%
4. JFrog Ltd.	57.53%	55.64%	57.25%
5. Microsoft	20.71%	28.39%	57.64%
6. Thermo Fisher Scientific	39.77%	65.16%	67.85%
7. Synopsys	28.27%	19.12%	13.45%
8. Hewlett Packard Enterprise (HPE)	99.65%	24.98%	51.98%
9. Ping Identity	34.96%	46.11%	37.49%
10. Cisco Systems	79.64%	44.03%	78.83%
11. Splunk	25.60%	97.79%	8.02%
12. Booz Allen Hamilton	68.92%	70.21%	76.19%
13. RingCentral	82.70%	39.15%	84.50%
14. ServiceNow	31.54%	17.09%	43.70%
15. Xerox	27.51%	61.18%	33.63%
16. Snap Inc.	19.48%	48.25%	5.62%
17. Zscaler	31.54%	17.09%	43.70%
18. Motorola Solutions	57.36%	99.25%	21.75%
19. Unisys	87.51%	94.02%	68.31%
20. SAIC (Science Applications International Corp.)	67.85%	78.71%	70.08%

Table 4: The p-values of BHARs for the sampled stock portfolio

The current study's findings also demonstrate that the market-adjusted model is significantly weaker compared to the other two models used in this research, i.e., the constant return model and CAPM. Table 3 shows that the market-adjusted model was unable to detect any statistically significant CARs when compared to the other two models that could discern two relevant stocks in the portfolio that align to the criterion of interest. Table 4, on the other hand, shows that the constant return model is closer to CAPM in terms of accuracy in detecting anomalies in the stock market while emphasising the fact that the market-adjusted model is the weakest of the three.

Discussion

This portion of the study is focused on elucidating the US stock market in terms of efficiency as far as the semi-strong form of EMH is concerned. The current study was concerned with the speed with which the stock market reacted to information about M&A announcements with a keen focus on whether investors have the capacity to earn abnormal returns compared to the market. Simply put, the current study was attempting to find out the possibility of investors outperforming the market following the anticipation of an M&A announcement, the event itself or the adjustment period. The initial analysis using CARs and BHARs revealed that the event (i.e., M&A announcements) caused shifts in the US stock market, where securities (i.e., sampled stocks) were bringing in abnormal returns that were either positive or negative. In this regard, this study was attempting to determine whether these abnormal returns were significant enough to beat the market. The findings revealed that few (less than 3 companies) exhibited statistically significant abnormal returns compared to the entire portfolio of 20 securities (see Tables 3 and 4).

This outcome is indication that the US stock market embodies the semi-strong form of EMH, which means that it is impossible for investors to beat the market. According to Ţiţan (2015), a market in the semi-strong form of EMH quickly integrates all historical information so that prices change swiftly and without any biases in an effort to incorporate any new public information that enters the market. The evidence that the US stock market is in the semi-strong form of EMH Is evidenced by the findings of this study's event study which focused primarily on M&A announcements. The stock market adjusted quickly to incorporate information about M&A announcements during the three periods of interest, i.e., the anticipation, event and adjustment periods. According to Degutis and Novickytė (2014), in a stock market in the semi-strong form of EMH, the prices adjust to information related to earnings. The implication of this adjustment is that investors do not get the possibility to garner above-average returns on investments using portfolios of securities from the US stock market. In many cases, investors have been known to wait for either positive or negative news about the earnings of a company so that they can purchase or sale securities and earn mega profits. However, a market in the semi-strong form of efficiency negates this strategy because all the information has been integrated into the price and the market has adjusted effectively to reflect it. This scenario describes the US stock market as examined in this study because virtually all securities in the sample portfolio emerged as having statistically insignificant returns that were above-average. Simply put, the US stock market is in the semi-strong form because investors cannot beat the market, particularly in the technology sector.

Even though the number of M&A announcements has increased during this pandemic period, the findings of this study show that the said events do not impact the efficiency of the US stock market. The stock market responds quickly to incorporate new information in the stock prices, which in turn makes it difficult for investors to garner abnormal returns or losses. As shown in Tables 3 and 4, for example, very few companies had stocks that outperformed the market in the periods of interest (i.e., before, during and after the M&A announcement occurred). In particular, as per the CAPM model, it was identified that Sumo Logic's M&A announcement was the one whose information was not quickly incorporated by the market so that investors could earn abnormal returns for investing in this company's stocks. Even so, the other company stocks in the sampled portfolio were identified as not having the ability to yield abnormal returns for investors. Considering that a majority of the stocks in the 20-stock portfolio yielded no statistically significant abnormal returns, it

stands to reason to make the deduction that the US technology market is efficient as far as the semi-strong form of EMH is concerned. This outcome differs from studies that have focused on the US banking sectors in the context of M&A announcements. For example, Chronopoulos et al. (2012) observed significant abnormal returns during the M&A announcements for banks in the US combined with post-merger profit efficiency changes in the banking market. Al-Khasawneh and Essaddam (2012) also noted significant CARs in the banking market (particularly among acquirers) during M&A announcements for banks during the 1992-2003 period, which were similar to the observations made by Moffett and Naserbakht (2013). In contrast, the US technology market has revealed higher efficiency levels due to the fact that only two stocks, averagely, emerged as having the potential for statistically significant abnormal returns. The technology market in the US, therefore, has the capacity to respond quickly to information involving M&A announcements into price and eliminate the possibility of investors generating abnormal returns from their investment portfolios. This outcome is supported by the fact that the returns of technology firms in the US did not outperform the market (i.e., S&P 500 benchmark) before, during and after the event, i.e., M&A announcements.

Another point should to be mentioned is that compared to the US market around 2000, the tech market in US under the covid-19 situation(2021) shows less abnormal return, indicating that the higher extent of semi-strong form of the EMH based on the covid-19 background. According to the Tang and Xu in 2016, the stock price run-ups prior to M&A announcements that occurred between 1981 and 2011 in the US stock market. In the study of Tang and Xu, though they did not test the EMH by the event of M&A announcements, the probability of informed trading(Tang and Xu 2016) implied that it was not a semi-strong form of EMH during that time.But from the result of the current study, only 1 of the 20 companies has the statistically significant abnormal return in 2 models(Constant Return Model and CAPM), which indicates a semi-strong form of the EMH. Therefore, it can get the conclusion that under the covid-19 crisis, the market has the stronger form of the EMH than before.

An additional view that can be obtained from the findings of this study is the fact that the semi-strong form incorporates the weak form of EMH, which has been demonstrated amicably by the research. In particular, the alpha obtained during the data analysis is a tool used in finance as a historical number, i.e., it tracks stock

performance over a duration in an effort to show how it has performed (Fu, 2018). In this study, the alpha values have been used to show whether the stock has underperformed or overperformed relative to the benchmark or S&P 500 index as per this study's framework. Graph 7 in the previous chapter shows that the alpha values of the stocks in the sampled portfolio were primarily below 1%, which is evidence that the stocks underperformed relative to the market. The securities in the portfolio tracked almost perfectly to the benchmark so that the earnings or losses that investors incurred during, before or after the announcements of M&As were not abnormal (i.e., they were within expectations). From this perspective, it is an indication that the US technology market observes the weak form of EMH. Simply put, the asset prices in this market integrate the historical information, such as historical prices, past returns, among others (Leković, 2018). Since investors may attempt to use historical price information to predict future prices, the fact that the US technology market has achieved the weak form of market efficiency means that it has already incorporated historical information and adjusted accordingly. As such, it is impossible for investors to make predictions of the asset prices based on historical information, which means that abnormal returns are impossible. This position is further emphasized by the beta coefficients of the stock in the sample portfolio of securities used in this study. Graph 8 in the previous chapter of this research shows that the beta coefficient of many assets in the portfolio were closer to 1, which is an indication that these securities were less volatile than the market in the period of interest (Fu, 2018; Maniatis & Gioulbaxiotis, 2011). Even so, the evidence shows that some stocks were more volatile than the market, which could be the impact of the event of interest (i.e., M&A announcements). However, the fact that the US technology market is in the semi-strong form of EMH has shown that this volatility did not impact the value of the assets to the extent that investors could yield abnormal returns.

In light of this study's analyses and findings, three models for event studies have been compared, namely constant return model, market-adjusted model and CAPM. This study has demonstrated that the three models differ in terms of accuracy in testing for abnormal returns in the market. CAPM has emerged as the strongest of the three while the market-adjusted model has been identified as the weakest, especially when using CARs instead of BHAR. This deduction follows the fact that CAPM identified 2 stocks in the portfolio has having statistically significant CARs. The constant return model only identified 1 of the stocks while the

market-adjusted model was unable to detect any at all from the portfolio (see Tables 3 and 4 above). Even so, this observation changes when BHARs are considered instead of CARs, where the constant return model and CAPM demonstrate the capacity to detect the same stock in the sample portfolio.

Conclusion

The aim of this study was to observe and test the reaction of the capital market to M&A announcements in the context of the semi-strong form of EMH. The sample portfolio comprised primarily of US-based technology firms with the overall goal being to study the market in the period during the COVID-19 pandemic. The crisis has resulted in an increase in the number of M&A announcements in the technology sector as firms find novel ways to increase value. Using the event study methodology, the current study compared the performance of the sampled stocks portfolio to the S&P 500 index (as the benchmark) and came to the realisation that the US technology market conforms to the semi-strong form of market efficiency. This conclusion follows the observation that the abnormal returns calculated did not deviate from market returns in a statistically significant manner, which means that the stock prices had adjusted accordingly to new information following the M&A announcements. The fact that these companies were entering an M&A during this time of crisis did not affect the market's efficiency.Also the US tech market under covid-19 is kind of more efficient than the market 20 years before.A further conclusion was that the market-adjusted model was found to be weaker than the other two models used in this analysis, namely constant return model and CAPM, as far as event study analyses are concerned.

The limitation of this study, therefore, has been the fact that it was limited to a sample of 20 M&A announcements. Also, the study was restricted to the US technology market with the focus being on those firms that announced their M&As during this period of the pandemic. Furthermore, the current study focuses primarily on M&A announcements and fails to take other factors that may affect stock prices, particularly other known anomalies like the January effect, among others. Therefore, future studies should use larger samples to garner more informative results as far as the influence of M&A announcement on stock prices is concerned. In addition, when compare the effect of M&A announcement on stock prices, the current research only test the situation in US tech sector. Future studies could test the situations in different developing

countries by the effect of M&A announcement such as China, which can compare the developed country and developing country in terms of the efficient market hypothesis .

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Appendices

Appendix A: Summary table for returns for the sampled companies

	CAR												BHAR											
	Constant Return				Market Adjusted				CAPM				Constant Return				Market Adjusted				CAPM			
Acquirer	Event	Anticipation	Adjustment	Total	Event	Anticipation	Adjustment	Total	Event	Anticipation	Adjustment	Total	Event	Anticipation	Adjustment	Total	Event	Anticipation	Adjustment	Total	Event	Anticipation	Adjustment	Total
Iron Mountain Inc.	0.41%	-10.49%	-1.17%	-11.25%	0.47%	-9.40%	2.66%	-6.27%	0.09%	-13.06%	-0.68%	-13.65%	0.41%	-10.07%	-1.26%	-10.84%	0.47%	-9.07%	2.66%	-6.21%	0.09%	-12.38%	-0.71%	-12.92%
IBM	0.35%	-4.61%	-2.13%	-6.39%	-0.57%	-4.43%	-1.10%	-6.10%	-0.52%	-5.71%	-2.53%	-8.77%	0.35%	-4.64%	-2.14%	-6.36%	-0.57%	-4.51%	-1.11%	-6.11%	-0.52%	-5.72%	-2.52%	-8.57%
Sumo Logic	1.74%	20.13%	14.15%	36.02%	0.71%	10.25%	4.84%	15.80%	1.76%	20.78%	15.33%	37.87%	1.74%	21.82%	14.33%	41.71%	0.71%	10.48%	4.31%	16.05%	1.76%	22.56%	15.73%	44.34%
JFrog Ltd.	-3.14%	7.99%	-13.33%	-8.48%	-3.06%	8.19%	-14.21%	-9.08%	-3.12%	8.05%	-13.48%	-8.55%	-3.14%	7.86%	-12.98%	-9.09%	-3.06%	8.01%	-13.73%	-9.68%	-3.12%	7.92%	-13.10%	-9.15%
Microsoft	-0.14%	8.10%	0.55%	8.50%	0.04%	4.28%	0.77%	5.10%	-0.06%	3.07%	-0.32%	2.69%	-0.14%	8.30%	0.50%	8.69%	0.04%	4.33%	0.76%	5.17%	-0.06%	3.08%	-0.33%	2.68%
Thermo Fisher Scientific	3.62%	7.78%	-4.14%	7.25%	2.31%	1.66%	-7.13%	-3.16%	2.63%	4.73%	-4.11%	3.26%	3.62%	7.99%	-4.18%	7.22%	2.31%	1.63%	-7.04%	-3.34%	2.63%	4.80%	-4.17%	3.06%
Synopsys	0.87%	3.56%	4.37%	8.79%	0.93%	2.70%	4.74%	8.37%	1.04%	2.44%	5.55%	9.03%	0.87%	3.50%	4.40%	8.99%	0.93%	2.65%	4.78%	8.56%	1.04%	2.39%	5.58%	9.23%
Hewlett Packard Enterprise (HPE)	-2.29%	3.43%	-0.88%	0.26%	-2.25%	-2.55%	-2.04%	-6.83%	-1.98%	-1.77%	0.15%	-3.60%	-2.29%	3.43%	-1.08%	-0.03%	-2.25%	-2.55%	-2.15%	-6.79%	-1.98%	-1.78%	0.02%	-3.71%
Ping Identity	-0.86%	-4.88%	-5.10%	-10.84%	-1.99%	-0.74%	-5.24%	-7.97%	-2.25%	-1.24%	-6.32%	-9.81%	-0.86%	-5.18%	-5.06%	-10.75%	-1.99%	-1.18%	-5.18%	-8.17%	-2.25%	-1.68%	-6.21%	-9.86%
Cisco Systems	-0.25%	1.15%	-2.27%	-1.37%	0.83%	4.15%	-1.85%	3.13%	0.70%	3.16%	-2.73%	1.13%	-0.25%	1.06%	-2.27%	-1.49%	0.83%	4.20%	-1.85%	3.13%	0.70%	3.18%	-2.71%	1.09%
Splunk	1.51%	-0.80%	13.21%	13.92%	1.76%	-6.18%	5.24%	0.82%	3.16%	2.67%	12.41%	18.24%	1.51%	-1.19%	13.86%	14.21%	1.76%	-6.35%	5.25%	0.30%	3.16%	2.30%	13.03%	19.28%
Booz Allen Hamilton	0.13%	1.92%	-4.10%	-2.05%	0.44%	1.83%	-4.05%	-1.78%	0.38%	2.09%	-3.83%	-1.37%	0.13%	1.91%	-4.09%	-2.13%	0.44%	1.82%	-4.02%	-1.84%	0.38%	2.09%	-3.81%	-1.44%
RingCentral	2.12%	2.78%	-1.17%	3.74%	1.05%	-2.73%	-8.19%	-9.87%	1.35%	1.48%	-4.34%	-1.51%	2.12%	2.32%	-1.57%	2.85%	1.05%	-3.02%	-8.33%	-10.16%	1.35%	1.19%	-4.73%	-2.30%
ServiceNow	-3.36%	-11.85%	3.19%	-12.03%	-2.41%	-14.08%	1.95%	-14.54%	-1.07%	-11.62%	5.35%	-7.34%	-3.36%	-11.66%	3.04%	-12.04%	-2.41%	-13.68%	1.80%	-14.25%	-1.07%	-11.57%	5.20%	-7.97%
Xerox	-0.21%	-5.52%	-4.84%	-10.57%	-0.01%	-3.03%	-1.13%	-4.18%	-0.20%	-4.93%	-3.22%	-8.35%	-0.21%	-5.67%	-4.80%	-10.38%	-0.01%	-3.21%	-1.15%	-4.34%	-0.20%	-5.04%	-3.20%	-8.27%
Snap Inc.	6.30%	4.51%	11.41%	22.22%	4.81%	1.31%	5.32%	11.43%	3.86%	11.65%	10.79%	26.29%	6.30%	4.17%	11.64%	23.63%	4.81%	0.99%	5.17%	11.31%	3.86%	11.79%	11.11%	29.01%
Zscaler	-3.36%	-11.85%	3.19%	-12.03%	-2.41%	-14.08%	1.95%	-14.54%	-1.07%	-11.62%	5.35%	-7.34%	-3.36%	-11.66%	3.04%	-12.04%	-2.41%	-13.68%	1.80%	-14.25%	-1.07%	-11.57%	5.20%	-7.97%
Motorola Solutions	-0.74%	0.69%	-3.03%	-3.09%	-0.11%	1.08%	-0.99%	-0.02%	-0.24%	-1.63%	-3.31%	-5.18%	-0.74%	0.66%	-3.02%	-3.10%	-0.11%	1.07%	-0.99%	-0.04%	-0.24%	-1.63%	-3.27%	-5.08%
Unisys	3.57%	10.51%	-11.22%	2.86%	2.60%	7.79%	-10.57%	-0.18%	2.33%	9.47%	-6.75%	5.06%	3.57%	10.80%	-11.10%	2.02%	2.60%	7.87%	-10.43%	-0.86%	2.33%	9.69%	-6.85%	4.55%
SAIC (Science Applications International Corp.)	0.20%	2.86%	1.36%	4.41%	0.60%	1.35%	1.09%	3.05%	0.05%	2.96%	1.12%	4.13%	0.20%	2.84%	1.32%	4.40%	0.60%	1.32%	1.07%	3.02%	0.05%	2.93%	1.06%	4.08%