IMPACT OF INTANGIBLE ASSETS AND INTELLECTUAL PROPERTY ANNOUNCEMENTS ON SHAREHOLDERS' WEALTH: EVIDENCE FROM TECHNOLOGY-BASED COMPANIES IN AMERICA

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Abstract

In the modern knowledge economy, intangible assets play a vital role in creating value for shareholders, particularly the wealth of intangible assets and information content of announcements of intellectual property rights for the first time. Thus, measuring and analyzing the impact of intangible assets and IP announcements on shareholders' wealth is a decisive effort in the direction of creating a company's value. In the 21st century, the driving force of creating wealth for companies and economies is the information on innovation in information and communication technology. These paradigm changes have induced, firms to increasingly adapt to technological advancement and innovations in the recent past. Therefore, this paper aims to shed light on how intangible assets and IP announcements impact on shareholders' wealth of the world's top eight (08) brands, which are American-based technology companies. The IP portfolios and the announcements of intellectual property rights for the period 2005 to 2019 were considered for the analysis. The findings revealed that goodwill and patent were showing a positive significant impact on the shareholders' wealth, while trademarks and trade secrets were indicating a positive, however, insignificant impact on shareholders' wealth. Further, IP announcements significantly impacted on the shareholders' wealth followed by abnormal returns in the short run. This paper, therefore recommends that the shareholders of technological firms can obtain higher returns through the Patent and Goodwill, and further justifies that they can maximize the shareholders' wealth through the IP announcements. The study also directs the research literature into a new direction towards identifying the impact of intellectual property announcements on shareholders' wealth of industry of technology. Further, the findings of current research will assist in forecasting the future development vision of information technology companies based on intangible assets.

Keywords: Event Study, Intangible Assets, Intellectual Property Announcements, Shareholders' Wealth.

1. Introduction

The investment helps companies improve their competitive abilities and, therefore, to grow the shareholder's wealth, which can be presented in two ways. The first type is a tangible asset, and the second is an intangible asset. The traditional industrial age has been replaced by knowledge-based economies, with the highest concentration of development and protection of intangible assets (Chareonsuk & Chansa-ngavej, 2015). This shift has an important implication for organizations because intangible investments are growing faster than tangible investments in several countries (Borgo *et al.*, 2012). Obviously, intangibles such as computerized information, innovative property, and economic competencies are currently considered more significantly important to enhance the firms' performance than tangible assets (Schautschick & Greenhalgh, 2016). In the 21st century, intangible assets have become the dominant factor for maximizing the revenue and profits of organizations, and it becomes major value drivers for companies in many industries (Li & Wang, 2014). The measurement, analysis, and management of intangible assets are decisive efforts in the direction of understanding and improving value creation at different economic levels and sectors.

Especially as a vital component in assets, intellectual property has become a significant factor in enhancing the economic and financial performance of companies (Schautschick & Greenhalgh, 2016). When an intangible asset is protected by law, it becomes an intellectual property right (IPR), and IPRs are, therefore considered a group of intangible assets that can be enforced through the law (WIPO, 2019). The tendency to adapt to IPRs is reflected by their increasing importance, where investors can obtain higher returns through innovations. Therefore, the concentration in the IPRs has become more crucial; particularly by looking at the effect of a firm's IPR on stock market performance, it can be said that the companies are highly focused on IPRs with the purpose of obtaining maximum abnormal returns through this (Ferdaous & Rahman, 2019). As a result, the current study focuses not only on the influence of intangible assets on value but the effect of intellectual property announcements on stock prices. Moreover, the authors intend to consider the IP announcements based on the technological advancements of companies. However, recently, the majority of studies have mainly considered the non-technological intangibles of companies. However, rapid globalization and the deregulation of the world have brought competition to the forefront as one of the most significant factors that drive the survival of a business industry (Andonova & Guluiermo, 2016). Therefore, the salient feature of the knowledge economy is the high adaptation of technological advancement and innovation and the majority of those innovations are of an intangible nature. For example, compared with other sectors the technology sector represents 91% of intangibles globally, and in the

USA, the technology sector accounts for 98% of intangibles (Brand Finance, 2019). Moreover, organizations achieve sustainable competitive advantage and superior shareholder returns through intangible resources such as brand equity, new product capability, superior technologies, patents, trademarks, copyrights, and specialized knowledge. Hence, this paper intends to substantiate the importance of intangible assets in creating value for technology-based companies which are mainly housed in the US.

It is well documented that the most influential framework for measuring the contribution of IP announcements on shareholders' wealth is the event study methodology. As per MacKinlay (1997), an event study is the standard method of measuring stock price reaction to the arrival of new information or announcements to the market. Even though most researchers have focused the stock price behavior around the event, such as dividend announcements, changes in accounting rules, and changes in the severity of regulations and money supply announcements, studies have not been conducted to examine the changing pattern of stock prices around the event such as intellectual property announcements. Given the importance of intangible assets and firm IP announcements, this paper aims to investigate the impact of intangible assets and intellectual property announcements on shareholders' wealth as measured by the market value-added approach and abnormal returns of companies. For the said purpose, this paper enhances the following objectives.

1. To examine the impact of the intangible asset on shareholders' wealth of top American technology companies.
2. To examine the impact of intellectual property announcements on shareholders' wealth of top American technology companies.
3. To determine the dominant technology type of each company based on the categorization of technological advancements of companies

2. Literature Review

Currently, the economies of many countries are moving very fast in the rise of globalization and increasing industrialization. In a digital and knowledge-based economy, intangible assets are predominant and have become key success factors in sustaining the business. Therefore, companies fix mussels with more intangible assets in their asset class. This new trend induced the researchers to shed light on how intangible assets bring more value to the firms. For example, Andonova & Guluiermo (2016) documented that it is weightless wealth that generates real profit. This further amplifies the contention made by (Gouri *et al.*, 2012), revealing that the number of patent applications has doubled in the 21st century. It brings reason to believe that companies' concentration on innovation and IP protection creates more value for them. Moreover, (Karius & Tim, 2016)

highlight that in the perspective of economic contribution to the wealth and growth of countries, the IP plays a remarkable role.

Moreover, firms often use innovation and disruptive technologies to become dominant players in the market. As per Bradley *et al.* (1998), shareholders' value is another term for the total value of equity of a firm or its market capitalization. The market capitalization of a publicly traded firm is highly transparent, and it is the number of shares listed on the market multiplied by the average price per share. Importantly, Volkov and Garanina (2017) explored the importance of Intangible Assets (IA) in the knowledge-based economy based on 43 Russian companies covering the five fields : mechanical engineering, extractive industry, engineering, communication services, and metallurgy. The findings proposed emphasized there is a positive relationship between the average market value of company assets and the 5-year average fundamental values of tangible and intangible assets.

Furthermore, Richard *et al.* (2007) pointed out that intangible assets other than goodwill, which include the value of patents, copyrights, licenses, and trademarks, have a significantly positive impact on shareholders' wealth, investigating the impact of intangible assets and expenditures on corporate shareholder accountability based on 1,657 manufacturing. The dominant characteristics of intangible assets in the marketplace now have become one of the major causes of the volatility of stock prices. The response announcement of new intangible assets is a positive piece of information for the market participants. For example, Alsinglawi and Aladwan (2018) found the intangible assets on the volatility of stock prices as an important indicator of firm value. Obviously, these researchers suggest that firm value is not only restricted to the value of the physical assets but also the non-physical assets.

Another study has been conducted by Tania *et al.* (2014) to analyze the relationship between financial performances, intangible assets disclosure, and value creation within Brazilian and Chilean information technology companies. This research stated that wealth creation in business is related to intangible assets and also emphasized that intangible assets are responsible for better financial performance and value creation. Thus, companies possessing more intangible assets tend to create more value for their shareholders. Basso *et al.* (2014) have conducted research based on the impact of intangibles on value creation. For measuring intangibles, the research has taken into consideration the sectors of software, equipment, and technology for computing in the United States. Basically, this study consists of a comparison between the software sector and the hardware sector. Therefore, the sample comprised 792 software companies and 591 hardware companies. According to the findings, research and development expenditures and selling and administration expenditures are

strongly correlated with the shareholders' return in the software sector companies.

In the dynamic and challenging business world, the factors that affect the firm value can be changed dramatically. Consequently, as a sub-component of intangible assets, intellectual property rights (IPRs) have a significant role to play within the organization in terms of competing with their reveals. It provides the regulatory construct to overcome market failures by providing an incentive for firms to invest in IPs and enabling firms to capture the benefits of innovations and product developments. This is largely taken as a given by policymakers and impacts on reflecting the complexity of the relationship between creation and innovation processes, IPRs, and the market value of companies (Withers, 2006). According to specific announcements of intellectual properties it can affect the changes in the stock prices of a company. Investors and other stakeholders are highly aware of the communication of new information to the market; therefore, it can be identified whether the market positively or negatively reacts to specific announcements (Dosso & Vezzani, 2019). Share prices of every company change rapidly at every minute.

Most of the companies have been inspired by IP announcements because of adding new value to the company. The IP announcements are highly related to innovations and technological advancements as well. There is a higher probability of enhancing companies' returns against the flow of new information. As per Bessen and Meurer (2007), the IT industry has more of an effect compared to those in other industries for the following reasons. Bessen and Meurer (2007) performed an event study to measure the effect of patent litigation with large samples, showing that the impact of patent litigation on the value of a firm depends on the firm's characteristics, such as the size and the firm's financial conditions.

The basic requirement of creating shareholder value is ensuring the effective flow of information within the organization. Hence, it is important to determine how new information is negatively or positively influenced. Rappaport (1986) stated that the behavior of abnormal returns of companies reflects whether the wealth of a firm is increased or decreased. Furthermore, Mackinlay (1997) has stated that the best method to measure the changing pattern of abnormal return is event study methodology. Utilizing 30 firms and considering 600 events, this research is conducted using the Dow Jones Industrial Index. The adapted model to calculate the abnormal returns of each event was the Market model. It leads to an increased ability to detect event effects immediately (Brown & Warner, 1985). Using that market model, Mackinlay has analyzed the behavior of Abnormal Return, Average Abnormal Return, and Cumulative Average Abnormal Return, considering the daily share prices and market indexes. However, evidence from the literature proves that there is limited attention

provided in terms of quantifying the impact of intangible assets on shareholders' wealth; therefore, this study attempts to fill that gap in the understanding of the effect of intangible assets and intellectual property announcements on shareholders' wealth.

3. Data and Methodology

The study is confined to analyzing the impact of intangible assets and intellectual property announcements on shareholders' wealth considering the sample of eight (08) top branded American technology companies that are listed on the New York Stock Exchange (NYSE). The considered intangible assets of the study are namely, goodwill, patents, trademarks, and trade secrets. In here shareholders' wealth is measured by using the Market Value Added (MVA) approach. Further, forty intellectual property (IP) announcements are considered to analyze the impact of IP announcements on shareholders' wealth. Here, market reaction around each announcement is measured using the calculated daily abnormal returns. The study covers the period from 2005 to 2019.

3.1 Data

The research was conducted using quantitative data obtained from valid secondary sources. Considering the announcement date of each intellectual property, monthly and daily share prices and daily stock indexes are gathered. Those data are obtained from secondary sources such as annual reports, Yahoo Finance (markets indexes of New York Stock exchange: Standards & Poor's 500, share prices), patent scope, Espacenet, World Intellectual Property Report (WIPO), and websites of respective companies. The sample consists of the top eight (08) American technology companies. According to the importance awarded to information and communication technology, the current knowledge economy is highly adapted towards technological advancement and innovations, and the majority of those innovations are intangible in nature. For example, compared with other sectors the technology sector is 91% intangible in the world context, and taken as countries, the USA's technology sector is 98% intangible (Brand Finance, 2019). This induced the study to consider the sample as technology companies based on the highest brand value and availability of data. Most importantly, the majority of top global companies with the highest brand value are American technology companies, which are listed on the New York Stock Exchange. The list of companies is as follows.

Table 1: Sample of Companies and Intellectual Property Announcements

Company Name & Brand Value	Intellectual Property Announcements	Date of Announcement
Apple Incorporation $ 310Bn	Touch Screen device method, and graphical user interface for providing maps, directions, and location-based information	2008-12-31
	Touch screen device, method and graphical user interface for moving on-screen objects without using a cursor	2012-02-22
	Port Discovery and message delivery in a portable electronic device	2014-12-04
	Conversion management system, method, and computer program	2018-10-17
	Device, method, and graphical user interface for managing folders	2019-08-08
Google Incorporation $ 309Bn	Fault-tolerant data storage on photographs	2008-05-27
	Method for searching media	2008-10-14
	Automatic transliteration of a record in a first language to a word in a second language	2011-07-21
	Method and system for automatically creating an image advertisement	2012-11-13
	Stand assembly for an electronic device providing multiple degrees of freedom and built-in cables	2019-10-24
Microsoft Corporation $251 Bn	Method, apparatus, and user interface for managing electronic mail and alert messages	2008-03-06
	Changing the number of machines running the distributed hyperlink database	2012-12-16
	Embedded Web viewer for presentation applications	2017-11-02
	Software application creation for non-developers	2018-09-05
	Updating software components through online stores	2019-10-17
Facebook Incorporation $159 Bn	Urgency notification delivery channel	2015-11-27
	Protecting personal information upon sharing a personal computing device	2016-09-22
	Voicemail proxy server	2017-06-29

	Automated location check-in for geo-social networking system	2018-04-17
	Low power high frequency social updates for mobile devices	2019-05-09
IBM Corporation $86 Bn	Multiprocessor system snoop scheduling mechanism for limited bandwidth snoopers that uses dynamic hardware/software controls	2006-05-16
	System and method for multicore communication processing	2010-02-04
	Method for operating a computer cluster	2016-01-14
	Method and system for user-aware wireless video display	2017-06-08
	Method of invisibly embedding and hiding data into soft-copy text documents	2019-07-18
Intel Corporation $ 32 Bn	Verifying the integrity of a media key block by storing validation data in the cutting area of the media	2006-08-15
	Language-dependent voting-based user interface	2007-10-18
	Method and apparatus for migrating virtual trusted platform modules	2011-12-06
	Method and apparatus for remotely provisioning software-based security coprocessors	2016-11-22
	Techniques to pre-link software to improve memory de-duplication in a virtual system	2018-01-09
Cisco Corporation $ 29 Bn	System, method, and software for a virtual host bus adapter in a storage-area network	2007-07-03
	Rich multi-media format for use in a collaborative computing system	2009-12-22
	Message delivery coordination among multiple messaging media	2011-01-04
	Controlling computer program extensions in a network device	2012-08-07
	Address resolution suppression for data center interconnect	2017-01-17
Oracle Corporation $26 Bn	System and method for automatic generation of HTML-based interfaces, including alternative layout modes	2007-05-08
	System and method for searching data partially displayed on a user interface	2008-05-27

	Knowledge-intensive data processing system	2015-09-10
	External platform extensions in a multi-tenant environment	2018-07-31
	Techniques for similarity analysis and data enrichment using knowledge sources	2019-02-19

Source: World Intellectual Property Database and Brand Finance, 2019

3.2 Defining Variables

Intangible assets: Intangible assets are non-material sources of creating a company's value based on the employees' capabilities, the organizations' resources, the way of operating, and relations with the shareholders (Andonova & Guluiermo, 2016). According to previous studies such as Richard *et al*. (2007) and Li and Wang (2014), intangible assets are the key mechanism of creating value for companies in this knowledge-based century.

Goodwill: Goodwill is an intangible asset associated with the purchase of one company by another. It is the premium that is paid when a business is acquired. If a business is acquired for more than its book value, the acquiring business is paying for intangible items. (Wang and Chang, 2005).

Patent: A patent is an exclusive right to market a particular invention. It is considered an intangible asset, and it provides long-term value to the owning entity. Patents are generated for new, useful, and non-obvious inventions of the companies, and they will be affected to create the wealth of shareholders (WIPO, 2019). In recent years the information technology industry has been highly aware of patents, and IT firms have a higher probability of adopting the patent legislation because each IT devices, technological advancement, or innovations need to acquire a right of patent (Karius & Tim, 2016).

Trademark: A trademark is an intangible asset that legally prevents others from using a business's name, logo, or other branding items. It is a design, symbol, or logo used in connection with a particular product or a business. To maintain a good reputation, trademarked companies will often work harder to provide quality services and products. According to Richard *et al*., (2007), investing funds in intangible assets such as patents, trademarks, copyrights, and licenses is most valuable. The reason is those intangible assets have been impacted positively on the shareholders' value of the firm.

Trade Secret: Trade secrets are the types of intellectual property rights on confidential information that may be sold or licensed. It comprises formulas, practices, processes, designs, instruments, patterns, or compilations of information that have inherent economic value. When intellectual property types are considered, trade secrets are one of the most common types of IP that

are used by the company (WIPO, 2019). It adds value to a business. Today, they are gaining attraction as an effective way to protect certain intellectual assets. (Wang and Chang, 2005).

Shareholders' Wealth: Shareholder wealth is the collective wealth conferred on shareholders through their investment in a company. Companies can determine shareholders' wealth by looking at overall company value in terms of current value per share and the number of shares issued. Therefore, the share price is the direct measure of measuring the shareholders' wealth (Fisher, 1995). As per Stewart (1990) and Dekker et al. (2012), the current study has considered the Market Value Added (MAV) approach to calculate shareholders' wealth to analyze the impact of intangible assets on shareholders' wealth. MAV is the difference between the market value of shares and the value of shareholders' equity. Here, the market value of shares is calculated by multiplying the number of shares outstanding and the market price per share. Similarly, the value of shareholders' equity is the difference between total assets and total liabilities.

3.3 Model Adapted the Study

For analyzing the data, descriptive statistics were first performed to describe the basic features of variables, and Pearson correlation analysis was performed to measure the linear correlation between independent and dependent variables. Finally, panel data regression and event study methodology were employed to achieve the research objectives.

3.3.1 Panel Data Regression

To observe the impact of intangible assets on shareholders' wealth of selected eight technology companies, a panel data analysis is employed to build the regression model. Panel data analysis is a statistical method widely used in social science, medical science, and econometrics to analyze multi-dimensional data involving measurements over some time (Panel analysis, 2018). The data used in the research is derived from secondary sources and using the panel data regression model, the impact of intangible assets on shareholders' wealth was analyzed. In Panel data regression, Common Effect Model or Pooled Least Square (PLS), Fixed Effects Model (FE), and Random Effects Model (RE) are available for analyzing the data (Panel analysis, 2018). Three main tests are commonly applied to select the most appropriate regression model for examining the impact of intangible assets on shareholders' wealth. One is the F Test to decide which model should be used between the FE Model and the PLS model. The lagrange Multiplier (LM) test is used to determine the best model between the RE Model and the PLS Model. Moreover, the Hausman test is used to determine the best model between the FE Model and the RE Model. This study uses the E-

views statistic software is used to figure out the best regression model. The common panel data regression model is given as follows:

$$\text{SW}it = \beta0 + \beta1\text{GW}it + \beta3\text{PA}it + \beta4\text{ITM}it + \beta5\text{TS}it + \varepsilon t$$

In here, SW is shareholders' wealth, GW is goodwill, PA is patent, TM is a trademark, TS is trade secret, and εt is an unexplained variable or error term. Furthermore, i is the entity and t is the time.

3.3.2 Event Study Methodology

The event study methodology is the widely accepted methodology for analyzing stock market behavior. According to MacKinlay (1997), the primary use of event study methodology is to estimate the impact of an event on the company value using financial data. Essential for the event study is the abnormal return compared to the normal return. Short-horizon event studies focus on the announcement effects of a certain event. Szalavetz (2017) has stated that event studies are useful because, given rational markets, the effect of an event would be reflected in stock prices immediately. As per MacKinlay (1997), the event window usually consists of multiple days in cases where daily data is used. The day or days before the event day should also be included in the event window since information about the event has been acquired before the event day. Moreover, Pokrajcic (2012) has emphasized that 30-60 observations are usually viewed as a minimum requirement to get significant results when running regressions. Therefore, the study has initiated the event study methodology to examine how stock prices change according to when new information about IP announcements comes to the market. It examines the stock market's response to events that are often related to the release of information to the stock market. However, the researcher has considered the forty (40) intellectual property announcements of eight selected technology companies including five intellectual property rights from each company.

In this paper, abnormal returns were calculated to examine the impact of IP announcements on shareholders' wealth, , and it is the difference between actual returns and expected returns. MacKinley's market model has been considered to estimate the expected returns relative to each IP announcement (MacKinlay, 1997).

$$E (R_{at}) = \alpha_i + \beta_i R_{mt}$$

Here, E (Rit) is the expected return for company i in period t, and Rmt is the return of the market portfolio. α_i and β_i are the market model parameters used by the regression model, where α_i is constant, and β_i is the estimated systematic risk of share i. Expected returns are estimated using the Estimation window of -80 to -41 days. Those returns are estimated using the daily share prices and S&P 500 market indexes. The published date of an intellectual property right is the

event date, which is indicated in zero (0). Two event windows are considered for the study. The first window is considered as before and after when the particular event is happeneds (-40 to +40), which means 40-day event window and the second is the 10 day event window (-10 to +10) by incorporating the theory of Efficient Market Hypothesis.

Further, Average Abnormal Return (AAR) and Cumulative Average Abnormal Return (CAAR) are used to measure the impact of intellectual property announcements on stock return changes. The individual securities' abnormal return will be aggregated for the event period and divided by the number of events in order to calculate the AAR for all securities over the event window (MacKinlay,1997). CAAR is cumulates of abnormal returns over a specified period around the event date. To examine the aggregate return over the event window, the cumulative abnormal return is used. Finally, to ensure that calculated abnormal returns are statistically significant or not, it is necessary to apply the statistical test for this. Mainly there are two statistical tests: parametric test and a non-parametric test. Under the parametric test, the most common test to examine the significance of CAARs is the t-test (Browner and Warner, 1985).

4. Analysis

This section deals with the analysis and findings of research results. Initially, descriptive statistics and Pearson's correlation analysis were conducted. Afterward, the study was directed to analyze the data using two main methodologies, panel regression, and event study methodology for the purpose of achieving the research objectives.

Table 2: Descriptive Statistic of variables

VARIABLES	OBSERVATIONS	MINIMUM	MAXIMUM	MEAN	STD. DEV.
SW	120	10.42964	13.73626	11.81686	0.738677
GD	120	4.564344	11.20446	9.450694	1.245285
PA	120	7.876638	12.77198	10.68279	0.917907
TM	120	3.555348	9.133675	6.920925	1.142538
TS	120	6.086186	10.06875	8.948938	0.755282

Source: E-views Output

As per the values given in Table 2, the average shareholders' wealth is 11.8168, and it fluctuated between a minimum value of 10.4296 and a maximum value of 13.7362. The standard deviation of SW is 0.7386 which is a very low value. It indicates a low degree of variation in a set of variables. But it is not closer to the mean value. The mean values of goodwill, patent, trademark, and trade secret

are 9.4506, 10.6827, 6.9209, and 8.9489 respectively. These mean values stand for the average values of the study's considered variables. The standard deviation measures the amount of variation or dispersion from the average. A low standard deviation shows that the data points tend to be very close to the mean, and a higher standard deviation indicates that the survey data points are spread out over a large range of values.

Table 3: Pearson Correlation Analysis of Variables

	SHAREHOLDERS' WEALTH	GOODWILL	PATENT	TRADE MARK	TRADE SECRET
SW	1.0000				
SIG					
GW	0.2096	1.0000			
SIG	0.0216				
PA	0.8222	-0.0153	1.0000		
SIG	0.0000	0.8681			
TM	0.2802	0.5022	0.2662	1.0000	
SIG	0.0019	0.0000	0.0033		
TS	0.5295	0.5928	0.4415	0.5786	1.0000
SIG	0.0000	0.0000	0.0000	0.0000	

Source: E views output

The Table shows that goodwill, patents, trademarks, and trade secrets are positively associated with the shareholders' wealth. The value of Pearson's correlation of goodwill and trademark is 0.2096 and 0.2802 respectively, which indicates the low degree of a positive relationship between goodwill and trademark with a wealth of shareholders. Trade secret indicates a moderate degree of a positive relationship between shareholders' wealth, which is a 0.5295 correlation. The value of the Pearson correlation of patents is 0.8222, which means there is a strong positive relationship between patents and shareholders' wealth. The p-value of those five variables is less than 0.05. It demonstrates that goodwill (0.0216), patent (0.000), trademark (0.0019), and trade secret (0.0000) are statistically significant at a 5% confidence level and significantly impact the shareholders' wealth.

4.1 Panel Data Regression Analysis

Table 4: Panel Data Regression Analysis of Variables

VARIABLES		PLS	FE	RE
GW	Coefficient	0.1231	0.1888	0.1326
	P Value	0.0025	0.0066	0.0139

|				
PA	Coefficient	0.6204	0.4635	0.5334
	P Value	0.0000	0.0000	0.0000
TM	Coefficient	-0.0659	0.0304	0.0212
	P Value	0.09983	0.4147	0.5524
TS	Coefficient	0.1081	0.2035	0.1156
	P Value	0.1441	0.0338	0.0541
R2		0.7358	0.8988	0.6285
ADJ. R2		0.7242	0.8719	0.6155
F STATISTICS		0.0000	0.0000	0.0000

Source: E -Views output

The panel data regression results were obtained by conducting the F test, LM test, and Hausman test. The most appropriate model for the study was selected, which is the Random Effect Model (RE). According to the Model outcome of the RE model, the coefficient of goodwill is 0.1326, which means an increase of 1 million of goodwill results in an increase of 0.1326 million of shareholders' wealth. The coefficient of the patent is 0.5334, which means an increase of 1 million patents results in shareholders' value being increased at 0.5334 million. As the same, the coefficient of the trademark is 0.0212, which means an increase of trade secrets by 1 million, resulting in shareholder's wealth being increased by 0.0212 million. Also, the coefficient of a trade secret is 0.1156, which means an increase of 1 million trade secrets results in shareholders' value being increased at 0.1156 million. Overall, the coefficients of those five variables indicate positive values. However, according to the p-value of each coefficient, only goodwill (0.0139) and patent (0.0000) show a significant impact on shareholders' wealth because its calculated P-value is less than the critical P value which is 0.05 under a 5% confidence level. However, trademark (0.5524) and trade secret (0.0541) are not statistically significant. Moreover, the R square is 62.85%, and the adjusted R square is 61.22%. It demonstrates that the model can explain more than 61% of the variation in shareholders' wealth. Finally, to examine the impact of intangible assets on shareholders' wealth, the most appropriate model is the Random Effect Model (RE). According to the findings, Goodwill and patents indicate a positive significant impact on shareholders' wealth. Trademarks and trade secrets indicate a positive, however, insignificant, impact on shareholders' wealth.

4.2 Event Study Analysis

As per the results obtained from the event study analysis, the following graph illustrates the changing pattern of abnormal returns with the announcement of intellectual properties.

Figure 2: Average Abnormal Returns and Cumulative Average Abnormal
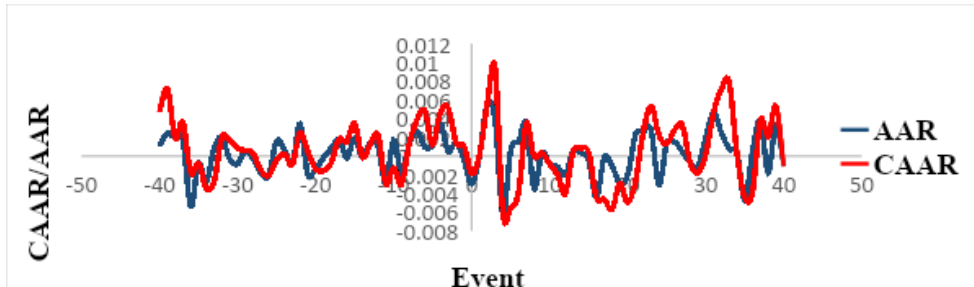
Returns of 40 days' event window
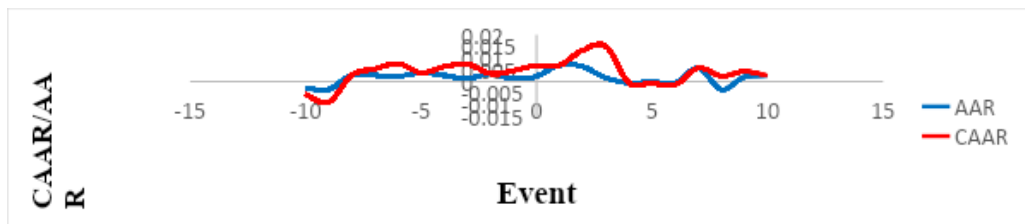
Source: Output of Data Analysis

Figure 2 shows the movements of AAR and CAAR relative to the event window. In this study, the event window is chosen as -40 days through 0 to +40. Here, 0 depicts the announcement date of a particular intellectual property, -40 is the 40 days' time period before the announcement date, and +40 is the 40 days after the announcement date. As illustrated in Figure 2, AAR and CAAR values fluctuate around zero. The behavior of CAAR and AAR indicates a similar pattern.

Before coming to the information about the IP announcements into the market, it shows the large positive values of CAAR and small negative values of CAAR. However, after the event, a significant fluctuation in CAAR can be seen. Further, within the period of 0 to +40 CAAR values rapidly increased and then rapidly decreased. Two days after the event (+2), there was a rapid increase in CAAR and AAR, which is 0.004. Subsequently, CAAR and AAR drastically declined up to the negative level, which indicates that 4 days after the event (+4) and it is the largest decrement of CAAR and AAR during the period. Overall, there is no stable level of CAAR and AAR. As a result, it can be observed that the market has not positively reacted to the IP announcements to a considerable extent.

Finally, considering the t-statistics of CAAR, if the CAAR value is greater than 1.96 (t table value) under the 5% confidence level within the 40 days after the publication of intellectual properties, t- statistic of CAAR is insignificant. It means those intellectual property announcements are not being able to influence the market. However, when the American stock market is considered,

it is a very efficient market. Therefore, according to the theory of Efficient Market Hypothesis it can be recommended that, when new information comes into the market, it is immediately reflected in stock prices.

Figure 3: Average Abnormal Returns and Cumulative Average Abnormal Returns of 10 Days Event Window

Source: Output of Data Analysis

Table 5: Average Abnormal Return, Cumulative Average Abnormal Return and t-statistic of CAAR for -10 Days and +10 Days

Period	AAR	t-statistics of AAR	CAAR	t- statistics of CAAR
-10	-0.00265	-0.272290276	-0.00545	-0.632131658
-9	-0.00339	-0.070163371	-0.00884	-1.080542811
-8	0.002764	0.112261142	0.002764	0.358162554
-7	0.002649	0.186528592	0.005413	0.749901062
-6	0.00229	-0.109557541	0.007703	1.152624432
-5	0.003808	0.155132205	0.003808	0.624162052
-4	0.002599	-0.015382924	0.006408	1.174193168
-3	0.001195	0.044010563	0.007603	1.608764502
-2	0.003429	-0.021074392	0.003429	0.888695381
-1	0.001218	-0.310041382	0.004647	1.703175251
0	0.002267	-0.306957513	0.006914	2.533982938
1	0.007067	-0.414217538	0.007067	2.589950502
2	0.006414	0.358162554	0.013481	3.493673776
3	0.001635	0.367009186	0.015116	3.198585279
4	-0.00057	0.34263871	-0.00057	-0.104112708
5	-0.00014	0.624162052	-0.00071	-0.1164238
6	-0.00073	0.476358779	-0.00144	-0.216065315
7	0.005812	0.252923019	0.005812	0.805041285
8	-0.00344	0.888695381	0.002374	0.307557078
9	0.001984	0.44637019	0.004357	0.532317612
10	0.002477	0.830807686	0.002477	0.287089428

Source: Microsoft Excel output

Table 5, depicts the AAR, CAAR, and t- statistics of AAR and CAAR within the time period of 10 days before and after the IP announcements. The pattern of positive CAAR and AAR starts from 8 days before the announcement day, and returns are positive up to 7 days after the announcement while they are negative for only 5 days. In here, CAAR and AAR values from the event date (0) to 3 days before the event (+3) are shown large positive values while showing a significant impact on the shareholders' wealth. That means the CAAR values of the event date (0) and the next 3 days, respectively, 0.006, 0.007, 0.013and 0.015, and those values are statically significant at 5% confidence level which is 2.533, 2.589, 3.493, and 3.198. Thereafter, starting from 4 days after the event (+4), both AAR and CAAR values are decreased while reaching the lowest AAR value during the period. However, CAAR values are positive from +7 day to +10 day, it can be recovered the largest negative values. The positive and significant AAR and CAAR indicate that the investors and other stakeholders perceive the intellectual property announcement because they have the ability to earn abnormal returns. Especially on the second day after the announcement indicated that the highest AAR and CAAR values and the highest significance level during the event window. That means within 10 days after the date of the intellectual property announcement, the market positively reacted within a shorter time period, considering the market is highly capitalized and efficient. The reason is that if the market is efficient, it states that when new information comes into the market, it is immediately reflected in stock prices.

Table 6: Abnormal returns (AR) and t-test value of considered IP announcements

Company Name		IP 1	IP 2	IP 3	IP 4	IP 5
Apple Incorporation	AR	0.4382	0.0252	0.0037	0.0086	0.0104
	t-test	2.3131	2.2591	-0.2224	0.4289	1.1477
Google Incorporation	AR	0.0080	0.0496	0.0137	0.0087	0.0004
	t-test	1.1577	1.4491	-0.4098	0.0601	0.1675
Microsoft Corporation	AR	0.0030	0.0177	0.0124	-0.0050	0.1007
	t-test	0.3196	0.2105	0.1746	1.3635	2.7605
Facebook Incorporation	AR	0.0478	0.1628	0.0595	0.0183	0.0054
	t-test	-0.2314	2.1284	0.4566	0.7178	0.0286
IBM Corporation	AR	0.0097	0.0039	0.0140	0.0074	0.0118
	t-test	-0.5576	1.9769	1.1406	0.7815	0.6548
Intel Corporation	AR	-0.0029	-0.0100	0.0057	0.0115	-0.0327
	t-test	0.1979	1.0421	0.6883	1.6413	-2.0931
Cisco Corporation	AR	0.0003	-0.0012	0.0014	0.0302	-0.0046
	t-test	0.0332	-0.2060	3.1366	1.6507	-0.4857
Oracle Corporation	AR	-0.0017	0.0210	0.0127	-0.0085	0.0021
	t-test	-0.2766	1.1455	0.2829	-1.1255	0.3807

Source: Microsoft Excel output

Table 6, shows the abnormal returns and t-test values of considered IP announcements. Here, IP 01 to IP 05 indicates each company's intellectual property announcements. This analysis assists in determining the most dominant technology intellectual property rights of each company. This paper also looks at types of technological advancements. In Apple Inc., among five IP announcements, IP 01 and IP02 show higher positive abnormal returns compared with the other three IP announcements, and they are statistically significant, and those two IPs are in the category of "multi-touch technology". According to this, it can be assumed that in the period from 2008 to 2012, the dominant technology type of Apple Inc. was multi-touch technology. In Microsoft, IP 05 indicates a higher abnormal return than the other four IPs, and it is statistically significant. As per this result, this IP belongs to the category of "software development, and it demonstrates that in 2019, the most popular technology type of Microsoft is software development. Similarly, in 2016, the most demotic technology of Facebook Inc. was software development because IP 02 contributes to obtaining the highest abnormal return of this company and is statistically significant. Moreover, according to the highest abnormal returns and level of significance, "artificial intelligent-powered robot microscopes technology" was the dominant technology of IBM in 2010. When considering the behavior of abnormal returns of Oracle, with respect to the five selected IPs, "digital assistant for personalized interactions technology" is the technology that attracted to the market in 2012. Considering the Google, Intel, and Oracle corporations, even though the t-test values are not statistically significant, the researcher has considered the highest abnormal returns which are obtained by each IP announcement. It is stated that the popular technology area of Google is artificial intelligence discovered modules in 2008, other two companies have captured the market through software development and machine learning technology in the year 2016 and 2008, respectively.

5. Conclusion

For the purpose of analyzing the impact of intangible assets on shareholders' wealth, the paper assessed the impact of goodwill, patents, trademarks, and trade secrets on shareholders' wealth. The study also directs the research literature into a new direction towards identifying the impact of intellectual property announcements on shareholders' wealth of selected top eight companies within the global technology industry. Even though the previous studies have stated different outcomes, the current research indicates that only two intangible assets have shown a positive significant impact on shareholders' wealth, namely goodwill and patents. Further, the trademark and trade secret did not imply a significant impact on shareholders' wealth. The IP

announcements of global technology companies generate a positive influence on shareholders' wealth in the short run. Therefore, it can be concluded that the goodwill, patent, and IP announcements positively and significantly impact maximizing the shareholders' wealth. Further, this study determines the dominant technology area of each company during the considered time period with respect to selected intellectual property announcements.

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