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A study of the technology crisis in the early 21st century and the valuation of the US technology companies

Anh Sao Kim NGUYEN

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Abstract

In the context of imperfections in financial market, which are no exceptions, the market price of companies usually stands a high chance of drifting away from their intrinsic value. The intrinsic value of stock is determined by fundamental indicators, for example: earnings, cash flow, company's performance and time value of money. Mis-valued stocks result in a stock bubble or stock crisis, which has an adverse effect on the economy. An example of this problem is the technology crisis 2000s. Therefore, it is essential to understand firms' real value and how their performance affected by being traded differently from such value so as to support companies' investment strategy, performance management, decision making and to prevent economic crises.

In order to support a solution to determining firms' intrinsic value, a well-known valuation method in corporate finance named discounted cash flow model was relevantly applied to address the real value of thirty technology companies in the United States. Regarding the influence of misevaluation on the companies' performance, a time series of their price to earnings ratio from when the previous technology crisis burst in 2001 to 2017 was demonstrated. Data used was numeric and collected from companies' financial statements and the stock market database. Microsoft Excel was the tool used for data analysis.
The results showed that fifteen among thirty companies were overvalued and the other fifteen firms were undervalued. Among those, one company had negative real value. The series of price to earnings ratio implied that from 2001 to 2017, the companies' performance had been unstable even though their stock's market price had been increasing significantly. To conclude, almost every technology company was mis-valued, which made their performance unstable and contradicted to their market value on which irrational investors base their investing decision.

Keywords (subjects)

Valuation, discounted cash flow model, fundamental value, stock bubble, price to earnings ratio

Miscellanous

Appendices attached (26 pages)

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Abbreviations

BV	Book value
CAPM	Capital asset pricing model
CCF	Capital cash flow
CFd	Debt cash flow
Cov	Covariance
DCF	Discounted cash flow
DPS	Dividend per share
EBIT	Earning before interest and tax
EBITDA	Earning before interest, tax, depreciation, amortization
ECF	Equity cash flow
EV	Enterprise value
FCF	Free cash flow
FCFE	Free cash flow to equity
FCFF	Free cash flow to firm
IPO	Initial public offering
Kd	Required return to debt
Ke	Required return to equity
NASDAQ	National Association of Securities Dealers Automated Quotation System
PER	Price-to-earnings ratio
Rf	Risk-free rate
Rm-Rf	Market risk premium
Var	Variance
WACC	Weight average cost of capital
WACCbt	Weight average cost of capital before tax
WCR	Working capital requirement

1 Introduction

This part introduces the research background of the thesis and the necessity of the topic chosen. Moreover, the research framework regarding research problems, research objectives and research questions will also be well demonstrated in this part.

1.1 Research background

The publicly traded companies disperse ownership among the general public through the issue of many shares of stock that are freely traded on stock exchange market. However, whether the market price of stock can fully reflect the real value of a company has been a controversial issue. Therefore, regarding such aspect, there is an important field in finance termed as valuation. The valuation is applied to study whether the stock price is based on fundamentals or it is a result of a bubble that is going to cause a sharp decline in stock price (Heaton & Lucas 1999). In other words, valuation is a tool to determine the real value of a security, an asset or a company. The real value is also called intrinsic value, fundamental value, equilibrium value, normal value or natural value. Such value implies the adjusted market value of the firm by taking into account the influence of time, economic trends, company's operation and potential growth expectation (Kraakman 2014). The price of stock can be overvalued or undervalued around its intrinsic value. That is, when the stock is trading at a higher price compared to its fundamental value, it is called overvalued stock and vice versa. Numerous studies regarding valuation have been conducted before by various well-known financial researchers, for example: Damodaran 1996, Fenedez 2009, Rao 2016. Several studies and researches provide strong aid for investors, speculators, companies' managers as well as governments in understanding the natural value of stock so as to give appropriate financial decisions. Moreover, those studies prove the importance of valuation in not only academic context but also in any real-life business issues.

This dissertation is oriented to apply the valuation concept to do valuation of thirty largest US technology companies by market capitalization determined by NASDAQ index in order to address some financial issues behind the 2000s technology crisis. The event started as a technology bubble caused by highly overvalued price of internet-based companies in the second half of 1990s. After that, the bubble burst in 2001, followed by the dramatic drop in price of those companies, which led to a

tremendous stock crisis in the history. Conducting this thesis is relevant because first, it studies and applies the valuation concept, one of the most well-known financial terms; second, it is aimed at bringing a real-life event into light - the 2000s technology crisis. Moreover, the outcomes of the thesis can be used as a valuable source to support the companies' management in adjusting short-term and long-term strategies so as to grow sustainably. By the same token, it can also well assist investors in picking the right stock to invest in with higher profitability and lower default risk.

1.2 The relevance of the topic

The fact that stocks are trading at different prices from its fundamental value may have substantially negative impact on the domestic stock market. Once it is widespread, the bad effect can reach national or global scale (Ross, Westerfield & Jordan 2010). For example, popular stocks can encourage investors to pour lots of money into them with the hope of becoming rich quick, which makes the market price of those stocks go very high above an average scale. However, when the market excitement is lowered down since investors realize the profitability is not as expected, the stock price decreases significantly. Therefore, it can be said that investors are pouring their money into trendy but not sustainably profitably stocks (ibid.). Such market mania towards popular stocks caused by overvaluation can result in a stock bubble. Once the bubble bursts, it can attack the entire domestic or global market adversely due to the dramatic fall in stock price to reach more relevant price level. Meanwhile, undervalued stocks bring about the anxiety of company's low growth rate for corporate's executives since their stocks are trading at lower price compared to the normal value. In general, misevaluation can lead to various bad consequences for not only the company such as wrong stock/portfolio investments, misleading planning and strategies, but also for the whole economy such as stock bubble or stock crisis. Nevertheless, thanks to valuation methods, investors are able to get good assumption about picking up the right stocks to invest in so that they can have better decision of whether to sell, hold or buy more of the stocks. Also, valuation techniques can help board of executives with better idea of the firm's financial health and growth expectation, along with being well supported to enhance the quality of business strategy management. In a broader scale, the concept of valuation makes great contribution to stabilize the security market and to prevent stock mania, stock bubble and economic crisis by limiting the stocks deviation from their real value. Subsequently, even though there have been many studies around the concept of

valuation, this topic still needs continual research and analysis for further improvement and development. For these reasons, the thesis's topic is relevant. Valuation is an indispensable requisite for people working in corporate finance, investment management and some other streams of finance, which, in this thesis, is applied through the prism of the 2000s technology crisis. Therefore, it can be said that this dissertation will be a very useful source of both theoretical and empirical information to assist investors and companies' managers in financial decision-making process.

1.3 Research framework

This section illustrates clearly the research problem to determine research objectives and to set up research questions according to the defined objectives.

1.3.1 Research problem

This thesis has been inspired by the context of the technology crisis 2000s. During the late 20th century, the internet appeared as a big phenomenon about the profitable future of online commerce for businesses. Accordingly, many internet-based companies were launched. From investors' perspective, companies that operated through internet foundation would soon worth millions. At the same time, the taxpayer relief act 1997 was implemented, which gave a big support for the growth of small businesses, which led to the IPOs (initial public offerings) of a mass of public dot-coms (internet-based companies) (Geier 2015). Thanks to the market excitement on the internet at that time, investors poured money into these dot-coms with the desire of getting rich quick by promising profit from their investment. For this reason, many of those companies were worth billions market capitalization after IPO. Entrepreneurs were inspired by the success of several dot-com companies, for example: Amazon, Ebay and Kozmo so that they lost in daydreams of becoming dot-com millionaires, or even billionaires. There were some of them somehow managed to become successful internet companies, hundreds of others failed. Such failure of these companies soon brought about the stock market crash in 2001 and many investors lost a big deal of money. Those investors ignored fundamental rules in stock investment like price-to-earnings ratio, analyzing trends, intrinsic value of the stocks; instead, they just followed an overconfident market trend whose reliability had been yet proven. Most importantly, they did not notice the signals of a bubble that was about to explode (ibid.)

In real-life context, there is a high probability that companies' stocks are trading at different price from their equilibrium price. Accordingly, it can be said that a company's actual performance and further advancement do not always tone with the market price at which its stocks are currently traded on the stock market. Moreover, the fact that technology stocks were once traded at a very high level above the average scale, leading to the technology bubble's burst in the beginning of 2000s, indicates the significance of overvalued stocks not only to companies but also to the entire economy. These days, technology stocks are again drawing much attention as popular speculating opportunities. Accordingly, these stocks are experiencing successive rise in market price. For example, at the end of 2017, it was recorded that the stock price of big technology companies in the NASDAQ 100 index had escalated by 32% since January of the same year (Russo 2017). For these reasons, it seems like we are again in another technology bubble, whose signals and potential consequences are gradually disclosed by various researchers, for example: Schwab 2015; Lim 2017; Sharma 2017.

This thesis is conducted to study the real value of thirty publicly traded companies in technology sector traded on the NASDAQ index by applying two fundamental valuation approaches. The techniques used are discounted cash flow model and valuation using multiples (the chosen multiple is price-to-earnings ratio). The time frame is 17-year time since the previous technology bubble burst in 2001 till the most updated financial data year, the year of 2017

1.3.2 Research objectives and research questions

Concerning the research problems indicated in the previous section, this dissertation aims at making the following research objectives come into light. Firstly, the current study is planning to figure out which stocks among the thirty sample companies are trading at different prices, which are drifting away from their intrinsic value. Secondly, this thesis is going to study how being traded at much different price compared to the real value affects the companies' financial health. In detail, this dissertation aims at measuring the performance growth of sample companies from the previous technology bubble burst in 2001, where technology stocks' price dropped significantly after being traded at much higher level than its natural value, to 2017. Last but not least, it aims at constructing the suitable investment strategies in the sample companies for investors.

In order to reach the desired outcomes of those objectives, these research questions need to be answered appropriately:

- What is the extent of the drift between the market value and real value of sample companies' stock price/return?
- Has financial performance of the sample companies changed since the technology bubble 2000s?

In addition to the principle questions above, the following sub-question will also be well addressed:

- What investment strategies should investors consider for selected technology companies in modern times?
- What management strategies should selected technology companies' managers implement to better companies' performance?

2 Literature review of valuation of technology companies

The section is the review of literature regarding the valuation of technology companies. In this section, numerous academic concepts related to valuation and the three most popular valuation models, including the two exploited to value the sample companies, are going to be well illuminated. The two valuation methods hat are going to be applied are discounted cash flow model and valuation using multiples, another valuation technique that is going to be introduced is dividend discount model. Moreover, the context that has inspired this dissertation, the technology bubble 2000s, will be introduced clearly and backed with updated information along with its financial characteristics. Beside various related theoretical concepts, this section also provides relevant empirical studies and pertinent previous studies done by other researchers about related issues around the research scope. This literature review is crucial because it is a highly useful source of both theoretical and empirical information for not only the reader but also for the researcher herself. On the one hand, it assists the readers with financial academic background within the sphere of research so that they can approach the research topic more efficiently without being too confused about academic issues. On the other hand, the literature review backs the researcher with stronger foundation of theoretical concepts as well as an idea of previous studies associated with that of the researcher. With the help of the literature review, the researcher will be able to give accurate interpretation on the research problem and to reach the desired outcomes of the research.

2.1 The concept of “value” and “price” in corporate finance

The market price of stock fluctuates throughout the trading days according to the investors’ decision of holding or selling the stocks, that is, when there are more people buy a specific stock or the demand for that stock increases, the price of the stock will rise, in contrast, the price will start to fall when people sell more of the stocks (Heaton & Lucas 1999). The causes of such fluctuation may come from the volatile nature of the firm itself or that of the national or global economy (ibid.). For example, when a company is performing well with significant increase in income as well as reputation, the demand for the company’s stock will rise as more people want to buy the stock to earn profit, which makes the price of the stock higher accordingly. Adversely, when the firm is performing low, loss increases, stockholders want to sell the stock to prevent them from possibly significant loss in the near future. Such theory is also applicable to industrial or national situations. That is, when an industry is gaining high reputation for large potential profit, the stock price of companies in that industry commonly increases and vice versa.

In the field of corporate finance, there is a well-known theory called the efficient market hypothesis, which refers to the impossibility that an investor cannot outperform the market by either purchasing undervalued stocks at low price or selling stocks that are overpriced to gain profit (Brealey, Myers & Allen 2008, 355-358). The foundation of the efficient market hypothesis is the concept of stock market efficiency, which was developed in 1970 by economist Fama (1970). This indicates that the prices of stocks and other securities reflect all relevant and available information. Moreover, the role of the market is to ensure that information is available to all investors and no investors can have access to private company information to take unfair advantages (ibid.). The efficient market hypothesis states that all available information is fully reflected in the prices of securities, and all market participants such as investors, speculators, firms, banks, government receive and react to the relevant information right at the time it is available (Ricciardi & Simon 2000, 2). Nevertheless, according to Fenendez (2015, 2), the price is just the mutually agreed amount between the buyer and seller in the case of trading an asset. Meanwhile, the value of an asset may be different for different participants in a transaction, and there should not be any confusion between the two terms. Moreover, the notion of the imperfection of the market argues that impossibly a perfectly competitive market, where all information is accessible to all traders in a transaction, could ever arise due

to the heterogeneous nature of goods and productions, of buyers and sellers (Madura & Fox 2014, 84-85). In conclusion, because the market is imperfect in nature, the market price of securities may or may not coincide with the true value of stock as there is always a high probability that the price is drifting away from the stocks' natural value. Accordingly, whether the market prices of stock can fully reflect the actual performance of a firm and its further development is yet to be confirmed.

2.2 The concept of valuation in general

There are two factions of though regarding the application of valuation. The first group consists of people who believe that asset valuation is irrelevant as long as there are still people willing to buy the asset. This group is considered the "bigger fool" theory of investing, where there are "bigger fool" people willing to buy assets from the "bigger fool" people who argue that valuation is irrelevant. Such investing game can somehow return certain amount of profit sometimes. However, it is obviously an unsustainable and even dangerous strategy to take since fool buyers are no guarantee still available at the trade's settlement time. The other group is of those who make decisions on acquiring assets based on rational fundamentals. That is, every asset, financial or real, has a certain value attached to it, and it is determined by reality and expectation of the cash flows it can generate. For this reason, the term valuation is vital in order to imply the intrinsic value of assets, which the market usually makes mistakes to determine. (Damodaran 2002, 1.)

Due to the fact that the market is imperfect in nature, practically the market price of an asset and its real value are hardly identical. And because of market imperfection as stated, analysts take their time and resources to do valuation. In contrast, if the market is already perfect and efficient, ones only need to make decisions based on the market price, which sounds relevant and convincing enough (ibid., 6). Moreover, the value of an asset today is not equivalent to the value of that asset in one year, 2 year, and so on due to changes in the time value of asset. Therefore, it is vital to compare values at the same point of time or at the present value of an asset (Berk & DeMarzo 2013). For these mentioned noticeable reasons, valuation in finance is crucial as it creates the foundation for giving rational decisions on investing in or managing underlying assets. In reality, valuation has brought about various valuable benefits as it can be applied for a wide range of purposes, some major of which can be listed as follow (Fenendez 2015):

- In company buying and selling operations: the results derived from valuation process can back both seller and buyer, that is, the seller can estimate the lowest price he can accept to sell his asset, meanwhile, the buyer has an idea of the highest price he should go for in a transaction.
- For stock exchange, valuation helps to ascertain the relevant price and the date at which the stocks' owners should sell, hold or buy more shares of certain companies. It also helps make clear concentration for stock portfolios. Moreover, as the stock's price reflect the market size of a company, valuation's result can also aid in making relevant comparison between companies, industries and sectors.
- It also facilitates the process of identifying the factors that are creating or destructing the value of the companies. Valuation demonstrates the main value drivers within the company and those that lower down the growth of the relative entity.
- For fair and sensible compensation structure, valuation plays an important role in quantifying appropriate value creation of a company attributable to its stakeholders.
- For initial public offering (IPO) event, valuation helps determine the price at which a share can be offered to the public
- Valuation is crucial for inheritances and wills as it is used to compare the value of shares with that of other assets.
- Valuation assists the board of executives in capturing a proper idea of the company's existence and in addressing appropriate strategic decisions on whether to continue the business, sell, merge, milk, grow or buy other companies
- Valuation is necessary for strategic planning of the company's sustainable growth in a long run. The company valuation gives fundamental ideas of what products, targeted customers, business model, production line and so on that the firm needs to maintain, grow or abandon so as to increase the creation of value.

Besides, there have been various theoretical as well as practical debates around the concept of valuation, some of which are going to be introduced sketchily as follow with the aim of describing the empirical review of valuation in real-life context:

- The argument that valuation is based on investors' perceptions alone while earnings and cash flows are not a matter at all in determining the value of a company is inadequate because, value must be based on both perceptions and static parameters like earnings and cash flows. and perceptions must link to reality and expectations drawn by available information (Damodaran 2002, 13)
- Valuation is a quantitative concept because it is derived from numerical formula, so it is supposed to be objective. However, valuation actually still conceals subjective components due to the indispensable bias issues attached to it. The numerical formulas used to calculate the company's value is static, but the inputs for the calculation such as earnings, interest rate, growth forecast and expectations, risk measurements, firm policies, economy, society and so on are often biased issues (ibid., 2)
- One of the most common used techniques to mitigate the bias regarding the inputs for intrinsic value's calculation process is to avoid taking strong public position (Damodaran 2002, 2). Meanwhile, Fenendez (2015, 14-15) stated that market communication with shareholders, partners, employees, board of directors, rating firms and governments. is one of the three main factors affecting value. The other two factors are expectations of future cash flows and required return to equity. As a result, it can be said that even though public communication may lead to bias issues and considerable error in valuation, it is considered an indispensable factor that is always taken into account in every valuation process. In other words, bias is inevitable in valuing companies.
- Information plays a key role in valuation process. As valuation requires the estimation of future growth, all information appropriate to value a company is about the future. However, it is not to say that the estimated future price reflects the future information, actually, all prices are derived from a same information set. According to the market efficiency, the present price reflects all current available information, and the estimation of future price is determined as the expectation for the future based on the same source of information. However, as the market is imperfect, future estimation may change easily once the future information is not as good as or not as bad as expected. Therefore, valuation is an inexact science (Madura & Fox 2014, 84-85.)

2.3 Valuation models

There is a wide pool of valuation methods, many of which have been applied popularly by various financial analysts in order to determine the intrinsic value of firms. Every method has its own characteristics and is helpful to apply as each of them is designed to definitely fit somewhere in the big picture of business valuation. However, as there are quite a lot valuation methods in the play, it is vital to classify them into relevant groups so as to make it easier first, to apply individual methods where relevant; second, to explain why they bring about different valuation results; and third, to acknowledge when they have significant error in logic (Damodaran 2002). Even though there are many valuation techniques in use, they can be classified into 6 major groups as follow (Fenendez, 2015):

Main valuation methods					
Balance sheet	Income statement	Mixed (good will)	Cash flow discounting	Value creations	Options
Book value Adjusted book value Liquidation value Substantial value	Multiples PER P/EBITDA Other multiples	Classic Union of Europeans Accounting experts Abbreviated incomes Others	Equity cash flow Free cash flow Capital cash flow Debt tax shield	EVA Economic profit Cash value added CFROI	Black and scoles Investment options Expand the project Delay the investment Alternative uses

Table 1 Main valuation methods (Adapted from Fenendez 2015)

Each of the six groups has particularly distinct function and usage. However, according to Fenendez (2015), cash flow discounting based methods are the most ”conceptually” correct and are increasingly popular in use these days. However, the other classes of methods are also still being used widely for certain purposes in valuing businesses. Along with those methods based on discounting cash flow, the first three groups from left to right in the chart are the remaining three out of the four most popularly used valuation methods, which are balance sheet based methods,

income statement based methods and mixed methods or good will based methods (ibid.)

Besides, as said by Damodaran (2002), there are three major valuation methods, first is discounted cash flow valuation, second is relative valuation and the final one is contingent claim valuation. The concept of discounted cash flow valuation of Damodaran is quite similar to that of Fenendez, which is that the intrinsic value of an asset is derived from the cash flows attached to that underlying asset. The general idea of the discounted cash flow model is discounting the future cash flows of an asset or firm's equity or firm's capital back to their present value using appropriate discount rate. Meanwhile, the basic of relative valuation method is that the value of one asset is determined based on the value of "comparable" assets with the help of variables like earnings, cash flows, book value or sales. One common-used illustration for this approach is to use the industry-average price to earnings ratio to value a firm. On the one hand, discounted cash flow affirms that the market price of an asset usually does not match with its intrinsic value and potential growth. On the other hand, in relative valuation, it is assumed that the market, on average, values companies correctly. For this reason, the assumption that the firm being valued is comparable to the average market value of the other firms in the same sector is applied. The root of such assumption is that the market values stocks correctly on average but when it comes to individual one, the market makes error. Not just price-to-earnings ratio, there are many other multiples that can be applied in relative valuation such as price to book value ratio, price to sales ratio and so on. Valuing a firm through other comparable firms in the same industry is called cross sectional category of relative valuation. Furthermore, in order to see the trend in stock growth over time, time series comparison is an effective approach to be implemented. Lastly, the final valuation group: contingent claim valuation, utilizes option pricing models to estimate the assets' value which have option characteristics. Those assets can be either financial assets such as warrants or real assets such as projects, patents, oil reserves. The latter class of assets is often called real option.

Additionally, Rao (2016, 47) divides the valuation methods into two categories, which are fundamental approaches and relative approaches. The fundamental approaches in this case are those that based on cash flow discounting, similar to the methods applied by Fenendez. Furthermore, relative approaches in this case consist valuation methods whose assumption base is the same of that of relative method of Damodaran, that is,

the market plays a fair role in average valuation so that an asset's value can be derived from other "comparable" assets' market value.

In general, the amount of valuation methods as well as the styles of classification varies among different researchers and different contexts in which the valuation is applied. However, it is worth noticing that each approach is supposed to yield significantly different result from others but they should correspond appropriately together. In other words, their effect should be supplementary to one another in an underlying valuation process (Damodaran 2002, 14). Moreover, although valuation is an inexact science, valuation result will be rewarding whether a right portfolio of valuation approaches and principles is set at the right time, in the right context (Rao 2016, 47).

This thesis is going to apply discounted cash flow method and valuation using multiples method to value thirty companies in the selected list because the author thinks that these techniques can generate results that match best with the research objectives. Discounted cash flow model is considered the most "conceptually" correct method in valuation. The principle of this model is the present value of the attached cash flow of the underlying firm, which can determine the fundamental value of that enterprise and measure the difference between such value and the firm's market value. Moreover, valuation using multiples can not only value the companies based on industry average value but also can draw the companies' value growth as in time series comparison mentioned above. Such function can support to make up the estimation of the selected companies' performance growth from 2001 to 2017 as indicated in the research objectives. Other valuation models are also helpful in this thesis, however, the author believes that these two methods are the best fit to be conducted. Furthermore, applying to many models will make this thesis really enormous, complex, time-consuming and effort-consuming.

2.4 Discounted cash flow (DCF) valuation model

Cash flow discounting-based valuation methods, which are also commonly called discounted cash flow methods, were first primarily used in the early 1770s and 1780s. Later in 1960s, people discussed more about the methods in financial economics, and finally since 1980s, the model has been widely applied in US Courts (Wikipedia). According to Fenendez (2015), valuation methods that are based on cash flow discounting are the most "conceptually" exact methods compared to various other

valuation approaches. In addition, Damodaran (2002) stated in his investment valuation book that discounted cash flow valuation is the basic for almost other methods. That is, if one can understand the fundamentals of discounted cash flow methods, he will be able to apply other methods easily. Furthermore, in order to apply other valuation methods, the input of company value derived from discounted cash flow method is usually necessary.

The general idea of valuation based on cash flow discounting lies in the rule of present value. It means that the value of an asset is the present value obtained by discounting the future estimated cash flow that the underlying asset can generate by an appropriate discount rate (Brigham & Ehrhardt 2005, 507-508). There are various types of cash flow since there are various assets creating cash flow in different way, consequently, the discount rate also varies between different cases. The discount rate is a measure of the risk attached to the estimated cash flow. Generally, the higher the discount rate is, the riskier the asset is; contradictorily, the lower the rate is, the safer the asset is (ibid.). In other words, Ross, Westerfield and Jaffe (2005, 60-68) consider a company or an asset as a cash flow generator, hence, the company's value can be determined by calculating the present value of the future potential cash flow it can create based on detail forecast of every financial items related to cash flow in each period. The financial items are commonly sales, expenses, employees, administrative, materials and so on. In the same discussion, Ullas Rao (2016) acknowledges that discounted cash flow model is a fundamental approach in valuation. The model captures a firm's value with the help of fundamental financial parameters because it is believed that valuation is a reflection of the business's financial performance shown by the cash flow created over a forecasted time frame. The general formula of discounted cash flow valuation model written by Damodaran (2002) is as follow, regardless of the types of cash flow:

$$\text{Value} = \sum_{t=1}^{t=n} \frac{\text{CFt}}{(1+\text{r})^{\text{t}}}$$

in which

n: life span of the asset

CFt: the cash flow of the underlying asset at time t

r: appropriate discount rate reflecting the risk inherent in the underlying asset

Discounted cash flow model is commonly used to find the present value of a company or an asset or to determine the favorable scale of a project. The working mechanism of

this method is to discount the future cash flow projections to arrive at the present value, and if that present value of the future cash flow is higher than the current expenses of the project, then that project is considered good enough to implement in (ibid.). In other words, it can be said that the higher the net present value of the project, which is the difference between the present value of estimated cash flow and current cost injected to raise the project, is, the more favorable the project is supposed to be.

In valuation, a firm being valued must be a going concern, which means its operation is still going on and is supposed to last for a very long time ahead, in other words, it is expected to last forever. Therefore, in order to determine the present value of a going concern, the terminal value of the company at the end of its life span will be discounted back to the present value. However, because the company's operation cycle is unknown in time and is considered indefinite, its cash flows also have to be created indefinitely (Fenendez 2007). Assuming that with a constant stream of cash flow payment for a perpetual period, the present value of the going concern is as follow:

$$\text{Present value} = \frac{C}{(1+r)^1} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + \cdots = \frac{C}{r}$$

And with constant growing cash flow:

$$\text{Present value} = \frac{C}{(1+r)^1} + \frac{C \times (1+g)}{(1+r)^2} + \frac{C \times (1+g)^2}{(1+r)^3} + \cdots = \frac{C}{r-g}$$

where:
C: cash flow
r: discount rate
g: cash flow's constant growth rate

Even though the present value of a company can be obtained through a perpetual series of cash flow, such valuation technique is not reasonable to conduct since the present value will change significantly after long time travel. Moreover, most companies will surely lose their competitiveness and market position after a certain period of time (Berk & DeMarzo 2013)

In valuation, instead of using inputs from the full balance sheet, adjusted inputs in the economic balance sheet are exploited. The adjustment is made in order to fit the demand of valuation and to reach the desired outcomes of valuation process. For example, when we refer to a company's financial asset, it is the total assets less spontaneous financing from suppliers or creditors, not the entire assets from full balance sheet. Such assets also equal the net fixed assets plus the working capital requirement, which is the amount of cash the firm must have on hand to serve day-to-day operation. And when we talk about the company's financial liabilities in valuation, we acknowledge it as the combination of the shareholders' equity (the shares) and its debt (short-term and long-term financial debt). From this point of writing till the rest of this dissertation, when the company's value is mentioned, it is referring to the value of the debt plus the value of the shareholders' equity. The figure below, which is adapted from Fenendez (2015), shows more details in simplified form about the difference between the full balance sheet and economic balance sheet

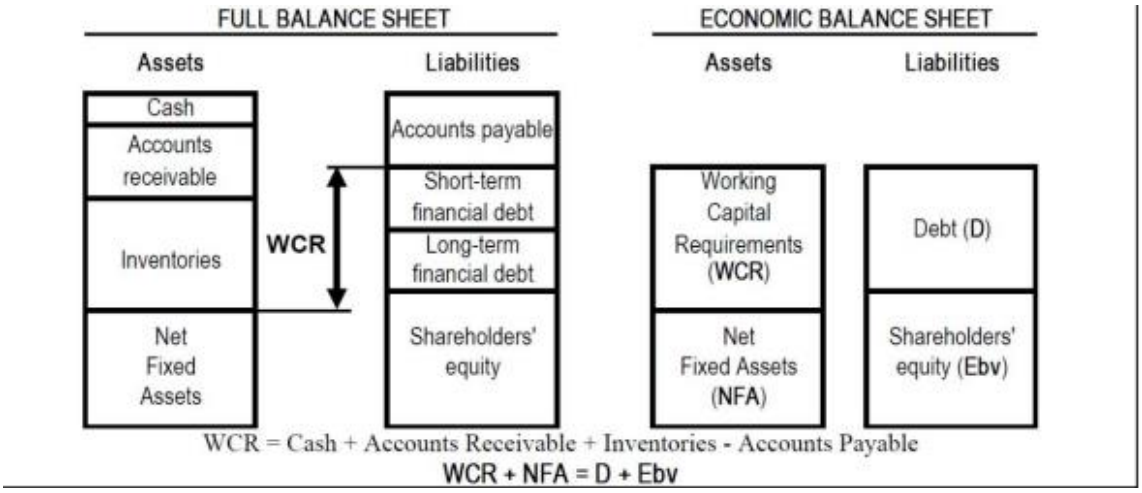

Figure 1 Full balance sheet and economic balance sheet (Adapted from Fenendez 2015)

2.5 Types of cash flow and appropriate discount rates

There is a variety of assets whose characteristics are distinct and particular, so as the cash flow attached to them. And accordingly, each type of cash flow contains different kinds of risk at different level. Therefore, in order to capture the risk inherent in each cash flow, there's much call for appropriate discount rates into which the risk can be translated correctly. The word "appropriate" is vital. Discount rate is the reflection of risk attached to the assets being valued, for this reason, any mistakes in choosing irrelevant discount rate for certain valuation can lead to significant error in the

valuation outcomes. According to Damodaran (1996), calculating the present value for equity by applying cost of capital will make the equity's present value higher than its true value. Otherwise, using cost of equity to calculate the present value of the firm will lead to lower value of the firm. Therefore, even though discounted cash flow valuation has many approaches to be used and they all yield relevant justifications, the above mismatching in calculation is a crucial error to avoid.

In a valuation article, Fenendez (2017) lists ten discounted cash flow approaches to value companies, each of which refers to different types of business cash flow generators and appropriate discount rates. On the other hand, Koller, Goedhart & Wessels (2010, 103-104) demonstrate a framework of discounted cash flow valuation consisting four types of model, which are enterprise discounted cash flow, discounted economic profit, adjusted present value, capital cash flow and equity cash flow. Meanwhile, Damodaran (2002) mainly investigates cash flow to equity and cash flow to the firm when categorizing discounted cash flow methods. Even though there is a wide range of cash flows that can be restated to value a company, there is still favor in some certain cash flows that can imply particular characteristics of a firm. The table below shows the three popular cash flows and their appropriate discount rates, which is adapted from Fenendez (2015):

CASH FLOWS	**APPROPRIATE DISCOUNT RATE**
Free cash flow (**FCF)**	Weighted average cost of capital (**WACC)**
Equity cash flow (**ECF)**	Required return to equity (**Ke)**
Debt cash flow (**CFd)**	Required return to debt (**Kd)**

Table 2 Cash flows and appropriate discount rates (Adapted from Fenendez 2015)

Further in this section, four noticeable types of cash flow, which imply particular characteristics of a firm, along with their appropriate discount rates are going to be well analyzed. The four cash flows and their discount rates are equity cash flow and required return to equity, debt cash flow and required return to debt, free cash flow and WACC, capital cash flow and WACC before tax respectively.

This thesis applies the discounted cash flow model to value thirty selected companies with their free cash flow and the discount rate WACC only because (1) the present value of future free cash flow is also called the enterprise value, which is suitable with the research objectives of finding the real value of the companies and (2) measuring too many cash flow types will make the result less condensed and make this paper

enormous, time-consuming and effort-consuming. Therefore, the author believes that the choice of only free cash flow discounted model is relevant and sufficient enough to reach the desired outcomes.

2.5.1 Debt cash flow (CFd) and required return to debt (Kd)

The debt cash flows (CFd) represent the streams of interest payment and the principal amount of loan that the company has to pay back to all the debt holders like lenders, bondholders or banks after a certain period of using to finance the firm. Because the company always has to pay interest beyond the principle amount of debt, it can be said that the loan taken today will rise tomorrow according to the relative interest payment. With the aim of determining the present value of the debt cash flows, the future flows of interest payment plus that of principle amount must be discounted back by the required return to debt or the cost of debt (Kd). Simply, the cost of debt (Kd) is the return that creditors demand on the firm's debt (Ross, Westerfield & Jordan 2010, 443). When the required return to debt is equal to the cost of debt, the restated debt cash flows are commonly found equivalent to the book value of debt. Therefore, using the book value is sufficient, there's no need to calculate the so-called market value or fundamental value of debt (Fenendez 2015.). According to McClure (2007), the cost of debt is commonly determined by applying the current market rate at which the firm is paying its debt. In case the company does not pay debts at market rates, an appropriate market rate payable by the enterprise should be estimated. Moreover, because the company takes advantage of the tax deduction available on interest paid, actually, the net cost of debt is equal the interest paid less tax savings from the tax-deductible interest payment. The formula to calculate the after-tax cost of debt, is as follow (ibid.):

$$\text{After} - \text{tax cost of debt} = \text{Kd} \times (1 - \text{corporate tax rate})$$

For example, company XYZ can borrow long-term at 10% and the corporate tax rate for the firm is 50%. The after-tax cost of debt for company XYZ is: $\text{After} - \text{tax cost of debt} = 0.1 \times (1 - 0.5) = 5\%$

2.5.2 Free cash flow (FCF) and WACC

The free cash flow has long been considered a useful technique to estimate and evaluate corporate performance. Among different variations, the free cash flow is commonly deprived from cash generated by operating activities less capital expenditure. Cash from operating activities can be found as the bottom line of the operating activities section of the firm's cash flow statement, meanwhile, cash spent

as capital expenditures is listed as an item in investing activities section (Ketz 2016). In the other words, the free cash flow is the operating cash flow, which is generated from the company's operation without consulting the impact of debt used to finance such operation. The free cash flow is the cash flow that is distributable to shareholders after covering working capital requirements (WCR) and reinvestments in fix-assets. Furthermore, the free cash flow must be an after-tax cash flow (Fenendez 2015). The free cash flow can be used to calculate the company's value, which is the market value of debt plus the market value of equity. Interestingly, calculating the future free cash flow is quite similar to calculating cash budget, that is, to measure the collection of cash inflows and the payment of cash outflows over a specific period of time so as to determine the sufficient amount of cash a business has on hand. Nevertheless, the difference between the two terms is that, with free cash flow, the time horizon to forecast the cash flow is usually longer than that used in normal cash budgeting process (ibid.). Saksonova (2009) has proposed the formula to estimate the free cash flow as follow:

Free cash flow to firm = Earnings before interest and tax (EBIT) – Taxes (corporate income tax and other taxes paid out of profit) + Depreciation + Reserves (reserves for bad debts) – Additional expenses – Changes in noncash working capital – Cash flow from investment operations

As can be seen from the above formula, the free cash flow is originally derived from the operating income in each period. It also doesn't take into account the interest payment because in free cash flow, the company is supposed to take no financial debt, and all the cash from its operation can come to shareholders.

In order to restate the estimated future free cash flows of firm back to present value, the discount rate called weighted average cost of capital (WACC) is commonly employed. As mentioned above, the free cash flow can be acquired in estimating the company's present value (D+E), therefore, the formula of the WACC used to restate the future free cash flow contains the company's biggest financial components, which are the debt (D) and the equity (E). The general formula of the weighted average cost of capital is as follow (Fenendez 2007):

$$WACC = \frac{E \times Ke + D \times Kd \times (1 - T)}{E + D}$$

in which:

E: the market value of the firm's equity

Ke: the required rate of return to equity

D: the market value of the firm's debt

Kd: the required rate of return to debt

T: corporate tax rate to firm

However, according to Fenendez (2017, 3), the E and D in the above formula are neither the market value nor the book value, instead, they are the value obtained by restating the equity to firm and debt to firm using DCF model. Therefore, it is considered that the valuation is an iterative process, that is, in order to get the present value of a firm, we need WACC, but so as to obtain WACC, we need to have the company's value (E+D)

2.5.3 Equity cash flow (ECF) and required return to equity (Ke)

The equity cash flows or the free cash flows to firm's equity is the residual cash flows distributable to shareholders after dealing with all expenses, reinvestment needs, tax obligations and net debt payments (interest, principal payments and new debt issuance) (Damodaran 2002). According to Alberro (2015, 689-698), the equity cash flow can be obtained by subtracting the interest payment and principal repayment and adding new debt issuance from the future free cash flow. In other words, the equity cash flows are the cash streams that pour directly to the pocket of the equity's holders from the cash of the company. The relationship between the free cash flow to firm (FCFF) and the free cash flow to equity (FCFE) can be described as followed (ibid.):

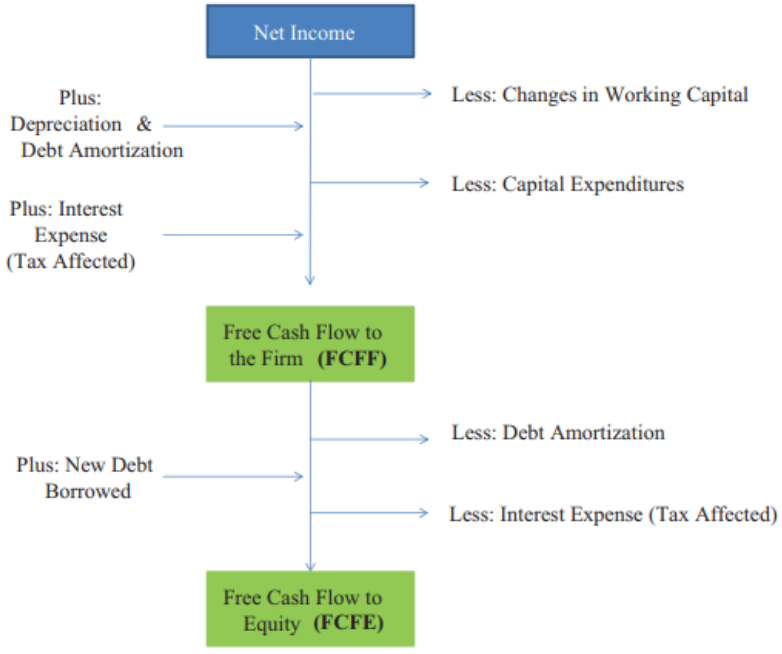

Figure 2 Free cash flow to equity (FCFE) (Adapted from Alberro 2015)

In order to achieve the present value of the free cash flow to equity, the flows must be discounted by the required rate of return to equity, or the cost of equity (Ke). Normally, the cost of equity (Ke) is obtained through the capital asset pricing model (CAPM), which would be investigated deeper in the next section.
As stated by Fenendez (2015,13), discounting the expected future cash flows to equity is the most suitable valuation methods among those in discounted cash flow valuation group because it assumes the company as a going concern and measures the capability of the company in generating cash flows to the equity's owners.

2.5.4 Capital cash flow (CCF) and WACC before-tax (WACCbt)

Another alternative discounting-based valuation method popularly used to value risky cash flows is the capital cash flow approach. In free cash flow valuation, interest tax shields are excluded from the free cash flow and the tax deductibility of interest is regarded as a decline in the cost of capital, hence the after-tax weighted cost of capital (WACC) is applied. Meanwhile, according to Ruback (2002, 85-103), capital cash flows cover all cash available to capital providers, also containing the interest tax shields. For this reason, it can be said that the capital cash flow equals the free cash flow to firm plus the interest tax shields. By combining the interest tax shields in the cash flow, the discount rate applied in capital cash flow valuation is before-tax weighted cost of capital (WACCbt) so as to capture the corresponding risk in the cash flows. Moreover, in the case that a capital structure only includes ordinary debt and common equity, the capital cash flow equals the free cash to firm's equity, which is calculated as net income plus depreciation minus capital expenditure and the rise in working capital (ibid.).

The cost of capital used to restate the capital cash flow is also the WACC, but the before-tax one, which is calculated as follow (Fenendez 2015):

$$WACCbt = \frac{E \times Ke + D \times Kd}{E + D}$$

It is worth noticing that there's a significant difference between capital cash flow and free cash flow, so there should not be any confusion between the two terms. The present value of capital cash flow represents the entire company's value (E+D), meanwhile, the present value of free cash flow indicates the value of the company

assuming that it has no financial debt (ibid.). The following formula describes the difference in numerical form:

$$FCF = CCF - Interest\ payment \times Corporate\ tax\ rate$$

The capital cash flow valuation considers that debt is proportional to value, therefore, the higher the value of the firm, the more debt it uses as a source of financing. Accordingly, the more debt, the higher the interest tax shields. The risk carried by the interest tax shields is therefore proportional to the risk inherent in the debt as well as the changes in the debt level (Ruback 2002, 85-103).

2.6 Forecasting future cash flow

Damodaran (2002, 5) stated in his valuation book that the problems within valuation process are not with the valuation models we use, though, but with the difficulties we face to make estimates for the future. Forecasting cash flow for the future is not an exception, in fact, this is one of the most important and complicated steps in valuation. There are two major parts in a typical cash flow forecasting process. In the first part, we need to examine the past growth of the company, and in the second section, we have to forecast the future flows based on the past growth cycle. The first part is considered easier to conduct because it is based on static historic data, accordingly, the results it derives also have fixed reliability. Meanwhile, forecasting the future cash flows has never been an easy task to do. There are three key issues that need to be taken into consideration seriously when forecasting cash flows. The first one is the length of the forecast period, the second is the forecasting cash flows in the chosen period and the last one is the terminal value.

Besides, Welsh & White (1975) considered that cash flow forecasting is required mostly in ventures that require rapid and substantial change, including common cases as follow: (a) producing and marketing a new line of product, (b) extend the existing business by the opening of other new locations and (c) launching or acquiring a supplementary business.

This thesis is going to forecast an eleven-year period from 2018 to 2028 of the selected companies. The author believes that this period is relevant as it is not too short to give bias for temporary growth or not too long to lower the reliability of

future expectation due to long time travel of money issue. Moreover, the historical eleven-year cycle from 2006 to 2017 is also highly relevant for data availability.

2.7 The limitations of DCF model

Although DCF has various usage and benefits and is considered the most ”conceptually” correct valuation approach, it is not a one-size-fits-all valuation model that can satisfy all demands in valuation or prevent all mistakes. Looking back at the general formula of discounted cash flow valuation, the two core variables used to calculate the present value of asset or firm are the expected future cash flows and the discount rate. In cases where the firm’s financial conditions can provide these variables with certain reliability, estimating present value of those firms using DCF method is in the easiest condition. In contrast, when such required measurement scales are missing or lack of reliability, the application of DCF in valuing present value can be less productive or even impossible to deploy. There are a variety of assets, but some assets can be valued easier than others, and valuation process may vary from case to case with different level of uncertainty and reliability (Damodaran 2002). The following situations are when valuing a firm using DCF approach requires extra considerations and supplementary methods according to Damodaran(1996):

- A firm is in troubles: when a firm faces many issues, it can lead to negative record in earnings and cash flows, hence, valuing these firms by discounting the estimated future cash flow back at the present value is quite troublesome as the future cash flow is hard to label since the firm’s default risk is high. Valuation is just effectively applied for firms as a going concern, therefore, it is important that the cash flow needs to be estimated until it can reach positive sign because valuation using negative cash flow would result in negative equity of the firm.
- A cyclical firm: Due to such characteristic, these kinds of firm usually generate volatile cash flows, the cash flow would go up when the economy booms, but it can also face significant decrease during recession period.
- Unutilized assets of a firm: as DCF covers the value of all assets that produce cash flow, the existence of unutilized assets (they do not generate cash flow) make it harder to find out the true present value of the firm as their value can be understated. However, the situation can be managed through obtaining these assets externally then add on to the obtained value from discounted cash flow valuation.

- Firms with patents or product options: even though patents, licenses and options are valuable, they do not generate cash flow at present time or in the near future. Again, valuing the firm through discounting the expected cash flow would understate the value the firm truly holds. And the solution to this is quite similar to that in the above scenario, it is to value these assets in the open market then add on them to the value obtained from DCF method.
- Firms that are restructuring: these firms usually may have many changes in assets, financing mix, dividend payout policy, management, which make it more difficult to estimate the future cash flow and the level of risk of the firm. Accordingly, valuing these firms may mislead the present value obtained.
- Firms involved in acquisitions: there are 2 major issues that need to be taken into consideration seriously. First, whether there is any chance of merger and whether the firm can still be valued in such situation. Second, the effect of changing in management may affect the nature of cash flow.
- Private firms: the risk parameters are measured primarily from historical data of the underlying assets. Since the stocks of private firms are not traded on the stock market, it is no possible to obtain such data. However, there's solution to this, first is to get the average risk scale from other comparable assets or firms, second is to measure risk through available accounting variables.

Moreover, the taste towards risk of the person who conducts the valuation process also makes great contribution to establish the risk proportion existing in an asset or a firm, which is also the discount rate in the DCF method. Normally, there are risk lover, risk neutral, risk adverse, but actually, in each mentioned types, the risk taste also diversifies from those who hate risk more or less to those that like risk more or less. For this reason, the outcomes are truly diversified, which makes the present value of a firm varies across different perspectives (ibid.)

Besides, Vernon Martin (1990) made the conclusion list of the common errors in discounted cash flow analyses that should be taken into consideration seriously to improve efficiency, as follow:

- The growth rates of income are mismatched with those of expenses, especially when they are compounded over time
- The shortage of lease-by-lease analyses in properties and with long-term lease
- Failure to regulate completely for rental concessions and failure to utilize sufficient market rents

- The rate at which percentage rental income rises is equal to that for sales growth
- Expenses recovery income and expenses in properties hindered by gross leases grow at the same pace
- Vacancy and collection losses are not in line with market conditions
- Expense categories are unable to capture all the existing costs
- Ending capitalization rates are lower compared to those at the beginning
- Underestimation of sales and closing costs
- Using inadequate discount rates

2.8 Capital asset pricing model (CAPM)

The core idea of the capital asset pricing model was first known in the "mean-variance model" or model of portfolio choice developed by Harry Markowitz in 1952. The model argued that investors are risk adverse and efficiently choose portfolio maximizing expected return given a specific level of variance. The CAPM extends the Markowitz model with more assumptions given by Jan Mossin, William Sharpe, Jack Treynor, and John Lintner (Brealey et al 2008, 214). By combining the model of Markowitz and new assumptions added, the general CAMP is based on the following assumptions (Elbannan 2015, 216-222):

- Investors are efficient and risk adverse, they always try to minimize the portfolio variance (the risk they have to take) and to maximize the expected return
- All investors are capable of borrowing or lending at risk-free rate
- The homogeneous expectations of investors: they share same estimation of distributions of future rates of return
- All investors hold investments for the same one-period of time
- Investors have the right to buy or sell parts of their shares of any securities or portfolio that they are holding
- In the case of purchasing or selling assets, there are no tax or transaction costs incurred
- There is no inflation or interest rate movements
- Investors make no contribution to affect the changes of price, the prices of all investments are fairly determined by the market mechanism

The general idea of CAPM is used to formulate the relationship between the expected return and potential risk hold by a certain security. The model indicates that the

expected return on a security can be calculated by multiplying the sum of risk-free rate and market risk premium with the market beta of that security plus the riskless rate. The formula of CAPM is (the components in the formula will be illuminated in the following sections):

$$Ri = Rf + \beta i \times (Rm - Rf)$$

in which:
Ri: expected return of security i
Rf: risk-free rate of return
β: Beta of security i
Rm: expected market return
Rm-Rf: market risk premium
From the above formula, we have $Ri - Rf = \beta i \times (Rm - Rf)$, which demonstrates that the excess return of security i over the risk-free rate is equal to the excess return of the market multiplied by the beta associated with i. The CAPM model clarifies investors' awareness of systematic risk, the risk incurred from the market's volatility and cannot be hedged through diversification, because investors calculate their expected return based on market beta and market risk premium. Therefore, the riskier a project is, the higher return investors demand to yield from it as they have to bear greater risk (ibid., 216)

The CAPM model has met various assessment, doubts, questions and attacks, resulted from the limitations of the assumptions on which it relies. Some of the limitations are the unrestricted risk-free borrowing and lending; heavy and sole focus on the one-period portfolio; volatility of risk-free rate and market return; the unlikeliness to borrow at risk-free rate; the uncertainty of expected risk premium and imprecise market beta usually lead to error in cost of equity; and so on. (ibid., 222)
According to Fenendez (2015,12), CAPM defines the required return to equity in the following term:

$$Ke = Rf + \beta * (Rm - Rf)$$

Therefore, given certain data of market beta (β), the risk-free rate (Rf) and market risk premium (Rm-Rf); CAPM model can help calculate the required rate of return to the firm's equity.

Furthermore, by comparing actual rate of return of a stock and the required rate of return to equity, we obtain the value of Jensen's alpha. This is equal to the actual rate of return minus the required rate of return. This value is helpful to assess whether the stock return has performed better or worse than market expectation. If the value of Jensen's alpha is negative, the stock has performed lower than expected and vice versa.

2.8.1 Beta (β)

The concept of beta, or the variation of an asset with the appropriate risk factors, has been considered a vital tool in financial economics. The application of the beta varies flexibly, it plays a significantly effective role in asset pricing, portfolio choice or risk management (Hollstein & Prokopczuk 2016, 1437-1466). In other words, market beta is a statistics method used to measure the volatility of a security or a portfolio compared to its market sector. The market beta represents the units of market risk or systematic risk of a single security of a portfolio. It informs investors of how a security's rate of return fluctuates according to the rate of market return. Beta is also well-known for its usefulness in demonstrating the stock's trading tendencies.
The formula of calculating market beta for security i is as follow (Fenendez 2015):

$$\beta i = \frac{Cov(Ri; Rm)}{Var(Rm)}$$

in which:
Cov (Ri;Rm): covariance between rate of return on security i with market rate of return, covariance only concerns with the strength of the relationship between the two term, it is not considered a statistical particularity primarily due to the easy mismatching in units.
Var (Rm): Variance of market rate of return
Nonetheless, the use of beta does not always work, hence there are other instruments have been put into the game so as to measure the usefulness of beta, which are (ibid.):

- R-squared: it is a statistical method used to verify the dependent of a security's rate of return on a market portfolio's, it is measured in percentage unit within

the value range from 0 to 100. The result of R-squared accounts for the portfolio risk coming from the market, while (1-R-squared) represents the portfolio risk acquired by the specific risk of the firm. The higher the R-squared is, the more useful the beta is.

- Correlation coefficient: it is an approach used to measure the degree of how the movement of two variables associates with one another. In the case of valuation, the two variables in use are the rate of return of a certain security or a portfolio and that of the market sector.

2.8.2 Risk-free rate of return (Rf)

The risk-free rate of return is commonly described as zero risk rate of return on an investment. It represents the minimum rate of return that an investor expects to get from an investment that theoretically contains no risk over a specific time frame (Boskovska 2013, 70-73). With a risk-free investment, investors are able to know the expected return at an exact level, in other words, risk-free assets always have actual return equal to the expected return. In order to be termed as risk-free investments, there are two basic conditions that need to be fulfilled (Damodaran 2002):

- There can be no default risk. Such condition easily eliminates small and private firms from the list of risk-free investment due to the insecure growth and high probability of default risk these businesses have. Even big and mature companies have some signals which can lead to bankruptcy. In this case, securities issued by the governments or the states, which are commonly treasury bills and treasury bonds, are supposed to have less default risk. It is because the governments control the printing of currency and they are more capable to keep their agreements. However, it is not one hundred percent sure that these securities bear no default risk since governments can also refuse to keep their words, they just do it better than corporates.
- There can be no reinvestment risk. This condition is commonly forgotten. When investing in a six-month treasury bill, we know that it’s default free, but it is not risk free because the treasury bill rate in six months is unknown. In this case, treasury bonds are considered to contain more risk than treasury bills because bonds have longer period of investments, and with longer time travel, higher chance of reinvestment is supposed to happen.

2.8.3 Market risk premium (Rm-Rf)

The market risk premium represents the excess return of market portfolio over the risk-free rate. In the CAPM risk and return model, market risk premium plays the significant role in addressing the premium that investors, on average, require over the risk free rate for an investment with average risk, for each factor. In other words, in CAPM model, while the beta measures the risk added on by a certain investment to the portfolio, the market risk premium implies what investors, on average, insist on the extra return by investing in that investment over the risk-free assets. The market risk premium is similar for a large subset or all investors in the same market sector since it is built based on available data of specific areas or market indexes. However, it is not to say that the market risk premium is a fixed number, in fact, it does observe various changes and require up-to-dated calculations regularly. Both expected market return and the risk free rate may suffer from fluctuation due to the volatility of the stock market and the probability of reinvestment. Therefore, the calculation of the market risk premium does not only show us the benchmark of the premium that investors require on average but also indicates the overview of each market price's reaction to the economic fluctuation over a period of time (Damodaran 2002, 217-218.)

2.9 Dividend discount model

Dividend discount model has been widely used in valuation for decades. Traditionally, the model is applied to estimate the attractiveness of a security relative to its universe, therefore, it is helpful for stock selection. Another less traditional usage of dividend discount model is to appraise the class of stocks, relative to bonds or cash (Einhorn & Shangquan 1984). Meanwhile, from the view point of Damodaran (2002), the dividend discount model is to value a company's equity based on the assumption that the value of stock is the present value of the expected dividend attached to it. The model is considered a specialized version to value a company's equity, where the value of equity is equal to the present value of dividends. In most cases, dividends are the only frequent flows that are distributed to shareholders, other flows are share buybacks and subscription rights. In other words, when one invests in a publicly listed company's stocks, dividends are the only cash flow he or she can receive from that firm, to say in the strictest sense. Besides the dividends to be received, the price of the stock at the end of the investment is also a highly expected cash flow for investors. Nevertheless, because the expected price is determined based on the growth of future

dividends, the value of stock is the present value of infinite dividends. The general formula of dividend discount model, adapted from Damodaran (2002, 450), is:

$$Value\ per\ share\ of\ stock = \sum_{t=1}^{t=\infty} \frac{E(DPSt)}{(1+Ke)^t}$$

in which:
DPSt: expected dividend per share
Ke: cost of equity

The four major versions of the discounted cash flow model, from the simplest to the most complicated, are the Gordon growth model, the two-stage dividend discount model, the H model for valuing growth and the three-stage dividend discount model. The Gordon growth model is used to value firms in stable state, that is, the company's dividends are growing at a sustainable rate. This is considered the simplest model used to value equity. Meanwhile, the two-stage dividend discount model assumes that the growth path of future dividends divides into two phases. In the initial phase, the company's dividends grow at different rate to the stable rate, in most cases, this rate is higher than the stable rate. After that, in the subsequent steady phase, the rate is stable and is expected to remain the same for a long-term. In addition, the H model for valuing growth is also a two-stage model for growth, but it is different from the classical version in the characteristics of the initial phase. In this period, the growth of dividends drops slightly and gradually reaches the stable rate in the second phase, instead of staying the same during the first time then change immediately like described in the previous model. Finally, the three-stage model is a combination of the two-stage and the H model for growth. It makes room for a high-rate period at the beginning, then an intermediate phase where growth goes down, and finally the long-term stable growth phase (ibid., 451-478)

With firms that pay more dividends as a proportion of their earnings, there is empirical evidence indicating that those companies are unable to produce growth in the share price. Instead of using the residual income to reinvest in new investments and to expand operation and potential growth, the company distribute it to shareholders as dividends, which understandably reduces its growth (Fenendez 2015,6). Therefore, valuing firm's equity using dividend discount model is considered outmoded with many analysts. They argue that the model, despite its simplicity and intuitive logic, does not imply useful valuation result. The model is just highly applicable to companies that have established dividends payout policies or those

where high dividends are pay frequently. According to Damodaran (2002, 479), the following issues are widely discussed to indicate whether dividend discount model is able to produce efficient outcomes:

- With companies that pay little or even no dividends, the value of its equity can still be obtained through dividend discount model as long as the dividend payout ratio is adjusted to reflect the changes in the expected growth rate. In contrast, if the adjustment cannot be made, the value of non-dividend paying or low-dividend paying stocks can be underestimated.
- The dividend discount model is considered to be a conservative valuation model as it concentrates primarily on the dividend payout. The model seems to take for granted other ”unutilized assets” such as brand name, patents, copyrights. Moreover, it also does not combine other ways of returning cash to shareholders such as stock buybacks or subscription rights. For this reason, the estimation of value obtained by this method is quite conservative.
- The dividend discount model is regarded as a contrarian model, that is, when the market rises, fewer and fewer stocks will be found undervalued using this model. In more details, if the market increase is based on fundamental parameters such as higher expected growth or lower interest rate, the value obtained also goes up equivalently. However, when the market rise without consulting the impact of fundamental issues, the values will not follow accordingly. That is, the model is giving hint that the market is overvalued and certain cautious attention should be paid.

2.10 Valuation using multiples

When it comes to valuation, we usually think about discounted cash flow model, however, in reality, most valuations are done with the help of financial multiples to comparable companies (Sehgal & Pandel 2010, 89-108). Fenendez (2017b) also gave evidence in his valuation book that multiples are more common used in valuation rather than discounted cash flow method. Cash flow discounting based valuation methods are ranked only fifth on the list of most popularly used valuation methods according to Morgan Stanley Dean Witter while multiples such as EV/EBITDA (enterprise value/earnings before interest and tax, depreciation and amortization) and PER (price to earnings ratio) are the most widely used valuation methods. Valuation using multiples is also referred to as comparable company valuation, guideline-

company valuation, relative valuation analysis and twin company approach (Holthausen & Zmijewsk 2012).

Multiples used to value a company need to somehow match with the valuation's situation, industry, business model and many other issues. There are multiples that are popularly used for some specific industries and business models, for example, price to book multiple is often used to value companies in paper and pulp industry, real estate and insurance industry; price to sales for internet companies, telecommunications infrastructure companies, bus and pharmacies companies; value to unit multiple suits soft drink and consumer products companies, to name just a few (Fenendez 2017). More matches between industries and most commonly used multiples in the relative industry can be found in the following figure (ibid.):

Industry	Sub-Sector	Most commonly used multiples
Automobiles	Manufactures	P/S
	Components	P/CE relative and P/S
Banks		P/BV
Base Materials	Paper	P/BV
	Chemicals	EV/EBITDA, EV/S, P/CE
	Metals & Mining	P/LFCF and EV/EBITDA
Building & Construction		P/LFCF, EV/FCF, PER and EV/EBITDA
Business Services		EV/EBITDA, ROCE, P/LFCF, PER and PER to growth
Capital Goods	Engineering	PER, EV/EBITDA and EV/S
	Defence	PER, EV/EBITDA and EV/S
Food, Drink & Tobacco	Food Producers	EV/EBITDA and EV/CE
	Brewers & Pubs	ROCE, PER to growth and PER relative
	Alcoholic Beverages	EV/EBITDA
	Tobacco	ROCE
Healthcare		PER, PER relative to S&P and EV/EBITDA
Insurance		P/AV
Leisure		EV/EBITDA
Media		PER relative and EV/EBITDA
Oil & Gas	Integrated	PER and EV/CE
Real Estate		P/FAD, EV/EBITDA and P/NAV
Retail & Consumer	Clothing	PER relative to market and sector, EV/EBITDA
Goods	Food	PER relative
	Luxury Goods	PER, PER to growth, EV/S and EV/E to EBITDA growth
Technology	Software, equipment & semiconductors	PER y PER relative
Telecoms		EV/E to EBITDA growth, EV/S and P/customer
Transport	Air	EV/EBITDA
	Travellers through road	P/S
Utilities		PER and P/CE

Table 3 Most commonly used multiples in different industries (Adapted from Fenendez 2017)

In multiples valuation, the value of a firm is inferred in regard to other comparable firms' value. Such consumption is based on the law of one price, that is, identical assets have identical prices (Serra & Fávero 2018, 1973-1992). Valuation using multiples, again, must accept the assumption that the market is correct in valuing companies in average scale, however, when it comes to more individual cases, the market usually fails to determine the real value of a single company. Thanks to such assumption, the value of assets are theoretically equal to the average market value of

other “comparable” assets in the same industry or sector. However, those people who believe that market makes mistake in valuing individual company, then make relevant decision of holding, buying or selling stocks according to such situation, ultimately, they must believe in another assumption that the market will then sooner or later fix its mistake to pull the market price back to the real value of the underlying asset. That is such a market mechanism investors usually take to gain profit. Accordingly, the argument that the market is completely inefficient is quite extreme (Damodaran 2000)

2.10.1 Types of multiples

There are various financial multiples used in valuation, each of which has particular function in order to make relevant contribution to build up the big picture of an asset’s value and of a firm’s financial health and potential growth. The denominators in most multiples used for valuation are purely accounting based, for example: earnings, sales, cash flow, book value; while inputs for the numerators consist more market factors such as share price, market capitalization and are based on the value of the enterprise or the firm’s equity. Most multiples usually mix the variables from both accounting statements and from the market information so as to acquire more efficient interpretation for the valuation (Holthausen & Zmijewsk 2012). The table below lists the most commonly used multiples according to Fenendez (2017):

Most commonly used multiples			
P/E, PER	Price earnings ratio	P/output	Price to output
P/CE	Price to cash earnings	EV/EBITDA	Enterprise value to EBITDA
P/S	Price to sales	EV/S	Enterprise to sales
P/LFCF	Price to levered free cash flow	EV/FCF	Enterprise value to book value
P/BV	Price to book value of the enterprise	PEG	Price earnings (PER) to growth
P/AV	Price to asset value	EV/EG	Enterprise value to EBITDA growth
P/Customer	Price to customer		
P/units	Price to units		

Table 4 Most commonly used multiples (Adapted from Fenendez 2017)

Fenendez (2017) classifies various multiples into 3 main groups, which are multiples based on the company's capitalization, multiples based on the company's value and growth-referenced multiples. The multiples in each group acquire relevant variables to fit the context implied in the relative group's name. For instance, common used multiples based on the company's capitalization are price to earnings, price to sales, price to book value; those based on the company's value are usually enterprise value to EBITDA, enterprise value to sales; finally, price earnings to growth and enterprise value to EBITDA growth are common in the third group of multiples. Besides, multiples which are also used to make relevant comparison in valuation are called relative multiples. Relative multiples are used to compare the financial condition and potential growth among companies, industries, with market or over a specific time frame. Therefore, their usage is sorted into three main categories, which are multiples with respect to the firm's history, with respect to the market and with respect to the industry (ibid.).

Even though there are various types of multiples introduced above, this thesis will exploit only price to earnings ratio to value the companies and to draw time series comparison to assess their performance growth from 2001 to 2017. The reasons are (1) price to earnings ratio is capable of capturing well the market performance of the company (the stock price) with its real performance in creating real value (the earnings), (2) this ratio's components are simple and easy to obtain from the chosen companies so the calculation process will be smoother and (3) applying too many multiples will be time-consuming, effort-consuming while making the result complex and less condensed.

2.10.2 The dispersion issue of multiples

Due to the volatile nature of the inputs of most multiples, most of them usually contain relatively high dispersion. To make it clearer, there are a huge amount of factors, both internal and external, can make great influence on the result of a multiple, such as business model, industry, country's policies on tax and interest rate, economic and society situation, customers' utility and so on. For examples, EBITDA used in most multiples has such limitation: first, it does not include the amount increased or decreased in the working capital requirements; second, it does not take into account capital investments (Fenendez, 2017). Besides, historic multiples valuation meet greatly affection from exogenous factors such as interest rates, stock market volatility along with the substantial change in firm's business model and

market position over time. Therefore, many people argue that using historic multiple valuation to compare the value of a business with its growth over the past time does not make much sense (ibid.) However, it is somehow very valuable to see how the growth of business affected by the external factors over time, it is to address the significant value creation and destruction of the firm over a certain period. For example, the technology companies have experienced a very tough time during the dotcom crisis 2000s, however, their growth path and evolution after the crisis is worth exploring and analyzing. Among groups of relative multiples as stated above, industry-referenced multiples are considered more helpful than the other two due to their practical support in addressing the real value of an asset based on other comparable ones in the same industry. However, those multiples have a rare but significant drawback, that is, when an industry is undervalued or overvalued, there will be a high probability that all the companies in that industry will be mis-valued the same way. Back to the example of the dotcom crisis 2000s, when the market mania turned towards the technology sector, especially the emerging internet mine, nearly all the internet-based companies at that time were overvalued with extremely high price to earnings ratio and market capitalization.

According to such relatively high dispersive characteristic, valuation using multiples meets lots of debate. Nevertheless, it is considered valuable in the second stage of valuation in order to make comparison among companies, industries or time comparison over the growth development of a business (ibid.)

2.11 Irrational exuberance

The adjective “rational” is commonly used in finance to describe financial decision-making process that yields optimal benefits to the individual. The decision must be based solely on relevant facts and available information without consulting the impact of emotional components. Accordingly, a rational investor do not pay for an asset more than its worth. However, such perception of rational behavior is hardly adopted completely and efficiently in every time and in every market (Rachlin 2003.). On the opposite site, irrational exuberance refers to the phenomenon that asset prices escalate much higher than its intrinsic value, which caused by over enthusiasm of irrational investors. Irrational exuberance is obviously considered a bad phenomenon because it makes room for bubble in asset prices. When the bubble bursts, economic recession appears and may damage the entire domestic or even global economy (Shiller 2000, 60-63.)

2.11.1 Speculative bubble

There are two schools of thoughts towards the determination of share's price. The first one includes those who believe that the price of shares on the stock market reflects rational future expectations and it is equal to the net present value of all expected future dividends, which is also the fundamental value. In other words, the share's price replicates the current earnings flows along with the growth expectations, and the main parameters influencing the price consist of interest rate, growth expectations, investing risks and so on. Meanwhile, the other group of hypothetical idea argues that the prices of shares mainly affected by the terms of psychological and sociological behaviors. It is that the share's prices do not derive from any rational rules, instead, they follow the state of optimism, pessimism driven by the financial community, economy and society at any given point of time. For instance, given the past evolution of the share's prices, if the investors' mood does not change frequently, psychological phenomenon will appear as ones will believe that the upcoming prices of shares will probably repeat the past's growth cycles. (Fenendez 2015)

The speculative bubble is a dilemma concept that can be built based on the fundamental analysis, and lies on the middle area between the two given theory groups. In more details, speculative bubble measures the degree to which the behavior and past evolution influence the share price over its fundamental value (ibid.). In the same discussion regarding the impact of psychological components on share price, Damodaran (2002) stated that it must be completely agreed that it is impossible to justify asset prices only by the argument that there will be other investors around willing to pay higher price in the future.

2.11.2 The 2000s technology crisis and the present technology bubble

Bagust (2017) stated that the way we do business today has been changing so fast, in 2030s, it can be said that the skill required in doing business cannot be imagined from today's perspectives. Even though the reliance on technology is predicted to be much higher, how technology would change business structure and our life is still unknown. During modern era, we have gone through some economic "revolutions" including Financial-agricultural revolution (1600–1740), Industrial revolution (1780–1840), Technical revolution (1870–1920), Scientific-technical revolution (1940–1970) and from 1975 until now is the time of information and telecommunications revolution

(Wikipedia). We did witness the dot com bubble during 2000s caused by great irrational exuberance. At that time, internet-based companies were a great euphoria for investors as they appeared to be a valuable opportunity to get rich in the age of online commerce. However, after the excited investors realized the unprofitability even in long-term of internet-based companies, the prices of those companies fell significantly to get back to more relevant level. After this event, we are now in the post-post crisis where technology are shaping its new empire, and this era with a much more rapid movement of technological change is referred to as a technological revolution (Schwab, 2015). The technological revolution we are in today is very different from other ones in the past, because its effect does not stop at changing the way we do thing, but it is changing us, changing our lives and the way we interact with the world. After the big crisis since 1997, 20 years later, people are again chasing towards technology and technology business despite the painful fact that it once devastated our economy. The reason behind is diversified, but the major one is that technology has gradually been an indispensable part in our life (ibib.)

When we look back at the dot com era, it was the time of the emerging internet was shaping its root into the economy and technology start-ups became a mania for investors, which made these companies' market capitalization and price to earnings ratio went very high above the justified market scale. But today, the technology revolution is happening along with various innovations, they are sprawling and implicitly waiting for a boom. However, because such innovations are hard to label, the present bubble is lack of a popular name (Sharma 2017). The term of internet of things, artificial intelligence, machine learning, cloud computing and many other technology innovations seem to not really impress many people these days as they are still not being applied really widely. However, the appearance of such innovations has created a big repercussion for technology area, which indicates that technology has truly been revolutionized, it is no longer just building the bolts and nuts of the internet like it was in 1990s, it is now trying to change us and the whole world completely. According to Forbes's most valuable brands list, 7 out of the top 10 are in technology sector. And it is said that Apple is very likely to become the first trillion-dollar company (ibid.)

According to the above signals, technology stocks are again increasingly popular to investors. However, the section of being super frenetic about these stocks like in 1990s has yet to come. Only some few internet giants are trading close to the dot

come crisis, where the average price-to-earnings ratio of this sector reached 50. These days, the average ratio for this sector is around 18. Thus, it is said that technology stocks are not too overvalued as it was. However, it is still of great importance to remember the last lessons from the 1990s crisis that market excitement will soon turn into manic phase when the stock price go too high above the underlying market scale. Nevertheless, as the recent technology boom has yet shown any transparent signs, the answer of whether it would turn into a big bubble and end up a crisis is still unknown (ibid.)

2.12 Hypotheses

Hypotheses are considered as tentative assumption, then as their compulsory nature, hypotheses have to be tested for logical and empirical consequences. The hypotheses are based on available data sources, previous similar findings so as to figure out possible trends, particularities, relationships and other clues over the research problem. Therefore, they should be specific and closely related to the research objectives and problems, it is also because they have to be tested. Hypotheses are helpful to set up a focal point for research. They allow the researcher to eliminate the area of research and keep her on the right track by drawing her attention to more important aspects of the problems. This current section addresses the two working hypotheses that are appropriate with the research problem, research objectives and the review of previous findings. Those are predictive statements and are going to be objectively tested by scientific techniques in later steps of the research conduction. Based on the review of literature, prior studies and researches, in one way or another, assume that there's always a likelihood that companies' stocks market price are drifting away from their natural value. Accordingly, such prices do not describe effectively the genuine accomplishment and the potential growth of the companies. Moreover, there seems to be a tendency of being overvalued for technology stocks because these stocks are considered popular and promisingly profitable with investors. Given such facts, the first hypothesis of this research is:
Hypothesis 1: Most sample technology companies are found currently trading at higher price compared to their intrinsic value. In other words, most technology stocks are being overvalued.

Moreover, even though during the technology crisis 2000s, most companies in technology sector were devastated adversely, technology revolution is now reaching

its empire era again and technology stocks are greatly profitable opportunities, the development of technology companies should have been going up correspondingly. Accordingly, the second hypothesis of this dissertation is as follow:
Hypothesis 2: Most sample technology companies have been growing strongly and sustainably from after the previous bubble burst in the beginning of 2000s until the present time.

3 Methodology

Research method includes all the methods or techniques that the researcher uses to conduct a research. In other words, it refers to all the methods or techniques that are used in the research operation so as to reach possible solution to certain research problems. Meanwhile, research methodology is a broader term, it is considered a systematic process to solve a research problem. In more detail, research methodology does not only address the research methods used for the conduction of research but also explains the scientific reasons behind the selection and application of those methods. Therefore, it helps to guarantee the relevance and reliability of information and to minimize bias (Kothari 2004, 7-8).

In this section of research methodology, the researcher presents all the research methods and techniques used in order to discover the research problem defined initially. Also, it gives relevant explanation about the appropriate effect of each selected research method on the research conduction. Moreover, it describes precisely how the research is planned and how it is conducted based on the research design. This section consists of these major issues: research design, research sampling, the sources and collection of data, data analysis. Generally, this research methodology section is a systematic, scientific and statistical research process employed to reach the objectives of this dissertation.

3.1 Research design

Kerlinger (1986) defines research design a grand plan needed before data collection and data analysis, it is used as a systematic guidance for these processes. In other words, it is a conceptual framework concerning arrangement of conditions, perceived strategies and approaches along with the relevance to research purpose in order to obtain answers for research questions or problem. Normally, for a better house construction, a blueprint (or a map of the house) well-prepared by architect experts is

needed in advance. Similarly, it is vital to have a research design carefully thought before data is collected, processed and analyzed so as to maximize available information and minimize effort, time and money (Kothari 2004, 32). Briefly stated, a research design must encompass at least these important features (ibid., 32):

- It is a plan specifying data sources, data types that are appropriate to the research problem
- It is a strategy defining approaches obtained for the collection and analysis of data
- It also well describes in advance the time and cost situation under which the study is conducted

According to Cooper and Schindler (2013), research design is defined differently based on different way it is perceived and applied for various different studies. Therefore, it can be said that there is no one-size-fits-all definition of research design. However, it is popularly agreed that a research design consists of the following common attributes: (a) a plan concerning all activities and timeline, (b) a research-question-based plan, (c) an arrangement of information sources and information types, (d) an outline of relationship between variables, (e) a blueprint for every step in research operation.

In order to build a research design, one faces the task of choosing a specific design to use, which must be relevant to the research problems and objectives. There's a wide range of different design classifications provided by different experts because no single classification is able to fulfill all the requirements of a standard research design defined previously. Cooper and Shindler (2013, 126-129) group research design into eight different classes, determined by eight separate dimensions of research scope, including: degree of research question crystallization, method of data collection, researcher control of variables, the purpose of the study, the time dimension, the topical scope, the research environment and participant's perceptual awareness. Among these groups, the purpose of the study is considered one of the most popular categories. Various studies are listed in this group, namely reporting study, descriptive study, casual-explanatory or casual-predictive study. Kothari (2004) also splits several research designs to different groups recognized by the purpose of study. But the three study's purposes are defined not similarly, in this case, they are distinguished as exploratory study, descriptive and diagnostic study, hypothesis-testing study, which is also termed experimental study. Meanwhile, partially agreed with the previous view,

Sauder, Lewis and Thornhill (2009) classify the research purpose into three dimensions as follow: exploratory study, descriptive study and explanatory study. They also imply an interesting point that a study can have more than one purpose, for example, a study can be both exploratory study and descriptive study, and the purpose can even change over time. (138-141)

Even though the definition towards the purpose of study varies across experts, this research is conducted with both exploratory and descriptive purpose. As stated by K. Singh (2007, 62-67), exploratory study focuses mainly on exploring the research topic with vast scope when the problem's background is ambiguous. Subsequently, it does not aim at offering concrete solution or answers to problems. Instead, the study tries to fulfill these major requirements: (a) to explore the problem through different angles, (b) to make the researcher familiar with the nature of the problem that has not been clearly defined yet, (c) to better understanding of the problem in support of more effective conclusive researches and (d) to be a pioneer in exploring a fresh problem. Due to such characteristics, an exploratory study allows room for flexibility and changeability in research. This thesis aspires to learn about the relationship between the present technology stock market in the US with the technology stock bubble in 2000s. Though, this research does not aim at presenting any exact answers or solution to the problem. Alternatively, according to the research questions specified initially, it studies the intrinsic value of sample US technology firms and the financial development progress of them since the previous technology bubble burst in 2001 by identifying financial multiples. Thanks to the result of this research, there will be a valuable foundation for more conclusive researches indicating specific solution to the research problem. Through reviewing previous findings, the researcher acknowledges that there have not been any similar studies to this one. The term valuation is commonly used for valuing enterprises in special cases like IPO and revised bankruptcy while this study focuses on fundamental value of technology firms in the US. Moreover, when it comes to the technology bubble in 2000s, most researchers concentrate on behavioral finance when studying this issue. In lieu, this research employs quantitative financial techniques (DCF model, dividend discount model, financial multiples) to brighten the companies' background serving for further conclusive researches. For these reasons, this study is considered one of the first papers addressing such research questions set in the previous section. Meanwhile, Kothari (2004, 37) describes descriptive research are those specifying the

characteristics inherent in a particular individual or a group. This type of study requires the researcher to know clearly what he/she wants to measure with specific predictions and facts. Therefore, sufficient measuring techniques, clear population and well-planed procedure are highly expected and accordingly, the design is rigid so as to minimize bias and maximize reliability. As mentioned above, this research aims to expound these characteristics of the sample US technology companies: the firms' intrinsic value and their financial development progress since the technology crisis 2000s. In order to obtain the results for these issues, adequate financial methods are utilized, they are expected to provide exact and unbiased outcomes. In conclusion, this research does not only deal with exposing particular features of the US technology enterprises, but it also demonstrates a foundation serving for further researches into the precise relationship between the present technology stock market in the US with the technology crisis in 2000s. For these reasons, this research is completely relevant for both exploratory and descriptive study.

Besides, there are two basic approaches to research: qualitative and quantitative approach. According to Surbhi (2016), qualitative research is acquired to obtain in-depth understanding of human attitudes, behaviors, feelings, experiences, intentions and motivations through observation and interpretation. This approach gives more weight to participants' point of view and the researcher's subjective assessment, insights and impressions. Such approach is popular in social science area, it generates non-quantitative data, data in verbal form like spoken or written data. Commonly-used techniques for this type of research are focus group interview, grounded theory, case study and ethnography. On the other hand, quantitative research deals with natural sciences and focuses on reaching exact result with the help of adequate measurement techniques. It involves quantitative data generation, formal and rigid data analysis. Conducting quantitative research usually relies on working with numerical data, coding, statistical and mathematical methods (Sauder et al 2009, 482-485). The difference between these two approaches is controversial, however, they are obviously distinguishable.

Although quantitative research and qualitative research are distinctive in nature, it is possible that a single study can make use of both approaches so as to investigate research problem more comprehensively and effectively. Such technique is termed mixed-method approach or multi-method approach. Greener (2008, 36) reckons the major reason behind the phenomenon of increasing business researches combining

these two methods is ”triangulation”, where different methods of data collection and data analysis will both ameliorate and reinforce the background of research problem. Meanwhile, Creswell and Plano Clark (2011) explain the situations where multi-method approach is applicable are: (a) there is a contradiction between quantitative results and qualitative findings, (b) one data source is not sufficient, (c) initial results require further explanation to be more comprehensive, (d) a second method is needed to improve the first one and (e) the project has multi-phases.

This table below indicates some major different characteristics between qualitative research and quantitative research according to the viewpoint of Johnson and Christensen (2014):

Criteria	Qualitative research	Quantitative research
Purpose	To understand and interpret social interactions	To test hypotheses, look at cause & effect, and make predictions
Group studied	Smaller & not randomly selected	Larger & randomly selected
Variables	Study the whole, not variables	Specific variables studied
Type of data collected	Words, images or objects	Numbers and statistics
Form of data collected	Open-ended responses, interviews, participant observations, field notes and reflections	Data based on precise measurements using structured and validated data collection instruments
Type of data analysis	Identify patterns, features, themes	Identify statistical relationships
Most common research objectives	Explore, discover & construct	Describe, explain & predict
Focus	Wide-angle lens; examine the length and depth of topic	Narrow-angle lens, test a very specific topic
Result	Findings that are more generalized and directional	Findings that are projectable over population base

Table 5 Qualitative research and Quantitative research (Adapted from Johnson, B. & Christensen, L. 2014)

After reviewing the above common attributes of each approach and considering the merits and demerits of using each method, the researcher believes that this research is most apposite to quantitative approach because it possesses the following characteristics which are in accordance with that of a standard quantitative research but are in contrast with that of qualitative approach:

- The research utilizes specific and exact measurements to value companies in rigid fashion
- Data used is mostly numerical data collected from balance sheets, income statements, cash flows and historical market prices of the companies' stocks. Data is from accounting sources, therefore, data is reliable, unbiased, static and unchanged
- Microsoft Excel is acquired as a statistical tool to organize, analyze and process data
- This study gives more weight on the researcher's viewpoint rather than the participants'
- The relationship between the researcher and the participating companies are distant rather than close

3.2 Sampling design

Sampling design is a crucial part before data collection and data analysis. Theoretically, data sampling is a statistical approach used to collect, filter and investigate a representative subset in order to figure out the general tendencies and patterns inherent in the whole population. This is a definite plan concerning the number of items to be collected, the size of the sample and the techniques or procedure adopted to select samples. (Kothari 2004, 55-56). All the items to be studied in an inquiry constitute a "population', they are what the researcher truly wants to study and what the sample is expected to reflect. Obviously, there are many cases that the researcher is unable to examine every single item in a population due to its significance. The task of studying the whole population requires substantial effort, time and money, so it is not logical and is even impossible. In fact, such situation is prevalent as even in small scale researches such as school projects or retail store management, digging into every elements of a population brings about considerable tasks (Cooper and Shindler 2009). For example, in order to investigate consumers' reaction towards the new chocolate bar, the store manager may interview certain number of consumers on some specific days because she is unable to fully interact

with hundred people coming on a daily basic. After that, based on interview results, she can make relevant interpretation and infer it to all available customers of the store, that is, if there is 75% “like” responses from the interviewees, it can be inferred that about 75% consumers are interested in the new chocolate bar. For these reasons, it is obvious that sampling plays a vital part in doing research, it helps enhance the quality of data collection and data analysis and also reduce effort, time and money (ibid.)

It is no doubt that a larger sample can reflect the population better as it embraces the population more comprehensively. However, a well-designed sampling is not less able to do so. There are many approaches to sample data, falling into two big categories: probability and non-probability sample. According to Sauder et al (2009), with probability sampling, sample selection is based on mathematical calculation so that the chance of cases being selected is known and is usually equal for all cases. Probability sampling is helpful for answering questions and reaching objectives that require inferring statistical characteristics of the population from the sample. Therefore, it is commonly associated with survey and experimental researches. However, such technique takes much time and effort mainly because the researcher is unable to reach out to all potential elements of a population. Probability sampling category includes these common sampling techniques: simple random, systematic, stratified random and cluster sampling. Meanwhile, for non-probability sampling, the probability of each element being selected from a total population is not known. This sample is also unable to solve research questions that require making statistical inferences about the characteristics of a population. It may be helpful to address generalized characteristics inferred from the sample for a population, but not at statistical level. This category provides various sampling techniques that allow selecting samples based on the researcher’s subjective opinion, which are quota, purposive, snowball, self-reflection and convenience sampling. The chart below describes an overview about the sampling categories along with their common techniques (Sauder et al 2009, 213):

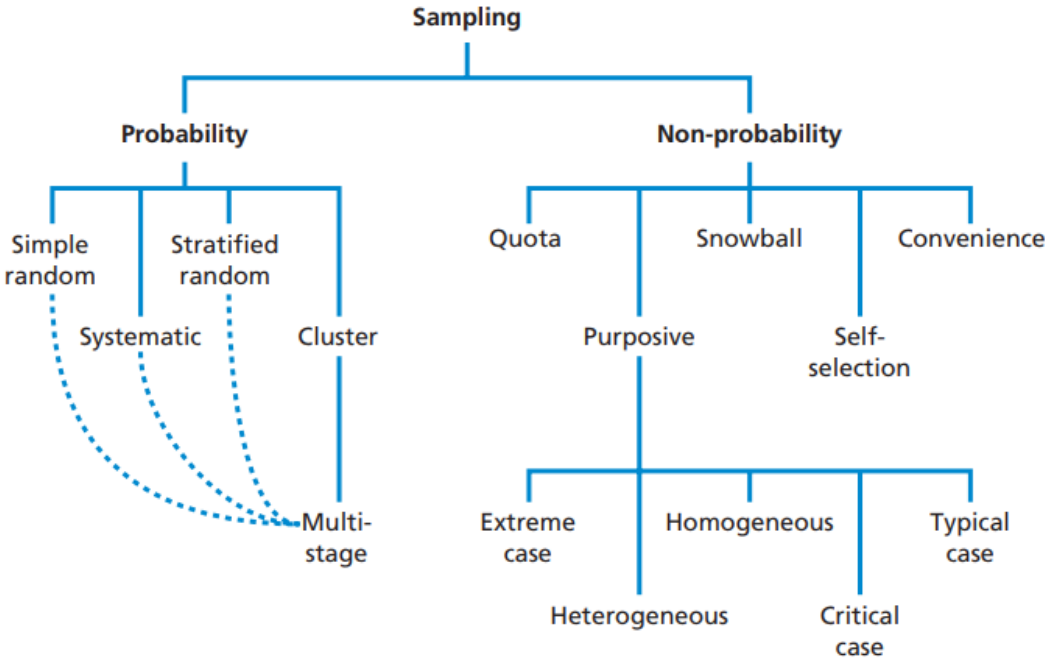

Figure 3 Sampling categories (Adapted from Sauder, Lewis and Thornhill 2009)

This dissertation attempts to study the relationship between the present technology stock market in the US with the technology bubble 2000s. This research problem is going to be clarified with the following objectives: (a) to study the intrinsic value of US technology firms to specify whether they are undervalued or overvalued, (b) to observe the financial development of the US technology companies since the technology crisis 2000s with the help of financial multiples. With such objectives, the population, or the universe, to be studied in this research is the technology companies in the US. According to a government website called Selectusa, there were more than 100000 software and internet companies in the US in 2015. This is obviously a significant amount, therefore, the researcher is totally unable to reach out to all available American technology companies and this bachelor thesis will become an enormous work that takes ages to complete. For such reason, choosing relevant sampling techniques for those listed enterprises is an essential step in conducting this thesis, which helps guarantee the outcomes' quality without causing pressure of limited resources, time and effort. In this research, sampling technique used is non-probability sampling because the selection of sample is mainly based on the researcher's subjective judgement. More specifically, the exact sampling method employed is purposive or judgmental sampling. Purposive sampling allows the researcher to use her judgement to select cases that best enables her to answer the research questions and to reach the objectives of research. This form of sample is

suitable for working with very small samples but it can still satisfy certain criteria to clarify the research questions and objectives (Sauder et el 2009). According to the objective of valuing US technology firms and describing their financial development through the spectrum of financial multiples, historical financial data of sample companies published in their balance sheet, income statements, cash flow statement and market indexes from 2001 to 2017 are obviously required. The time frame from 2001 to 2017 is chosen because this research aims to observe the development path of the sample companies since the technology bubble burst in 2001 until the present time where data of 2017 is the most updated one. For such reason, companies founded after 2001 or out of business are not relevant. In other words, qualified sample companies are those who satisfy these criteria:

- They have operated publicly before the technology bubble burst in 2001 so that they have experienced the technology crisis 2000s time
- They must be going concerns at the present time and have not involved in any merger and acquisition recently.

In consequence, the researcher randomly selected thirty US technology companies that fit mentioned description. Due to the largeness of the required operation period, companies selected are mainly biggest US technology firms whose domination have rooted into the US economy in particular and in the global economy in general. That can be considered a favoring point because biggest firms usually possess most updated technology that makes great contribution to the present technology revolution. Many other technology enterprises in one way or another may follow the footprint of the tycoons, therefore, the inference made from such sample companies can be effective at higher percent. The name list of the thirty selected publicly traded companies along with their trade code on NASDAQ index is as follow:

1. Activision Blizzard Inc. (ATVI)
2. Adobe system incorporated (ADBE)
3. Amazon.com Inc. (AMZN)
4. American Software Inc. (AMSWA)
5. Ansys Inc. (ANSS)
6. Apple Inc. (AAPL)
7. Autodesk Inc. (ADSK)
8. Cadence Design Systems Inc. (CDNS)
9. Cerner Corporation (CERN)

10. Cisco system Inc. (CSCO)
11. Citrix Systems Inc. (CTXS)
12. Cognizant Technology Solutions Corporation (CTSH)
13. Electronic arts (EA)
14. Intel corporation (INTC)
15. International business machine corporation (IBM)
16. Intuit Inc. (INTU)
17. Lam Research (LRCX)
18. Micron technology Inc. (MU)
19. Microsoft Corporation (MSFT)
20. NCR Corporation (NCR)
21. Nuance Communications Inc. (NUAN)
22. Nvidia Corporation (NVDA)
23. Oracle corporation (ORCL)
24. Qualcomm Inc. (QCOM)
25. Red Hat Inc. (RHT)
26. Symantec Corporation (SYMC)
27. Synopsys Inc. (SNPS)
28. Western Digital Corporation (WDC)
29. Xerox Corporation (XRX)
30. Xilinx Inc. (XLNX)

3.3 The sources and collection of data

From the point of view of Cooper and Shindler (2009), data are the facts that the study's environment tells the researcher. Data can be characterized into different categories based on their abstractness, verifiability, elusiveness and closeness to the phenomenon. The attribute of closeness to the phenomenon reflects the truthfulness level of data and also distinguishes the major difference between primary data and secondary data. Primary data are data that are collected for a specific research purpose on hand, the procedure used to collect such data must fit the research purpose best. Primary data are both collected and used by the collector. After being collected, they are added to the existing stock of social knowledge. The later use of such data will be considered as using secondary data. In more detail, secondary data are collected previously by other researchers for different research problems. However, they are accessible to later researchers through various channels such as official statistics,

administrative records or organizational public reports (Hox & Boeije 2005, 593-596). As mentioned above, the procedure of primary data collection must be well designed so as to best fit the specific research problem, therefore, the use of primary data in a research is tailor-made and highly appropriate. On the other hand, using secondary data brings about various problematic characteristics due to the fact that they are initially collected for different research purpose from that of the present researcher. For this reason, when collecting secondary data, researchers have to bear in mind the following major points: (a) they must actively locate relevant data sources for their own research problem, (b) they have to make sure that the data are accessible and (c) they have to ensure whether the available data can meet the quality requirements of the current research and the methodological standard of scientific practice (ibid.). Moreover, the differences between primary data and secondary data are diverse in terms of collection time, collection cost, data sources and collection process. (Surbhi, 2016). The table below indicates basic comparison between the two types of data (ibid.):

Basic for comparison	Primary data	Secondary data
Meaning	Primary data refers to the first hand data gathered by the researcher himself	Secondary data means data collected by someone else earlier
Data	Real time data	Past data
Process	Very involved	Quick and easy
Source	Surveys, observations, experiments. Questionnaire, personal interview.	Government publications. Websites, books, journal articles, internal records
Cost effectiveness	Expensive	Economical
Collection time	Long	Short
Specific	Always specific to the researcher's needs	May or may not be specific to the researcher's need
Available in	Crude form	Refined form
Accuracy and reliability	More	Relatively less

Table 6 Primary data and Secondary data (Adapted from Surbhi 2016)

As mentioned previously in the last section, data used in this research mostly comes from the sample companies' income statement, balance sheet and cash flow statement. Moreover, the market price of companies' stock and that of NASDAQ index throughout the chosen time frame are also collected. Due to the nature of such data, they are all publicly available. Obviously, it is not possible for the researcher to conduct interviews, questionnaires or surveys to collect such data directly from the companies. Therefore, the use of primary is not relevant while secondary data that is available, accessible and efficient is the best choice for data collection in this dissertation. Furthermore, if the author can have private access to companies' information before the public, according to the law of insider trading in corporate finance, such access is considered illegal. That is, when one can have information before the public, he or she can take unfair advantages of trading and investing. Besides, in order to obtain the data, there are various available sources where the data is available. They are Yahoo! Finance, Annualreports, World Bank, multpl, Selectusa. As each website has its pros and cons, the combination of them support the data collection better and smoother.

3.4 Data analysis

Overall, there are approximately 179510 pieces of data that has been used for this dissertation. Among these, around 510 pieces of data are from thirty companies' financial statements including income statement, balance sheet and cash flow statement over the 12-year period from 2006 to 2017. These data are collected from http://www.annualreports.com/ or directly from the firms' official website. The following information will make it clearer for readers regarding data type and the exact origin of data:

- From income statement, six types of data are in use: revenue, earnings before interest and taxes (EBIT), net income, income tax expense, interest expense, basic earnings per share.
- From balance sheet, seven types of data are collected: cash and cash equivalent, current asset, operating current asset, long-term debt, current liabilities, total debt, non-cash working capital.
- From cash flow statement, three types of data are used: depreciation and amortization, free cash flow, changes in non-cash working capital.

Besides, daily market data from 2001 to 2017 are also collected. Historical daily trading price from 03/01/2007 to 29/12/2017 of thirty companies and that of

NASDAQ index are collected so as to calculate companies' daily rate of return, companies' annualized rate of return, market daily rate of return, market annualized rate of return, market beta and market risk premium. Such data are gained from Yahoo! Finance https://finance.yahoo.com/. Also, the use of companies' market capitalization in 2017 (thirty pieces of data) collected from Macro Trend https://www.macrotrends.net/ , the US risk free rate in 2017 of 2.43% obtained from https://www.multpl.com/10-year-treasury-rate/table/by-year and the US corporate tax in 2017 of 35% provided by Deloitte are also included in measuring the companies' cost of equity and WACC.

When calculating the enterprise value of the companies using discounted cash flow model, the researcher utilizes Microsoft Excel to generate data. The data used are (1) imported ones that can be obtained directly from financial statements or market data and (2) calculated ones that cannot be gained anywhere but require calculation. The imported set of data for DCF model is as follow:

- There are 720 pieces of EBIT (earnings before interest and taxes) and income taxes data of each company from 2006 to 2017 founded in companies' income statement
- There are 1440 pieces of data of cash & cash equivalents, current asset, long-term debt, current liabilities of each company from 2006 to 2017 provided by companies' balance sheet
- There are 30 pieces of interest expense in 2017 of all companies
- There are 360 pieces of depreciation and amortization data of each company from 2006 to 2017 obtained from firms' cash flow statement
- There are 83070 pieces of historical daily return from 3/1/2007 to 29/12/2017 of all companies gained from Yahoo! Finance
- There are 2769 pieces of historical daily return from 3/1/2007 to 29/12/2017 of NASDAQ index gained from Yahoo! Finance
- There are 30 pieces of data of companies' market capitalization in 2017 collected from Macro Trend https://www.macrotrends.net/
- The US risk free rate in 2017 of 2.43% obtained from https://www.multpl.com/10-year-treasury-rate/table/by-year
- The US corporate tax rate in 2017 of 35% provided by Deloitte

On the other hand, the following data requires appropriate calculation to obtain sufficient inputs for discounted cash flow model measuring the present value of 11-year future free cash flow of the enterprises (the formulas is applied for the year 2007 to 2017 except operating current asset and non-cash working capital from 2006 to 2017):

- $Operating\ current\ asset = Total\ current\ asset - Cash\ \&\ cash\ equivalent$
- $Non - cash\ working\ capital = Operating\ current\ asset - Total\ current\ liabilities$
- $Changes\ in\ non - cash\ working\ capital = Non - cash\ working\ capital\ of\ current\ year - Non - cash\ working\ capital\ of\ previous\ year$
- $Total\ debt = Long - term\ debt + Total\ current\ liabilities$
- $Free\ cash\ flow = EBIT - Income\ taxes + Depreciation\ \&\ amortization - Changes\ in\ non - cash\ working\ capital$
- $Free\ cash\ flow\ growth\ rate = \frac{Free\ cash\ flow\ of\ current\ year - Free\ cash\ flow\ of\ previous\ year}{Free\ cash\ flow\ of\ previous\ year}$
- $Estimated\ free\ cash\ flow\ growth\ rate = Average\ of\ free\ cash\ flow\ growth\ rate\ each\ year\ over\ the\ period$
- $Company's\ daily\ stock\ return = \frac{Today\ stock\ price - Previous\ day\ stock\ price}{Previous\ day\ stock\ price}$
- $Company's\ annualized\ stock\ return = (Company's\ average\ daily\ return + 1)^{250} - 1$
- $NASDAQ's\ daily\ stock\ return = \frac{Today\ stock\ price - Previous\ day\ stock\ price}{Previous\ day\ stock\ price}$
- $NASDAQ's\ annualized\ stock\ return = (NASDAQ's\ average\ dailly\ return + 1)^{250} - 1$

With these inputs, the calculation process to get the present value of estimated future free cash flow of companies is as follow:

- Estimating future free cash flow from 2018 to 2028: Estimated free cash flow of one year = Estimated free cash flow of the previous year * (1+estimated free cash flow growth rate)

- Calculating market beta for each company case (thirty pieces of data) based on the set of daily historical stock price from 3/1/2007 to 29/12/2017 of the companies and that of NASDAQ index
- Cost of equity = US risk-free rate 2017 + Company's corresponding beta * (NASDAQ annualized rate of return – US risk-free rate of return 2017)
- $Cost\ of\ debt = \frac{Interest\ expense}{Total\ debt}$
- $Cost\ of\ debt\ after-tax = \frac{Interest\ expense \times (1 - US\ corporate\ tax\ rate\ 2017)}{Total\ \text{debt}}$
- $\text{Equity weighting} = \frac{\text{Market capitalization}}{\text{Market capitalization+Total debt}}$
- $\text{Debt weighting} = \frac{\text{Total debt}}{\text{Market capitalization+Total debt}}$
- Discount rate WACC = Cost of equity * Equity weighting + Cost of debt after-tax * Debt weighting
- Discounting estimated future free cash flow from 2018 to 2028 to the present value in 2017: $\text{Present value} = \frac{\text{Estimated future free cash flow of year t}}{(1+\text{WACC})^{t}}$. In this formular, the value of t is natural number, ranging from 1 to 11, which is equal to the year from 2018 to 2028 in the forecasted period
- The total present value of estimated future free cash flow equals the sum of present value of estimated future free cash flow of each year from 2018 to 2028. This is also the enterprise value of each company and is the final number to be obtained in discounted cash flow model

Regarding calculating price to earnings ratio of the companies since the previous technology bubble burst in 2001 until 2017, the below data are imported:

- There are 510 pieces of data of basic earnings per share from 2001 to 2017 founded in income statements of the companies
- There are 510 pieces of data of closing price in the last trading day of the year from 2001 to 2017 of the companies obtained from Yahoo! Finance

The price to earnings ratio in each year of each company is calculated by getting the basic earnings per share of the year divided by the closing price at the end of the same year. The formula is as follow: $\text{Price to earnings ratio} = \frac{\text{Basic earnings per share}}{\text{Closing price per share}}$

4 Results

This section demonstrates all the findings of this dissertation regarding (1) the enterprise value of all thirty companies in the selected list by applying discounted cash flow valuation model, (2) the performance growth of those companies since the technology bubble burst in 2001 until 2017 with the help of price to earnings ratio and (3) the researcher's assessment and recommendation of investing strategy for the sample companies. This section combines two parts: first is the result for the present value of estimated eleven-year future free cash flow of the selected companies, second is the performance growth from 2001 to 2017 of the selected companies indicated by price-to-earnings ratio value. The purpose of this section is to display transparently all the findings of the thesis to the readers and to give relevant answer to the research questions properly.

Due to large amount of companies, in this section, the research mentions the companies in their symbol as traded on NASDAQ index instead of their full name in order to make it easier and clearer for presentation. Furthermore, all the data in tables and charts in the first section are in million dollars as they refer to companies' value. In some cases, because of the long period chosen to assess the companies, from 2001 to 2017, and of the volatile nature of the firms; the calculation result is obtained by eliminating some existing outliers whose value is very higher or very lower than other variables. The elimination of outliers is mainly in calculating the average free cash flow growth rate, which will be explained clearer in the first part and in the calculation of price to earnings ratio over the period of the companies presented in the second part of the section.

4.1 The present value of estimated eleven-year future free cash flow of the selected companies

The present value of the future free cash flow is gained with the help of discounted cash flow model. The researcher collected relevant historical data of EBIT, income tax, depreciation & amortization, cash & cash equivalent, current asset and current liabilities, which are from income statement, balance sheet and cash flow statement of the companies, to calculate historical free cash flow in the past eleven years, from 2007 to 2017. Based on such data, the researcher calculated the average growth rate of

historical free cash flow and applied that rate to estimate future free cash flow for the next eleven-year period, from 2018 to 2028. Moreover, the historical share price of each company obtained from the stock market from 2007 to 2017 and that of NASDAQ index, where the selected companies are traded, are collected to calculate the market beta, companies' annualized return, NASDAQ's annualized return Combining these result with the risk free rate in the US in 2017 of 2.43%, the inputs to calculate the firms' cost of equity are all available. Then, along with the US's corporate tax rate of 35% in 2017, the firms' market capitalization, cost of debt; the discount rate WACC of each company can be calculated. The WACC is used as appropriate discount rate to calculate the present value of the estimated future free cash flow mentioned above. That is, the estimated free cash flow in the next eleven year, from 2018 to 2028 is discounted by the appropriate discount rate to the present value of 2017. Such present value is the enterprise value of the companies obtained with the help of discounted cash flow valuation model. The enterprise value is then compared with the market value of the companies for the same fiscal year 2017. The market value is calculated by getting the market capitalization from the stock market plus total debt obtained from the company's balance sheet. If the enterprise value is higher than the market value, the companies are considered undervalued by the market and vice versa.

The table below describes the calculation result for companies whose total present value of estimated eleven-year future free cash flow is higher than the market value. The companies whose enterprise value is higher than market value in the below table include: AMSWA, AMZN, ATVI, CERN, CTSH, CTXS, INTU, MSFT, MU, NUAN, ORCL, QCOM, SNPS, WDC, XLNX. As the enterprise value obtained from estimated future free cash flow is higher than the market value, the ratio of enterprise value/market value, whose result is displayed on the right column of the table, is higher than one. Based on the comparison of the present value of estimated future free cash flow of these companies and their market value, these companies in the table are considered undervalued. While the companies are able to generate large amount of cash flow in the forecasted future, the market underrated them with lower value compared to the free cash flow attached to them.

Company symbol	Market capitalization	Total debt	Market value = market capitalization + total debt	Enterprise value = present value of future free cash flow	Enterprise value/ Market value
AMSWA	340	42,737.00	43,077.00	350,379.50	8.13
AMZN	576,550.00	82,626.00	659,176.00	958,804.60	1.45
ATVI	48,250.00	8,053.00	56,303.00	59,233.47	1.05
CERN	22,780.00	1,304.60	24,084.60	99,455.66	4.13
CTSH	41,690.00	3,537.00	45,227.00	112,651.40	2.49
CTXS	13,640.00	3,805.00	17,445.00	19,583.83	1.12
INTU	40,570.00	2,382.00	42,952.00	1,271,521.00	29.6
MSFT	7,270.44	140,564.00	147,834.40	2,832,594.00	19.16
MU	50,910.00	15,206.00	66,116.00	829,733.30	12.55
NUAN	4,840.00	3,352.80	8,192.80	9,477.99	1.16
ORCL	190,300.00	72,290.00	262,590.00	407,259.20	1.55
QCOM	89,050.00	30,305.00	119,355.00	575,504.50	4.82
SNPS	12,740.00	1,748.00	14,488.00	14,917.67	1.03
WDC	22,750.00	17,262.00	40,012.00	90,089.20	2.25
XLNX	16,750.00	1,852.50	18,602.50	319,028.70	17.15

Table 7 Results of undervalued companies

The chart below demonstrates the graphical display of comparison among the companies who are considered undervalued by the market. Because the market value and enterprise value of company MSFT are much higher compare to that of other companies in the table, including this company's value in the chart makes the result less condensed and unclear. Therefore, the chart does not include the case of MSFT as outlier.

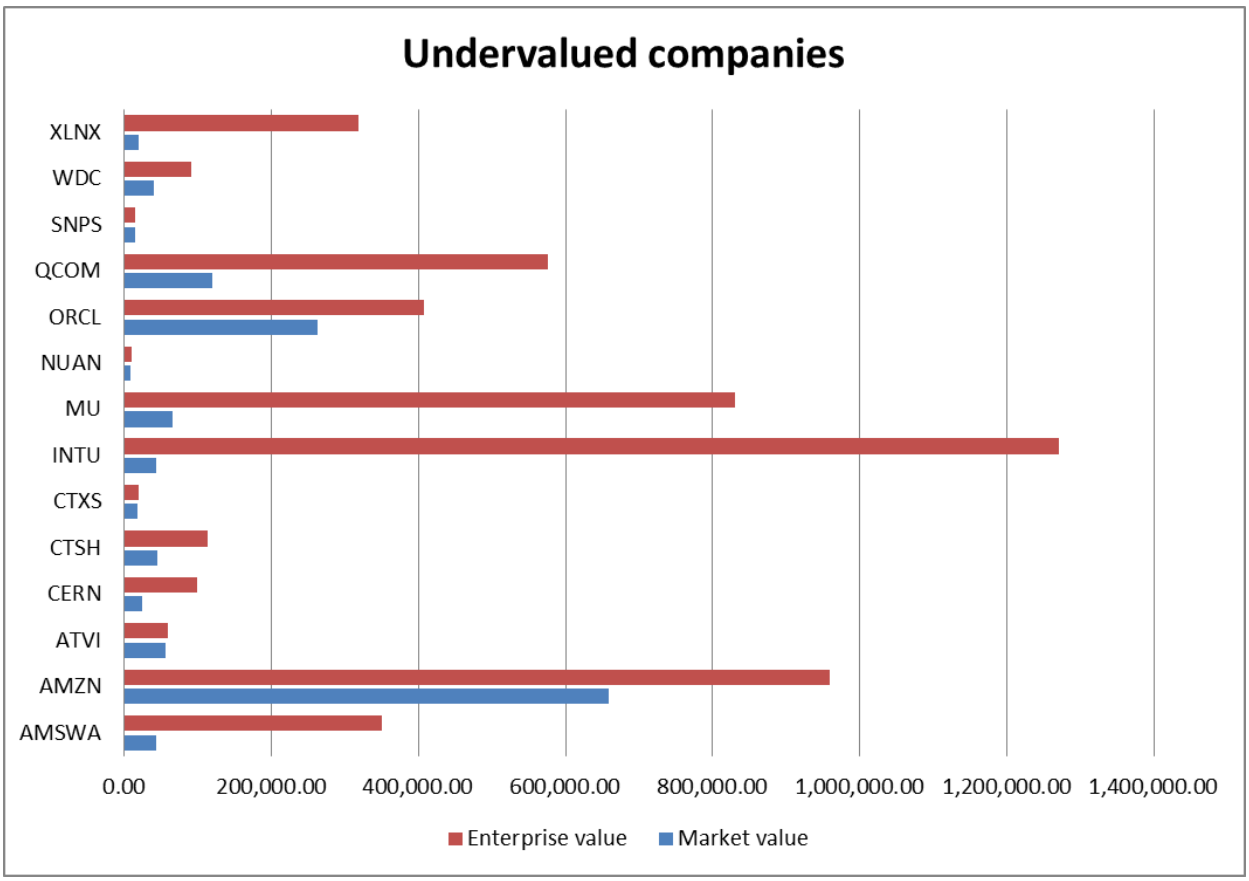

Figure 4 Undervalued companies comparison

The chart indicates clearly that there are companies whose enterprise value is very high above the market scale. For example, the case of INTU company, its enterprise value is 1271521 million dollars, while the market value of the firm is only 42952 million dollar, which makes the intrinsic value of the company almost 30 times higher than what the market assesses its value. The company is forecasted to generate large amount of free cash flow in the next eleven year, the present value of such cash flow is also very high as indicated. However, the market underrates such high performance and high profitability potential. Such undervaluation can cause the anxiety for the firms' board of executives as their stock is trading at lower price in the stock market despite the firm's healthy financial position in the forecasted future. Irrational investors who purchase stocks by following the market mania and the irrational exuberance tend to not purchase stocks whose price are declining. Meanwhile, rational investors make decision based on fundamentals considering the firm's current financial position and expectation for future development will not do the same. They appreciate the firm's performance, therefore, with such good performance of generating large cash flow in the future despite lower market price, rational investors still invest confidently in these undervalued firms in the list. However, not all

investors are rational. In order to maintain the firm's image with investors, it is better that the companies communicate closely and transparently with its stakeholders to relieve them with financial fundamentals demonstrating that the firm is going well and profit is secured.

The table below demonstrates the intrinsic value calculated by discounted cash flow model of the companies whose present value of future free cash flow is lower than the market value. These companies include: ADBE, ADSK, ANSS, CDNS, EA, IBM, INTC, LRCX, NCR, NVDA, RHT, SYMC, AAPL, CSCO, XRX. On the contrary to the case of undervalued companies mentioned above, these companies in the below table are overvalued by the market. That is, the stock price of these companies is still getting very high on the stock market even though the estimated free cash flow generated by them in the forecasted future is not high enough to be in line with such high price. Because the present value of future free cash flow gained from discounted cash flow model is lower that the market value of the firms, the result of enterprise value/market value ratio is lower than one.

Company symbol	Market capitalization	Total debt	Market value = Market capitalization + total debt	Enterprise value = present value of future free cash flow	Intrinsic value/ Market value
ADBE	87,520.00	5,408.00	92,928.00	59,957.07	0.65
ADSK	17,930.00	2,123.20	20,053.20	76.90	0.00
ANSS	12,820.00	609.00	13,429.00	4,988.97	0.37
CDNS	11,720.00	1,286.00	13,006.00	1,467.78	0.11
EA	32,360.00	2,415.00	34,775.00	6,552.88	0.19
IBM	135,950.00	77,200.00	213,150.00	170,287.58	0.80
INTC	216,370.00	42,458.00	258,828.00	106,799.80	0.41
LRCX	29,010.00	2,950.10	31,960.10	6.63	0.00
NCR	4,320.00	4,828.00	9,148.00	349.04	0.04
NVDA	121,830.00	3,138.00	124,968.00	-121.88	0.00
RHT	22,170.00	1,891.00	24,061.00	330.54	0.01
SYMC	18,410.00	11,498.00	29,908.00	385.90	0.01
AAPL	856,280.00	198,021.00	1,054,301.00	997,833.59	0.95
CSCO	181,570.00	53,307.00	234,877.00	174,813.09	0.74
XRX	7,120.00	7,976.00	15,096.00	10,963.40	0.73

Table 8 Results of overvalued companies

The table shows that the case of company NVDA has present value of future free cash flow in negative value, which means in the forecasted future, this company may not

just have downturn in profit but also experience dramatic loss. In fact, the enterprise value of company NVDA is significant low of minus 121.88 million dollars due to various free cash outflow in the past eleven years. Compared to other companies in the list, the market value of 1,054,301.00 million dollars the enterprise value of 997,833.59 million dollars of company APPL is significantly higher, therefore, it is considered an outlier in drawing chart for better graphical comparison among firms. The bar chart below displays the comparison of market value and enterprise value of overvalued companies among thirty companies in the selected list except the case of company APPL as outlier.

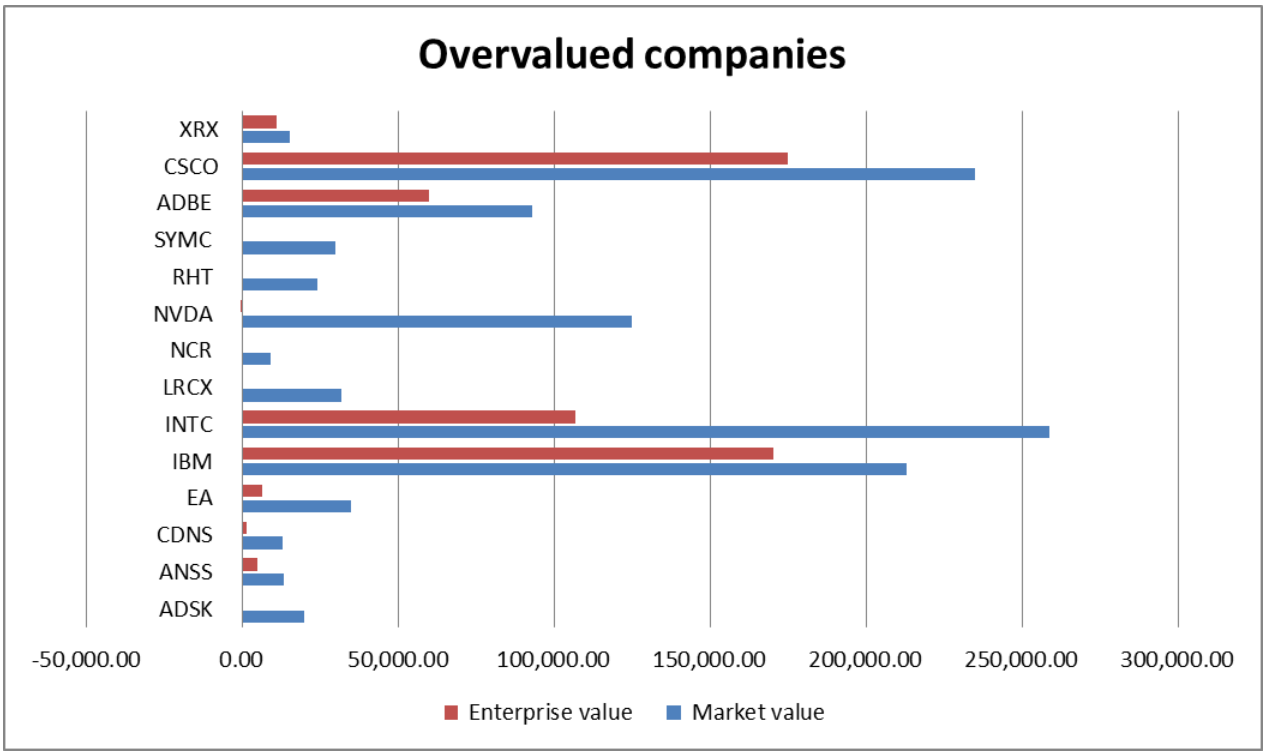

Figure 5 Overvalued companies comparison

The bar graph above indicates that there are various companies whose intrinsic value of the enterprise is not even half of the value that the market attaches to them. In fact, these companies are the majority in the list. Along with the case of APPL indicated before, the three giants in today technology industry, IBM, CSCO and INTC, are dramatically highly rated by the market compared to others in the list. The three companies have enormously large market capitalization of 135950, 181570 and 216370 million dollars successively and also tremendously high market value of 213150, 234877 and 258828 million dollars successively. In spite of this, the real value of the companies achieved by discounting the future free cash flow is still lower than such market's assessment. The case of INTC, the enterprise real value is just

nearly half of the market value. The overvaluation of these companies in the table list may be the result of irrational exuberance. That is, enthusiasm of irrational investors encourages them to buy stock that is trading at higher price compared to its fundamental value. In contrast, rational investors will not pay for stocks at price higher than its worth, therefore, such overvalued companies are commonly not desired investing potentials to them. Nonetheless, it is not to say that these companies are not potential for investing or that they are in unhealthy financial position. The overvalued companies are still generating large amount of free cash flow in the forecasted future and based on their historical data, their income is stable and level of profitability are secured. However, if the company's growth cannot be in line with its market price in a long run, market excitement will be lower down as investors are discouraged by the profit lower than expected. Such situation can lead to significant drop in the stock price once investors decide to sell the stock or not to buy more of them. In order to prevent the undervalued firms from such events, the companies' board of executives should firstly, allocate and utilize available resources of the firms effectively and efficiently to improve the companies' performance and enhance profit level; and secondly, maintain close and transparent communication with stakeholders to ensure them about the companies' strategies and profitable operations. The worst result of highly overvalued companies is that they will drop their price dramatically and bring about stock crisis that affects the economy. However, it does not mean that overvalued companies always lead to such bad situation, the overvaluation is mostly encouraged by high market excitement and the firm's or the industry's reputation. These overvalued enterprises are in good financial position within generating large income, their higher market value than intrinsic value can be considered as the perk of being popular or the perk of having dominance in the market.

Nonetheless, there are company cases that bring noticeable anxiety of unhealthy investment. For example, company ADSK, LRCX, RHT, SYMC and NVDA have enterprise value/ market value ratio just around 0.01 or lower, which means that the natural value of these companies obtained from discounting future free cash flow is just around one percent of its value being traded on the stock market. Such observation shows the extreme in being overvalued of those companies. In fact, the case of company NVDA even gets negative value in fundamental value as disclosed previously. These companies mostly experienced low and unstable income or even loss throughout the period, which leads to low or negative historical free cash flow

that results in low or negative flow accordingly in the forecasted future. Therefore, when investing in these companies' stock, investors should consider carefully as their financial health is not in really good position as reflected in low fundamental value.

4.2 The performance growth from 2001 to 2017 of the selected companies indicated by price-to-earnings ratio value

Price-to-earnings ratio is one of the most common used ratios to assess a company performance throughout a historical time frame or to evaluate whether a company's stock is currently undervalued or overvalued. The principle is to compare the price per share with the earnings per share to see how much income an investors can earn by buying a share or how much dollar an investor has to pay for a share to earn one dollar profit of the company's stock. The higher the value of the ratio, the more possible chance the company's stock is being overvalued and vice versa. That is because the market price investors have to pay for the stock is so much higher than what they can benefit from. However, as the price per share is commonly higher than the earnings per share, the ratio only cannot determine if the stock is overvalued or undervalued. Therefore, the average price to earnings ratio of the corresponding industry is usually applied as benchmark for stock valuation. As mentioned before in the literature review, the market, on average, can value the stock rightly, hence, it is relevant to use the industry average as benchmark for stock comparison and valuation. That is, if the price to earnings ratio of a company is higher than the industry ratio, its stock is considered overvalued and vice versa.

The result regarding price to earnings ratio value of the selected companies will be enormous to be presented in individual cases. Therefore, so as to prevent complexity and to make it easier for readers to follow the empirical findings, the result will be displayed in three main parts as follow:

- The average price to earnings ratio of industry: based on the historical price to earnings ratio of each company over the chosen period, the average price to earnings ratio of these companies will be calculated for each year from 2001 to 2017. Because the chosen companies in the list are all large US technology enterprises, they obviously have common attributes and they can draw major characteristics of the population of US technology firms as indicated in "sampling design" section. Therefore, the average price to earnings ratio of

these companies can be considered the value of the industry and can be applied as benchmark for relevant comparisons among these enterprises.

- Average price to earnings ratio by company: this part is helpful to measure the differences among companies over the period
- Price to earnings ratio in 2017: this part compares the result of price to earnings ratio of each company in 2017 with the average ratio in the same fiscal year. This result can be used to assess whether a stock is undervalued if its price to earnings ratio is lower the industry average or it is overvalued if its ratio is higher the industry average for the current time, the year of 2017

The line graph below describes the average price to earnings ratio of the industry calculated by getting the average price to earnings ratio (PE ratio) of the companies in each year during the 17-year period, from 2001 to 2017.

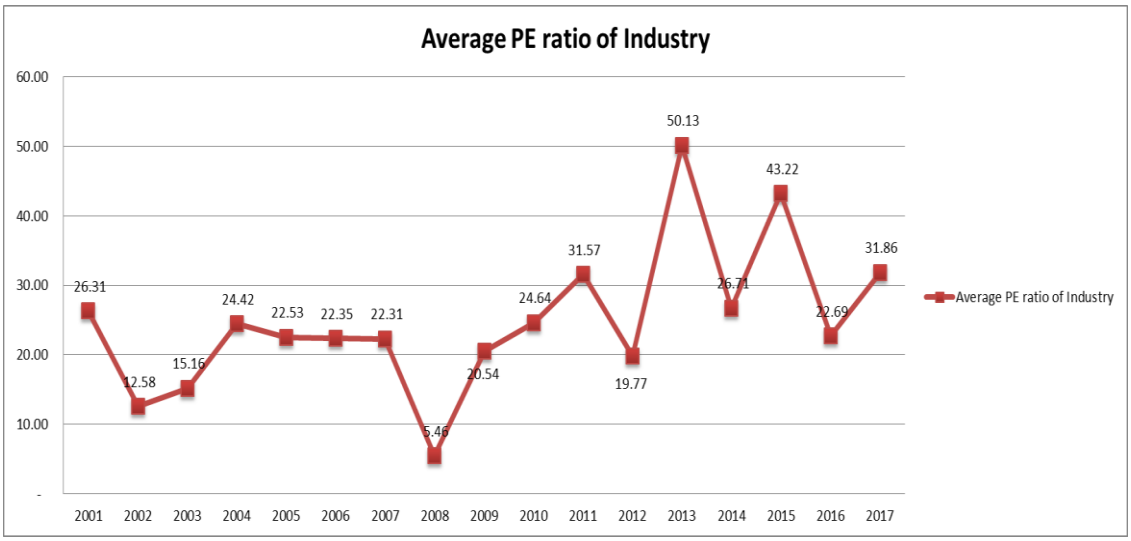

Figure 6 Average price to earnings ratio of industry

The graph shows clearly that the average price to earnings ratio of the industry reached the bottom line of 5.48 in 2008 and the peak of 50.13 in 2013. The significant downturn in 2008 can be explained by the housing crisis in the US in the same year, which affected the economy adversely so that stock price of most companies dropped dramatically. The value of 50.13 in 2013 is noticeable as it demonstrates the similar condition as in the technology bubble 1990s where technology stock was also traded with very high average price to earnings ratio of around 50 (Sharma 2017). After a significant decrease in 2002, the average price to earnings ratio of the technology industry in the US rose strongly and experienced stable phase from 2004 to 2007 before the dramatic drop in 2008. From 2012 to 2017, the result shows that it has been

fluctuating strongly, which implies the unstable performance of the companies in the list. The result of average price to earnings ratio of the industry throughout the time can somehow reflects the performance of the thirty companies in the selected list, whose performance moved in quite the same trend as described in the chart.

The following chart describes the average price to earnings ratio throughout the period from 2001 to 2017 of each among all thirty companies in the selected list. As indicated clearly in the bar chart, the average price to earnings ratio of company NUAN is the only case that has negative value, which is the result of successive loss in income over the chosen time frame that leads to negative earnings per share. Moreover, the case of XRX also gets very low result of average price to earnings ratio of only 0.99. On the contrary, AMZN has the highest average price to earnings ratio up to 125.46 during the time thanks to its stably high income and large market value as indicated in the previous section. Meanwhile, other companies' result fluctuates lightly from ten to sixty.

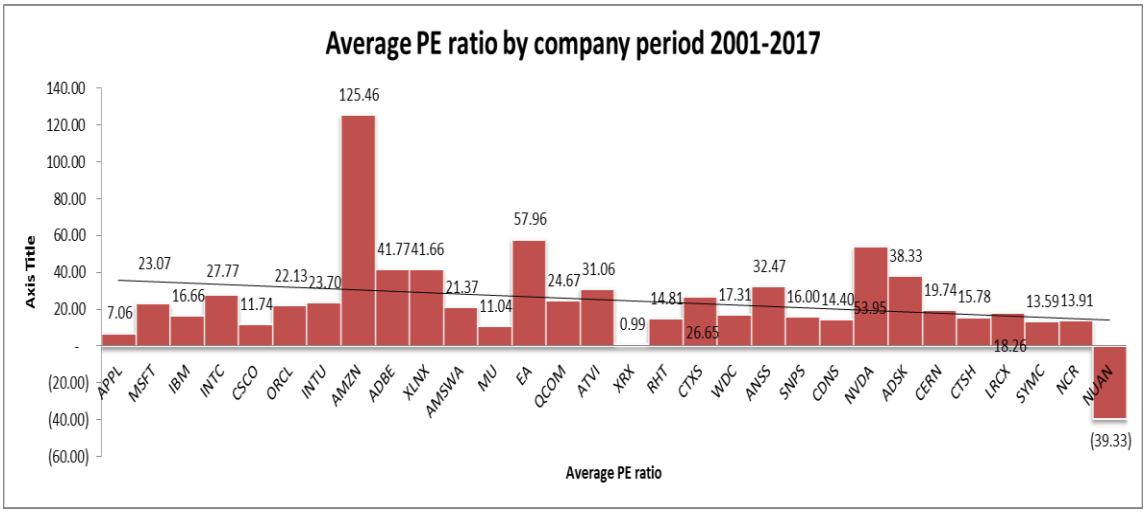

Figure 7 Average price to earnings ratio by company from 2001 to 2017

The following graph demonstrates the comparison between each company's price to earnings ratio and the industry average for the current fiscal year, 2017. It is helpful to indicate if the company's stock is overvalued or undervalued. It is undervalued if its price to earnings ratio is lower than the industry average benchmark or if the blue line is under the red line and vice versa. However, the ratio of company CTXS is significantly low with negative value, adding this value will make the chart unclear to present relevantly seeable comparison among enterprises. Therefore, the value of price to earnings ratio in 2017 of company CTXS is not included in the graph below or in the calculation of average industry price to earnings ratio 2017. The average price to

earnings ratio of the technology industry in the US in 2017 is 31.86, hence, the companies whose result is lower that this number are considered undervalued. They are: APPL, MSFT, IBM, INTC, CSCO, ORCL, XLXN, AMSWA, XRX, RHT, ADSK, CERN, CTSH, LRCX, SYMC and NUAN. Meanwhile, the list of overvalued companies includes: INTU, AMZN, ADBE, MU, EA, QCOM, ATVI, WDC, ANSS, SNSP, CDNS, NVDA and NCR. Such valuation based on price to earnings ratio is quite different from that obtained with the help of discounting cash flow method presented in the previous section because in this valuation method, because, the intrinsic value of the companies lies mainly in the amount of income they can earn while free cash flow including various other financial components is considered in discounted cash flow model.

Figure 8 Price to earnings ratio in 2017

The graph indicates that, in the year of 2017, the price to earnings ratio of 185.04 of AMZN is the highest among companies and nearly six times higher than industry average. It coincides with the result in the previous chart, which demonstrates that AMZN's price to earnings ratio has also been at the highest level over the historical time frame. The second higher player is ATVI with the result of 175.89. In contrast, SYMC has the poorest price to earnings ratio in 2017, which is only minus 165.06.

In conclusion, the use of price to earnings ratio can somehow indicates that since the previous technology bubble burst in 2001 till 2017, the performance growth of the

selected companies' stock has been quite unstable. The performance gap between the companies is also very large as there are companies possessing very high results while some others bear very low and unhealthy indicators. However, as the ratio only concerns the relationship between stock price and earnings, it cannot capture all the inherent risk as well as growth potentials of the companies. Nevertheless, such findings is helpful to those appreciate countable monetary income when investing in these companies' stock.

5 Conclusion

This part demonstrates the wrap-up of most important insights of this dissertation so that readers can have better and clearer final impression on the research. This part includes two sections, which are (1) key findings of the thesis and (2) limitations and recommendation. The first section illustrates the summary of core findings to answer the research questions. Meanwhile, the second section aims to point out the existing reservations in doing research as well as relevant recommendation for future research regarding the research scope.

5.1 Key findings of the thesis

This thesis aimed to figure out the real value of US technology companies in the context of the technology crisis 2000s and the financial performance of these companies from 2001 to 2017. This dissertation uses the combination of both exploratory and descriptive research design, secondary data and quantitative research approach so as to answer the research questions properly. By investigating the intrinsic value of thirty biggest technology companies in the US, the research found that fifteen companies including AMSWA, AMZN, ATVI, CERN, CTSH, CTXS, INTU, MSFT, MU, NUAN, ORCL, QCOM, SNPS, WDC, XLNX are undervalued while the other fifteen companies including ADBE, ADSK, ANSS, CDNS, EA, IBM, INTC, LRCX, NCR, NVDA, RHT, SYMC, AAPL, CSCO, XRX are overvalued by the market. Such result implies the fact that there is always a high probability that companies are being traded at different prices compared to its natural value. In response to the research question of companies' performance growth from 2001 to 2017, this thesis applied price-to-earnings ratio to demonstrate time-series comparison of sample companies and of companies' average over the chosen time frame and comparison of sample companies in 2017. The result shows that the price at which

the companies' stocks are being traded does affect the companies' financial health indicated by price-to-earnings ratio directly. When the companies' stocks are trading at much higher price level than the equilibrium value, their price-to-earnings ratios also get higher correspondingly, which means that only the price of the stocks accelerates while the companies' ability to generate profit shown by earnings remains the same. Moreover, most undervalued or overvalued companies determined by discounted cash flow model are found also undervalued or overvalued when applying price-to-earnings ratio and comparing with the industry average ratio. That is, the intrinsic value of the companies is also in line with its performance.

5.2 Limitations and recommendation

Even though the researcher designed and conducted the thesis in the most possibly proper way, there are still some existing constraints that affecting the research result. Concerning companies choice, there should have been much more sample companies to be studied in order to obtain better outcomes. Because the thesis aims at addressing the intrinsic value of US technology companies and the financial growth of companies in technology sector since the technology crisis 2000s, such objectives are large at an industrial and national scale, it requires a large number of companies to be analyzed so that the result would be more convincing and exact. However, this thesis will be an enormous work consuming lots of time and effort if analyzing a large amount of companies. Therefore, the researcher chose thirty biggest companies by market capitalization in the technology sector that qualifies for certain requirements of the research methodology to conduct the research. It doesn't mean that the company choice is not relevant and just a temporary plan, it just cannot illustrate the analysis as well as a bigger company population can.

Regarding performance growth of sample companies, although price-to-earnings ratio is the most commonly used ratio to measure financial health of companies, the application of only this metric cannot efficiently capture all the inherent risk as well as the potential growth of the sample companies. This ratio only is helpful to bear the relationship between the stock price with monetary benefit of the stock-earnings, hence, it just builds up a small part of the big picture of the companies' performance. Instead, the combination of more metrics should have been applied so as to gain better insights in companies' financial position over the time frame.

In conducting discounted free cash flow model to determine the companies' present value, there are various inherent limitations. First, historical data used to estimate future free cash flow is not really optimal as old performance is not always able to bear good prediction for future development of companies. In some cases, the present value of the company has negative value since in previous years, the company's structure of earnings and spending was not balanced when the company made huge reinvestment in new technology, innovation or corporate management. That is, even though in the past, the company's indicators bore negative value, but they are probably not a sign of unhealthy development but a preparation for future development. Therefore, using entirely such negative historical value that led to negative present value of some companies cannot result in most appropriate outcomes. Instead, some of the outliners in negative historical value should have been eliminated when forecasting future free cash flow to reduce bias and better the result. Second, the time period of eleven years used to forecasting future free cash flow is relatively short to actually capture the real present value of the sample companies. Because the chosen companies are largest by market capitalization in technology sector in the US, they are also considered healthy going-concerns, which means their operations are supposed to last for a very long period of time. A much longer period of time should have been applied so as to better measure the future free cash flows of companies then to relevantly discount them back to the present value. The chosen period was limited by the required data used for DCF model accessible by the researcher. The researcher is not able to find or access many sample companies' financial statements before 2001. Nevertheless, the way the researcher conducted the DCF model with 11-year period future free cash flow was relatively relevant to obtain certain helpful results regarding the research question as indicated in the previous sections.

In conclusion, this thesis was not conducted in the most optimal way to achieve the most exact outcomes but it was conducted with the most possibly available resources within the researcher's reach. However, this dissertation can still reveal certain valuable insights regarding the research's scope. The researcher believes that this thesis is a useful work that can be beneficial for further researches regarding valuation methods, intrinsic value of companies, financial ratios, financial management, investing strategies and so on.

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Appendices

Order	Company's name	Company's symbol
1	Adobe System incorporated	**ADBE**
2	Autodesk Inc.	**ADSK**
3	American Software Inc.	**AMSWA**
4	Amazon.com Inc.	**AMZN**
5	Ansys Inc.	**ANSS**
6	Apple Inc.	**AAPL**
7	Activision Blizzard Inc.	**ATVI**
8	Cadence Design Systems Inc.	**CDNS**
9	Cerner Corporation	**CERN**
10	Cisco System Inc.	**CSCO**
11	Cognizant Technology Solutions Corporation	**CTSH**
12	Citrix Systems Inc.	**CTXS**
13	Electronic Arts	**EA**
14	International Business Machine Corporation	**IBM**
15	Intel Corporation	**INTC**
16	Intuit Inc.	**INTU**
17	Lam Research	**LRCX**
18	Microsoft Corporation	**MSFT**
19	Micron Technology Inc.	**MU**
20	NCR Corporation	**NCR**
21	Nuance Communications Inc.	**NUAN**
22	Nvidia Corporation	**NVDA**
23	Oracle Corporation	**ORCL**
24	Qualcomm Inc.	**QCOM**
25	Ret Hat Inc.	**RHT**
26	Synopsys Inc.	**SNPS**
27	Symantec Corporation	**SYMC**
28	Western Digital Corporation	**WDC**
29	Xilinx Inc.	**XLNX**
30	Xerox Corporation	**XRX**

Appendix 1 Company list

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	2575	3158	3580	2946	3800	4216	4404	4055	4147	4796	5854	7302
EBIT	551	858	1028	691	993	1099	1180	423	413	903	1494	2168
Net income	506	724	872	387	775	833	833	290	268	630	1169	1694
Income taxes	174	223	207	315	268	202	286	66	93	244	266	444
Depreciation & amortization	308	315	270	282	293	270	300	321	314	339	332	326
Cash & cash equivalents	772	946	886	999	750	989	1425	835	1117	877	1011	2306
Current asset	2884	2573	2735	2474	3216	3771	4397	4046	4602	4822	5840	7248
Operating current asset												
Long-term debt	0	0	350	1000	1514	1505	1497	1499	911	1907	1892	1881
Current liabilities	677	852	763	845	1068	1251	1272	1526	2494	2214	2812	3527
Non-cash working capital	-677	-852	-763	-845	-1068	-1251	-1272	-1526	-2494	-2214	-2812	-3527
Changes in non-cash working capital		-175	89	-82	-223	-183	-21	-254	-968	280	-598	-715
Free cash flow		1125	1002	740	1241	1350	1215	932	1602	718	2158	2765
Free cash flow growth rate			-0.1093	-0.2615	0.67703	0.08783	-0.1	-0.2329	0.71888	-0.5518	2.00557	0.28128
FCF estimated growth rate	0.25151											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	3460.41	4330.72	5419.92	6783.06	8489.03	10624.1	13296.1	16640.1	20825.2	26062.8	32617.8	

Calculating WACC	
Beta	1.10615
ADBE average return	0.00075
ADBE annualized return	0.206
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.13503
Jensen alpha	0.07097
For the fiscal year 2017	
Market value of equity	87520
Total debt	5408
Coporate tax rate	35.00%
Interest expenses	74.4
Cost of debt Kd	0.01376
WACC	0.1277

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	3068.57	3405.46	3779.35	4194.28	4654.77	5165.81	5732.97	6362.38	7060.91	7836.12	8696.44
Total present value of the firm free ca	59957.1										
Market value of the firm	92928										

Appendix 2 DCF valuation of ADBE

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	1839.8	2171.9	2315.2	1713.7	1951.8	2215.6	2312.2	2273.9	2512.2	2504.1	2031	2056.6
EBIT	349.7	445.6	244.5	65.6	271.4	355.6	305.9	384.8	120.7	1.3	-499.6	-509.1
Net income	289.7	356.2	183.6	58	212	285.3	247.4	228.8	81.8	-330.5	-582.1	-566.9
Income taxes	76.8	113.8	68.9	26.7	60	77.6	62.6	51.1	1.2	310.2	58.3	9.6
Depreciation & amortization	53.5	61.3	91.8	111.5	105.4	115.5	127.8	128.9	145.9	145.8	139.2	108.4
Cash & cash equivalents	665.9	917.9	917.6	838.7	1075.1	1156.9	1612.2	1853	1410.6	1353	1213.1	1078
Current asset	1189.7	1481.8	1388	1379.6	1714.3	1859.9	2552.4	2835	2671.3	2993.1	2460.6	1877.9
Operating current asset	523.8	563.9	470.4	540.9	639.2	703	940.2	982	1260.7	1640.1	1247.5	799.9
Long-term debt	0	0	0	0	0	0	0	0	0	0	0	0
Current liabilities	574.2	746.5	800.1	704	869.8	954.1	1043.7	1071.5	1400.1	1591	2185.4	2123.2
Non-cash working capital	-50.4	-182.6	-329.7	-163.1	-230.6	-251.1	-103.5	-89.5	-139.4	49.1	-937.9	-1323.3
Changes in non-cash working capital		-132.2	-147.1	166.6	-67.5	-20.5	147.6	14	-49.9	188.5	-987	-385.4
Free cash flow		525.3	414.5	-16.2	384.3	414	223.5	448.6	315.3	-351.6	568.3	-24.9
Free cash flow growth rate			-0.21093	-1.03908	-24.7222	0.077283	-0.46014	1.007159	-0.29715	-2.115128449	-2.61632537	-1.04381
FCF estimated growth rate	-0.74423649											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	67.45413765	17.25231	4.412511	1.128559	0.288644	0.073825	0.018882	0.004829	0.001235	0.000315905	8.07968E-05	

263.7364

Calculating WACC	
Beta	1.233708
ADSK average return	0.000635
ADSK annualized return	0.172043
Nasdaq average return	0.000469
Nasdaq annualized return	0.124408
Risk free rate	2.43%
Cost of equity Ke	0.147804
Jensen alpha	0.024239
For the fiscal year 2017	
Market value of equity	17930
Total debt	2123.2
Coporate tax rate	35.00%
Interest expenses	24.2
Cost of debt Kd	0.011398
WACC	0.132939

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	59.53907324	13.44108	3.034354	0.685012	0.154643	0.034911	0.007881	0.001779	0.000402	9.06756E-05	2.04702E-05
Total present value of the firm free	76.89924494										
Market value of the firm	20053.2										

Appendix 3 DCF valuation of ADSK

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	76630	84367	89001	78024	75276	85589	102636	100467	100601	102873	113889	106286
EBIT	6008	10029	8095	7190	7299	9193	16168	13784	14525	9342	13527	7766
Net income	5019	8433	6533	3016	5794	7364	11343	10411	10331	8128	10242	14621
Income taxes	3631	5496	4004	2400	3434	3770	5928	5114	5566	2274	4458	6994
Depreciation & amortization	3618	4392	4027	3484	2160	3922	4302	4153	2605	5833	5618	6640
Cash & cash equivalents	29425	45627	59236	37629	21730	23928	39111	41164	55803	44655	49004	66001
Current asset	80536	91678	94061	70361	52543	66122	82392	79848	93347	85590	94095	109526
Operating current asset												
Long-term debt	0	0	0	0	0	0	0	0	0	0	0	0
Current liabilities	25488	28327	26899	24929	23415	29401	32283	28760	34527	39250	39294	42737
Non-cash working capital	-25488	-28327	-26899	-24929	-23415	-29401	-32283	-28760	-34527	-39250	-39294	-42737
Changes in non-cash working capital		-2839	1428	1970	1514	-5986	-2882	3523	-5767	-4723	-44	-3443
Free cash flow		11764	6690	6304	4511	15331	17424	9300	17331	17624	14731	10855
Free cash flow growth rate			-0.4313	-0.0577	-0.2844	2.39858	0.13652	-0.4663	0.86355	0.01691	-0.1642	-0.2631
FCF estimated growth rate	0.17486											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	12753.1	14983.1	17603	20681.1	24297.4	28546	33537.6	39402	46291.8	54386.3	63896.3	

Calculating WACC	
Beta	1.19546
AMSWA average return	0.00062
AMSWA annualized return	0.16862
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.14398
Jensen alpha	0.02464
For the fiscal year 2017	
Market value of equity	340
Total debt	42737
Coporate tax rate	35.00%
Interest expenses	74.4
Cost of debt Kd	0.00174
WACC	0.00226

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	12724.4	14915.6	17484.3	20495.3	24024.8	28162.2	33012	38697.1	45361.2	53172.9	62329.9
Total present value of the firm free ca	350380										
Market value of the firm	43077										

Appendix4 DCF valuation of AMSWA

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	10711	14835	19166	24509	34204	48077	61093	74452	88988	107006	135987	177866
EBIT	389	655	842	1129	1406	862	676	645	178	2233	4186	4106
Net income	190	476	645	902	1152	631	-39	274	-241	596	2371	3033
Income taxes	187	184	247	253	352	291	428	161	167	950	1425	769
Depreciation & amortization	205	246	287	378	568	1083	2159	3253	4746	6281	8116	11478
Cash & cash equivalents	1022	2539	2769	3444	3777	5269	8084	8658	14557	15890	19334	20522
Current asset	3373	5164	6157	9797	13747	17490	21296	24625	31327	36474	45781	60197
Operating current asset	2351	2625	3388	6353	9970	12221	13212	15967	16770	20584	26447	39675
Long-term debt	1247	1282	409	109	1561	2625	3084	3191	8365	8235	7694	24743
Current liabilities	2532	3714	4746	7364	10372	14896	19002	22980	28089	33899	43816	57883
Non-cash working capital	-181	-1089	-1358	-1011	-402	-2675	-5790	-7013	-11319	-13315	-17369	-18208
Changes in non-cash working capital		-908	-269	347	609	-2273	-3115	-1223	-4306	-1996	-4054	-839
Free cash flow		1625	1151	907	1013	3927	5522	4960	9063	9560	14931	15654
Free cash flow growth rate			-0.2917	-0.212	0.11687	2.8766	0.40616	-0.1018	0.82722	0.05484	0.56182	0.04842
FCF estimated growth rate	0.42865											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	22364.1	31950.4	45645.8	65211.8	93164.7	133099	190152	271661	388107	554469	792140	

Calculating WACC	
Beta	1.15942
AMZN average return	0.00154
AMZN annualized return	0.47006
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.14037
Jensen alpha	0.32969
For the fiscal year 2017	
Market value of equity	576550
Total debt	82626
Coporate tax rate	35.00%
Interest expenses	459
Cost of debt Kd	0.00556
WACC	0.12323

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	19910.6	25324.6	32210.7	40969.3	52109.5	66279	84301.3	107224	136380	173464	220632
Total present value of the firm free c	958805	higher			1.45455						
Market value of the firm	659176										

Appendix 5 DCF valuation of AMZN

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	264	385	478	517	580	691	798	861	936	943	988	1095
EBIT	36	127	170	183	219	266	294	322	347	354	376	391
Net income	14	82	112	116	153	181	203	245	255	253	266	259
Income taxes	19	42	55	57	63	84	90	77	93	104	115	136
Depreciation & amortization	27	39	50	64	61	66	85	81	82	78	70	68
Cash & cash equivalents	104	167	228	336	472	472	577	742	788	784	822	882
Current asset	216	305	397	515	715	740	913	1068	1082	1076	1169	1270
Operating current asset	112	138	169	179	243	268	336	326	294	292	347	388
Long-term debt	109	52	250	197	128	53	0	0	0	0	0	0
Current liabilities	180	196	268	267	311	439	477	440	465	484	539	609
Non-cash working capital	-68	-58	-99	-88	-68	-171	-141	-114	-171	-192	-192	-221
Changes in non-cash working capital		10	-41	11	20	-103	30	27	-57	-21	0	-29
Free cash flow		114	206	179	197	351	259	299	393	349	331	352
Free cash flow growth rate			0.80702	-0.1311	0.10056	0.78173	-0.2621	0.15444	0.31438	-0.112	-0.0516	0.06344
FCF estimated growth rate	0.16649											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	410.603	478.962	558.703	651.719	760.221	886.786	1034.42	1206.64	1407.53	1641.86	1915.21	

Calculating WACC	
Beta	1.01051
ANSS average return	0.00088
ANSS annualized return	0.24486
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.12546
Jensen alpha	0.1194
For the fiscal year 2017	
Market value of equity	12820
Total debt	609
Coporate tax rate	35.00%
Interest expenses	0.4
Cost of debt Kd	0.00066
WACC	0.11979

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	366.679	381.969	397.897	414.49	431.774	449.78	468.536	488.074	508.427	529.628	551.714
Total present value of the firm free ca	4988.97										
Market value of the firm	13429										

Appendix 6 DCF valuation of ANSS

Estimating future free cash flow													
In millions dollar													
Period	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Revenues	19315	24006	32479	36537	65225	108249	156508	170910	182795	233715	215639	229234	
EBIT	2453	4409	6275	7658	18385	33790	55241	48999	52503	71230	60024	61344	
Net income	1989	3496	4834	5704	14013	25922	41733	37037	39510	53394	45687	48351	
Taxes	829	1512	2061	2280	4527	8283	14030	13118	13973	19121	15685	15738	
Depreciation & amortization	225	317	473	703	1027	1814	3277	6757	7946	11257	10505	10157	
Cash & cash equivalents	6392	9352	11875	5263	11261	9815	10746	14259	13844	21120	20484	20289	
Current asset	14509	21956	32311	36265	41687	44988	73286	57653	68531	89378	106869	128645	
Operating current asset	8117	12604	20436	31002	30426	35173	62540	43394	54687	68258	86385	108356	
Long-term debt	0	0	0	0	0	0	0	16960	28987	53463	75427	97207	
Current liabilities	6443	9299	14092	19282	20722	27970	38542	43658	63448	80610	79007	100814	
Non-cash working capital	1674	3305	6344	11720	9704	7203	23998	-264	-8761	-12352	7378	7542	
Changes in non-cash working capital		1631	3039	5376	-2016	-2501	16795	-24262	-8497	-3591	19730	164	
Free cash flow		1583	1648	705	16901	29822	27693	66900	54973	66957	35114	55599	
Free cash flow growth rate			0.041061276	-0.57220874	22.97304965	0.764511	-0.07139	1.415773	-0.17828	0.217998	-0.47557	0.583386	
FCF estimated growth rate	0.191697198												
Period	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028		
Estimated future free cash flow	66257.17251	78958.48683	94094.60752	112132.2801	133627.724	159243.8	189770.4	226148.8	269500.9	321163.5	382729.6		

Calculating WACC	
Beta	1.015054
Apple average return	0.001159
Nasdaq average return	0.000469
Risk free rate	2.43%
Apply annualized return	0.335878
Nasdaq annualized return	0.124408
Cost of equity Ke	0.125915
Jensen alpha	0.209963
For the fiscal year 2017	
Market value of equity	856280
Total debt	198021
Coporate tax rate	35.00%
Interest expenses	2323
Cost of debt Kd	0.011731
WACC	0.103697

Appendix 7 DCF valuation of AAPL

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	1468	1513	3026	4279	4447	4755	4856	4583	4408	4664	6608	7017
EBIT	15	73	-233	-26	469	1328	1451	1372	1183	1319	1412	1309
Net income	40	86	-107	113	418	1085	1149	1010	835	892	966	273
Income taxes	6	24	80	121	74	246	309	309	146	229	140	878
Depreciation & amortization	15	30	395	347	198	148	120	108	90	95	829	888
Cash & cash equivalents	354	384	2958	2768	2812	3165	3959	4410	4848	1823	3245	4713
Current asset	1116	1401	5259	5329	5432	5380	6274	6241	6541	3387	4830	6520
Operating current asset	762	1017	2301	2561	2620	2215	2315	1831	1693	1564	1585	1807
Long-term debt	0	0	0	0	0	0	0	4668	4324	4079	4887	4390
Current liabilities	194	341	2084	2507	2960	2556	2652	2405	2714	2611	2656	3663
Non-cash working capital	568	676	217	54	-340	-341	-337	-574	-1021	-1047	-1071	-1856
Changes in non-cash working capital		108	-459	-163	-394	-1	4	-237	-447	-26	-24	-785
Free cash flow		-29	541	363	987	1231	1258	1408	1574	1211	2125	2104
Free cash flow growth rate			-19.655	-0.329	1.71901	0.24721	0.02193	0.11924	0.1179	-0.2306	0.75475	-0.0099
FCF estimated growth rate	0.2678348											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	2667.5243	3381.98	4287.79	5436.21	6892.22	8738.19	11078.6	14045.8	17807.8	22577.3	28624.3	

Calculating WACC	
Beta	0.92205
ATVI average return	0.00096
ATVI annualized return	0.27243
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.1166
Jensen alpha	0.15583
For the fiscal year 2017	
Market value of equity	48250
Total debt	8053
Coporate tax rate	35.00%
Interest expenses	150
Cost of debt Kd	0.01863
WACC	0.10166

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	2421.3729	2786.62	3206.96	3690.71	4247.42	4888.11	5625.45	6474.01	7450.57	8574.43	9867.82
Total present value of the firm free c	59233.468										
Market value of the firm	56303										

Appendix 8 DCF valuation of ATVI

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	1484	1615	1039	853	936	1150	1326	1460	1581	1702	1816	1943
EBIT	225	318	-1573	-124	-29	120	212	189	207	285	245	324
Net income	143	296	-1854	-150	127	72	440	164	159	252	203	204
Income taxes	100	68	252	4	189	23	252	5	22	15	34	111
Depreciation & amortization	147	131	129	93	88	92	89	98	116	118	120	116
Cash & cash equivalents	934	1063	568	569	557	601	726	536	932	617	465	688
Current asset	1312	1530	955	851	879	1064	1391	1221	1852	964	702	980
Operating current asset	378	467	387	282	322	463	665	685	920	347	237	292
Long-term debt	0	0	0	0	0	0	0	0	347	343	643	644
Current liabilities	548	785	564	398	698	1015	1217	1148	1393	536	586	642
Non-cash working capital	-170	-318	-177	-116	-376	-552	-552	-463	-473	-189	-349	-350
Changes in non-cash working capital		-148	141	61	-260	-176	0	89	-10	284	-160	-1
Free cash flow		529	-1837	-96	130	365	49	193	311	104	491	330
Free cash flow growth rate			-4.4726	-0.9477	-2.3542	1.80769	-0.8658	2.93878	0.6114	-0.6656	3.72115	-0.3279
FCF estimated growth rate	-0.0555											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	311.694	294.403	278.072	262.647	248.077	234.315	221.317	209.04	197.444	186.491	176.146	

Calculating WACC	
Beta	1.14234
CDNS average return	0.00063
CDNS annualized return	0.17132
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.13866
Jensen alpha	0.03266
For the fiscal year 2017	
Market value of equity	11720
Total debt	1286
Coporate tax rate	35.00%
Interest expenses	25.6
Cost of debt Kd	0.01991
WACC	0.12623

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	276.76	232.109	194.662	163.256	136.917	114.828	96.3022	80.7653	67.7351	56.8071	47.6422
Total present value of the firm free	1467.78										
Market value of the firm	13006										

Appendix 9 DCF valuation of CDNS

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	1378	1519.8	1676	1671.8	1850.2	2203	2665.4	2910.7	3402.7	4425.3	4796	5142
EBIT	166.2	201	278.8	292	359.3	459.8	571.6	576	763	781.1	911	960
Net income	109.9	127.1	188.6	193.4	237	306.6	397.2	398.3	525.4	539.4	636	867
Income taxes	57.6	76.8	92.7	99.2	124.9	163	190.5	189.7	248.7	242	282	100
Depreciation & amortization	125.2	152.8	170.4	189.6	193.3	212.5	222.6	263.5	302.3	452.2	504	581
Cash & cash equivalents	162.5	182.9	270.4	241.7	214.5	243.1	317.2	202.4	635.2	402.1	171	371
Current asset	751	818.6	858.8	1146.3	1146	1502.3	1790.5	1761.7	2348.8	1827.8	1619	2380
Operating current asset	588.5	635.7	588.4	904.6	931.5	1259.2	1473.3	1559.3	1713.6	1425.7	1448	2009
Long-term debt	187.4	177.6	111.3	95.5	67.9	86.8	136.5	111.7	62.8	563.3	528	515
Current liabilities	312.2	288.1	341.2	358.1	305.9	438.7	580.1	640.4	634.3	777.8	845.4	789.6
Non-cash working capital	276.3	347.6	247.2	546.5	625.6	820.5	893.2	918.9	1079.3	647.9	602.6	1219.4
Changes in non-cash working capital		71.3	-100.4	299.3	79.1	194.9	72.7	25.7	160.4	-431.4	-45.3	616.8
Free cash flow		205.7	456.9	83.1	348.6	314.4	531	624.1	656.2	1422.7	1178.3	824.2
Free cash flow growth rate			1.2212	-0.8181	3.19495	-0.0981	0.68893	0.17533	0.05143	1.16809	-0.1718	-0.3005
FCF estimated growth rate	0.51114											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	1245.48	1882.1	2844.11	4297.84	6494.64	9814.31	14830.8	22411.4	33866.7	51177.3	77336.1	

Calculating WACC	
Beta	0.77215
CERN average return	0.00082
CERN annualized return	0.22844
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.1016
Jensen alpha	0.12684
For the fiscal year 2017	
Market value of equity	22780
Total debt	1304.6
Coporate tax rate	35.00%
Interest expenses	8
Cost of debt Kd	0.00613
WACC	0.09631

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	1136.07	1565.94	2158.46	2975.19	4100.96	5652.71	7791.61	10739.8	14803.6	20405.1	28126.1
Total present value of the firm free c	99455.7										
Market value of the firm	24084.6										

Appendix 10 DCF valuation of CERN

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	23917	34922	39540	36117	40040	43218	46061	48607	47142	49161	49247	48005
EBIT	6996	8621	9442	7322	9164	7674	10065	11196	9345	10770	12660	11973
Net income	5580	7333	8052	6134	7767	6490	3041	9983	7853	8981	10739	9609
Income taxes	2053	2128	2203	1559	1648	1335	2118	1244	1862	2220	2181	2678
Depreciation & amortization	1293	1413	1744	1768	2030	2486	2602	2351	2439	2442	2150	2286
Cash & cash equivalents	3297	3728	5191	5718	4581	7662	9799	7925	6726	6877	7631	11708
Current asset	25676	31574	35699	44177	51421	57231	61933	65521	67114	76283	78719	83703
Operating current asset	22379	27846	30508	38459	46840	49569	52134	57596	60388	69406	71088	71995
Long-term debt	6332	6408	6393	10295	12188	16234	16297	12928	20337	21457	24483	25724
Current liabilities	11313	13358	13858	13655	19233	17506	17731	22192	19809	23623	24911	27583
Non-cash working capital	11066	14488	16650	24804	27607	32063	34403	35404	40579	45783	46177	44412
Changes in non-cash working capital		3422	2162	8154	2803	4456	2340	1001	5175	5204	394	-1765
Free cash flow		4484	6821	-623	6743	4369	8209	11302	4747	5788	12235	13346
Free cash flow growth rate			0.52119	-1.0913	-11.823	-0.3521	0.87892	0.37678	-0.58	0.2193	1.11386	0.09081
FCF estimated growth rate	0.130828352				outliner							
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	15092.03518	17066.5	19299.3	21824.2	24679.4	27908.2	31559.3	35688.2	40357.2	45637.1	51607.7	

Calculating WACC	
Beta	1.00748
CSCO average return	0.00029
CSCO annualized return	0.07429
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.12516
Jensen alpha	-0.0509
For the fiscal year 2017	
Market value of equity	181570
Total debt	53307
Coporate tax rate	35.00%
Interest expenses	861
Cost of debt Kd	0.01615
WACC	0.09913

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	13730.84423	14126.8	14534.1	14953.3	15384.4	15828.1	16284.5	16754.1	17237.2	17734.2	18245.6
Total present value of the firm free c	174813.0947										
Market value of the firm	234877										

Appendix 11 DCF valuation of CSCO

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	1,424	2,136	2,816	3,279	4,592	6,121	7,346	8,843.20	10,262.70	12,416	13,487	14,810
EBIT	259	382	517	618	862	1,136	1,361	1,677.90	1,884.90	2,142	2,289	2,481
Net income	233	350	431	535	734	884	1,051	1,229	1,439	1,624	1,553	1,504
Income taxes	-45	-64	-84	-102	-145	-286	-336	-459.3	-484.7	-540	-805	-1,153
Depreciation & amortization	34	54	75	89	104	117	149	172	200	325	359	408
Cash & cash equivalents	266	340	735	1,101	1,541	1,311	1,570	2,213.00	2,010.10	2,125	2,034	1,925
Current asset	1,040	1,242	1,468	2,308	3,518	4,086	4,814	6,148	6,421	7,908.60	8,600	9,111
Operating current asset	774	902	733	1,207	1,977	2,775	3,244	3,935	4,411	5,784	6,566	7,186
Long-term debt	0	0	0	0	0	0	0	0	938	881.2	797	698
Current liabilities	250	341	388	647	931	1,210	1,377	1,775	2,592	2,713.70	2,418	2,839
Non-cash working capital	524.951	561.65	345.476	560.03	1046.54	1564.9	1866.887	2160.374	1818.406	3069.9	4148	4347
Changes in non-cash working capital		36.699	-216.17	214.554	486.509	518.356	301.992	293.487	-341.968	1251.494	1078.1	199
Free cash flow		462.964	892.006	595.295	624.258	1021.04	1544.926	2015.914	2911.232	1755.506	2374.9	3843
Free cash flow growth rate			0.92673	-0.3326	0.04865	0.63561	0.513084647	0.304861204	0.444125097	-0.3969886	0.35283	0.61817
FCF estimated growth rate	0.31144											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	5039.88	6609.53	8668.03	11367.6	14908	19551	25640.1139	33625.58805	44098.09473	57832.2067	75843.7	

Calculating WACC	
Beta	1.19851
CTSH average return	0.00074
CTSH annualized return	0.20214
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.14428
Jensen alpha	0.05786
For the fiscal year 2017	
Market value of equity	41690
Total debt	3537
Coporate tax rate	35.00%
Interest expenses	23
Cost of debt Kd	0.0065
WACC	0.13333

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	4446.98	5145.88	5954.62	6890.47	7973.4	9226.52	10676.59291	12354.56043	14296.2427	16543.086	19143.1
Total present value of the firm free c	112651										
Market value of the firm	45227										

Appendix 12 DCF valuation of CTSH

Estimating cash flow													
In millions dollar													
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	
Revenues	1134	1392	1583	1614	1875	2206	2586	2918	3143	3276	2736	2825	
EBIT	203	202	170	179	321	417	391	381	302	350	560	571	
Net income	183	214	178	191	276	356	353	340	252	319	536	-21	
Income taxes	60	36	19	3	57	75	58	48	24	7	58	528	
Depreciation & amortization	63	85	124	139	138	159	215	268	353	429	178	170	
Cash & cash equivalents	349	224	326	261	396	333	641	291	260	369	836	1115	
Current asset	812	934	940	1039	1470	1373	1714	1563	1688	1684	2561	2621	
Operating current asset	463	710	614	778	1074	1040	1073	1272	1428	1315	1725	1506	
Long-term debt	0	0	0	0	0	0	0	0	0	0	0	2127	
Current liabilities	535	654	731	834	1020	1179	1343	1464	1590	1681	3098	1678	
Non-cash working capital	-72	56	-117	-56	54	-139	-270	-192	-162	-366	-1373	-172	
Changes in non-cash working capital		128	-173	61	110	-193	-131	78	30	-204	-1007	1201	
Free cash flow		123	448	254	292	694	679	523	601	976	1687	-988	
Free cash flow growth rate			2.64228	-0.433	0.14961	1.37671	-0.0216	-0.2297	0.14914	0.62396	0.72848	-1.5857	480.818
FCF estimated growth rate	0.34001												
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028		
Estimated future free cash flow	644.302	863.373	1156.93	1550.3	2077.42	2783.77	3730.29	4998.64	6698.23	8975.72	12027.6		

Calculating WACC	
Beta	1.12374
CTXS average return	0.00076
CTXS annualized return	0.21067
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.1368
Jensen alpha	0.07388
For the fiscal year 2017	
Market value of equity	13640
Total debt	3805
Coporate tax rate	35.00%
Interest expenses	51.6
Cost of debt Kd	0.01356
WACC	0.10888

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	581.038	702.148	848.502	1025.36	1239.08	1497.35	1809.46	2186.61	2642.39	3193.16	3858.73
Total present value of the firm free c	19583.8										
Market value of the firm	17445										

Appendix 13 DCF valuation of CTXS

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	2951	3091	3665	4212	3654	3589	4143	3797	3575	4515	4396	4845
EBIT	325	39	-487	-827	-686	-312	35	121	33	948	898	1224
Net income	236	76	-454	-1088	-677	-276	76	98	8	875	1156	967
Income taxes	147	66	53	233	29	3	58	41	1	50	279	243
Depreciation & amortization	95	147	164	198	192	180	216	264	227	220	197	172
Cash & cash equivalents	1242	1371	1553	1612	1273	1579	1293	1292	1782	2068	2493	2565
Current asset	3012	3597	3925	3120	2585	3032	2609	2325	3138	3720	4354	5199
Operating current asset	1770	2226	2372	1508	1312	1453	1316	1033	1356	1652	1861	2634
Long-term debt	0	0	0	0	0	0	0	0	0	0	0	0
Current liabilities	869	1026	1299	1136	1574	2001	2120	1917	2390	2747	2418	2415
Non-cash working capital	901	1200	1073	372	-262	-548	-804	-884	-1034	-1095	-557	219
Changes in non-cash working capital		299	-127	-701	-634	-286	-256	-80	-150	-61	538	776
Free cash flow		-179	-249	-161	111	151	449	424	409	1179	278	377
Free cash flow growth rate			0.39106	-0.3534	-1.6894	0.36036	1.97351	-0.0557	-0.0354	1.88264	-0.7642	0.35612
FCF estimated growth rate	0.20656											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	454.872	548.829	662.193	798.974	964.008	1163.13	1403.38	1693.26	2043.02	2465.01	2974.18	

Calculating WACC	
Beta	1.06587
EA average return	0.00055
EA annualized return	0.14851
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.131
Jensen alpha	0.01751
For the fiscal year 2017	
Market value of equity	32360
Total debt	2415
Coporate tax rate	35.00%
Interest expenses	47
Cost of debt Kd	0.01946
WACC	0.12278

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	405.129	435.357	467.84	502.747	540.259	580.569	623.887	670.437	720.46	774.216	831.982
Total present value of the firm free	6552.88										
Market value of the firm	34775										

Appendix 14 DCF valuation of EA

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	91424	98786	103630	95758	99870	106916	104507	99751	92793	81741	79919	73139
EBIT	13317	14489	16715	18138	19723	21003	21902	19524	19986	15945	12330	11400
Net income	9492	10418	12334	13425	14833	15855	16604	16483	12022	13190	11872	5753
Income taxes	3901	4071	4381	4713	4890	5148	5298	3041	4234	2581	449	5642
Depreciation & amortization	5201	4983	5450	4994	4831	4815	4676	4708	4492	3855	4381	4541
Cash & cash equivalents	879	755	1269	1285	10661	11922	10412	10716	8476	7686	7826	11972
Current asset	44660	53177	49004	48935	48116	50928	49433	51350	47377	42504	43888	49735
Operating current asset	43781	52422	47735	47650	37455	39006	39021	40634	38901	34818	36062	37763
Long-term debt	13780	23039	22689	21932	21846	22857	24088	32856	34991	33428	34655	39837
Current liabilities	40091	44310	42435	36002	40562	42123	43625	40154	39581	34269	36275	37363
Non-cash working capital	3690	8112	5300	11648	-3107	-3117	-4604	480	-680	549	-213	400
Changes in non-cash working capital		4422	-2812	6348	-14755	-10	-1487	5084	-1160	1229	-762	613
Free cash flow		10979	20596	12071	34419	20680	22767	16107	21404	15990	17024	9686
Free cash flow growth rate			0.87594	-0.4139	1.85138	-0.3992	0.10092	-0.2925	0.32886	-0.2529	0.06467	-0.431
FCF estimated growth rate	0.143217677											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	11073.20642	12659.1	14472.1	16544.7	18914.2	21623.1	24719.9	28260.2	32307.6	36934.6	42224.3	

Calculating WACC	
Beta	0.69953
IBM average return	0.00026
IBM annualized return	0.06734
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.09433
Jensen alpha	-0.027
For the fiscal year 2017	
Market value of equity	135950
Total debt	77200
Coporate tax rate	35.00%
Interest expenses	615
Cost of debt Kd	0.00797
WACC	0.06204

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	10426.36018	11223.3	12081.2	13004.6	13998.6	15068.6	16220.4	17460.3	18794.8	20231.5	21777.9
Total present value of the firm free cash	170287.5825										
Market value of the firm	213150										

Appendix 15 DCF valuation of IBM

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	35382	38334	37586	35127	43623	53999	53341	52708	55870	55355	59387	62761
EBIT	5652	8216	8954	5711	15588	17477	14638	12291	15347	14002	12874	17936
Net income	5044	6976	5292	4369	11464	12942	11005	9620	11704	11420	10316	9601
Income taxes	2024	2190	2394	1335	4581	4839	3868	2991	4097	2792	2620	10751
Depreciation & amortization	4912	4798	4616	5052	4638	6064	7522	10862	8549	8711	7790	8129
Cash & cash equivalents	6598	7370	3350	3987	5498	5065	8478	5674	2561	15308	5560	3433
Current asset	18280	23885	19871	21157	31611	25872	31358	32084	27730	40356	35508	29500
Operating current asset												
Long-term debt	1848	1980	1886	2049	2077	7084	13136	13165	12059	20036	20649	25037
Current liabilities	8514	8571	7818	7591	9327	12028	12898	13568	16011	15667	20302	17421
Non-cash working capital	-8514	-8571	-7818	-7591	-9327	-12028	-12898	-13568	-16011	-15667	-20302	-17421
Changes in non-cash working capital		-57	753	227	-1736	-2701	-870	-670	-2443	344	-4635	2881
Free cash flow		10881	10423	9201	17381	21403	19162	20832	22242	19577	22679	12433
Free cash flow growth rate			-0.0421	-0.1172	0.88903	0.2314	-0.1047	0.08715	0.06768	-0.1198	0.15845	-0.4518
FCF estimated growth rate	0.05981											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	13176.6	13964.7	14799.9	15685	16623.1	17617.3	18671	19787.7	20971.1	22225.4	23554.7	

Calculating WACC	
Beta	1.00548
INTC average return	0.00046
INTC annualized return	0.12152
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.12496
Jensen alpha	-0.0034
For the fiscal year 2017	
Market value of equity	216370
Total debt	42458
Coporate tax rate	35.00%
Interest expenses	646
Cost of debt Kd	0.01522
WACC	0.10608

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	11912.9	11414.5	10937	10479.4	10041	9620.98	9218.49	8832.84	8463.32	8109.27	7770.02
Total present value of the firm free ca	106800										

Appendix 16 DCF valuation of INTC

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	2293	2673	3071	3183	3455	3851	3808	4171	4243	4192	4694	5177
EBIT	565	637	651	682	863	1007	1168	1233	1300	738	1242	1395
Net income	417	440	477	447	574	634	792	858	907	365	979	971
Income taxes	235	251	245	205	276	332	374	387	447	299	397	396
Depreciation & amortization	113	134	215	275	256	241	242	232	197	231	238	236
Cash & cash equivalents	179	255	413	679	214	722	393	1009	849	808	638	529
Current asset	1817	1952	1774	1978	2295	2254	1523	2396	2621	2560	1614	1415
Operating current asset	1638	1697	1361	1299	2081	1532	1130	1387	1772	1752	976	886
Long-term debt	0	998	997	998	998	499	499	499	499	500	488	438
Current liabilities	1016	1160	1467	1084	1221	1805	1265	1280	1421	1744	2251	1944
Non-cash working capital	622	537	-106	215	860	-273	-135	107	351	8	-1275	-1058
Changes in non-cash working capital		-85	-643	321	645	-1133	138	242	244	-343	-1283	217
Free cash flow		605	1264	431	198	2049	898	836	806	1013	2366	1018
Free cash flow growth rate			1.08926	-0.659	-0.5406	9.34848	-0.5617	-0.069	-0.0359	0.25682	1.33564	-0.5697
FCF estimated growth rate	0.95942											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimating cash flow	1994.69	3908.43	7658.24	15005.7	29402.4	57611.6	112885	221189	433402	849216	1663968	

Calculating WACC	
Beta	0.86136
INTU average return	0.00075
INTU annualized return	0.20734
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.11053
Jensen alpha	0.09681
For the fiscal year 2017	
Market value of equity	40570
Total debt	2382
Coporate tax rate	35.00%
Interest expenses	31
Cost of debt Kd	0.01301
WACC	0.10487

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	1805.36	3201.7	5678.03	10069.6	17857.9	31670	56164.8	99604.9	176643	313266	555559
Total present value of the firm free	1271521										
Market value of the firm	42952										

Appendix 17 DCF valuation of INTU

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	1,642.20	2,566.60	2,474.90	1,115.90	2,133.70	3,237.70	2,665.20	3,598.90	4,607.30	5,259.30	5,885.90	8,013.60
EBIT	404.80	788.60	509.40	(281.20)	425.40	804.30	237.70	118.00	677.60	788.00	1,074.30	1,902.10
Net income	335.20	685.80	439.30	(302.10)	346.70	723.70	168.70	113.90	632.30	655.60	914.00	1,697.70
Income taxes	104.50	161.90	137.70	39.00	83.40	77.10	35.70	47.20	91.00	85.30	46.00	113.90
Depreciation & amortization	22.00	38.00	54.70	72.40	71.40	74.70	100.80	304.10	292.30	277.90	291.00	306.90
Cash & cash equivalents	910.80	573.90	732.50	374.20	545.70	1,492.10	1,564.70	1,162.50	1,452.70	1,501.50	5,039.30	2,377.50
Current asset	1,706.40	1,416.40	1,917.70	1,195.80	1,756.60	3,276.80	4,415.10	3,793.80	4,783.60	6,270.80	9,213.10	9,142.50
Operating current asset	795.60	842.50	1,185.20	821.60	1,210.90	1,784.70	2,850.40	2,631.30	3,330.90	4,769.30	4,173.80	6,765.00
Long-term debt	350.00	250.00	276.50	40.80	17.60	738.50	761.80	789.30	-	-	-	-
Current liabilities	567.60	672.80	637.70	340.70	558.60	684.30	1,426.90	1,404.50	1,582.00	2,631.40	2,418.00	2,950.10
Non-cash working capital	228	169.7	547.5	480.9	652.3	1100.4	1423.5	1226.8	1748.9	2137.9	1755.8	3814.9
Changes in non-cash working capital		-58.3	377.8	-66.6	171.4	448.1	323.1	-196.7	522.1	389	-382.1	2059.1
Free cash flow		723	48.6	-181.2	242	353.8	-20.3	571.6	356.8	591.6	1701.4	36
Free cash flow growth rate			-0.93278008	-4.72839506	-2.33554084	0.461983471	-1.057377	-29.1576355	-0.3757873	0.658071749	1.875929682	-0.978840955
FCF estimated growth rate	-0.82363737											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	6.349054604	1.119735955	0.197479576	0.034828017	0.006142361	0.001083283	0.00019105	3.36942E-05	5.9424E-06	1.04802E-06	1.84831E-07	

Calculating WACC	
Beta	1.209416
LRCX average return	0.000748
LRCX annualized return	0.205484
Nasdaq average return	0.000469
Nasdaq annualized return	0.124408
Risk free rate	2.43%
Cost of equity Ke	0.145372
Jensen alpha	0.060112
For the fiscal year 2017	
Market value of equity	29010
Total debt	2950.1
Coporate tax rate	35.00%
Interest expenses	117.7
Cost of debt Kd	0.039897
WACC	0.134347

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	5.597100571	0.8702093	0.135295805	0.021035117	0.003270435	0.000508471	7.9055E-05	1.2291E-05	1.9109E-06	2.97104E-07	4.61923E-08
Total present value of the firm free	6.627513299										
Market value of the firm	31960.1										

Appendix 18 DCF valuation of LRCX

Estimating cash flow												
In million dollars												
Period	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	44282	51122	60420	58437	62484	69943	73723	77849	86833	75956	85320	89950
EBIT	16472	18524	22492	20363	24098	27161	21763	26764	27759	12193	20182	22326
Net income	12599	14065	17681	14569	18760	23150	16978	21863	22074	12193	16798	21204
Income taxes	5663	6036	6133	5252	6253	4921	5289	5189	5746	6314	2953	1945
Depreciation & amortization	903	1440	2056	2562	2673	2766	2967	3755	5212	5957	6622	8778
Cash & cash equivalents	6714	6111	10339	6076	5505	9610	6938	3804	8669	5595	6510	7663
Current asset	49010	40168	43242	49280	55676	74918	85084	101466	114246	122797	139660	159851
Operating current asset	42296	34057	32903	43204	50171	65308	78146	97662	105577	117202	133150	152188
Long-term debt	0	0	0	3746	4939	11921	10713	12601	20645	27808	40783	76037
Current liabilities	22442	23754	29886	27034	26147	28774	32688	37417	45625	49647	59357	64527
Non-cash working capital	19854	10303	3017	16170	24024	36534	45458	60245	59952	67555	73793	87661
Changes in non-cash working capital		-9551	-7286	13153	7854	12510	8924	14787	-293	7603	6238	13868
Free cash flow		23479	25701	4520	12664	12496	10517	10543	27518	4233	17613	15291
Free cash flow growth rate			0.094638	-0.82413	1.80177	-0.01327	-0.15837	0.002472	1.610073	-0.84617	3.160879	-0.13183
FCF estimated growth rate	0.469606											
Period	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	22471.74	33024.59	48533.13	71324.55	104819	154042.5	226381.8	332691.9	488925.9	718528.2	1055953	

Beta	0.948351
MSFT average return	0.000529
MSFT annualized return	0.141255
Nasdaq average return	0.000469
Nasdaq annualized retur	0.124408
Risk free rate	2.43%
Cost of equity Ke	0.119237
Jensen alpha	0.022017
For the fiscal year 2017	
Market cap / Market valu	7270.44
Total debt	140564
Coporate tax rate	35.00%
Interest expenses	2222
Cost of debt Kd	0.015808
WACC	0.015634

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	22125.83	32015.72	46326.22	67033.29	96996.09	140351.8	203086.7	293863.2	425215.3	615279.7	890299.7
Total present value of the firm free cash f	2832594										
Market value of the firm	147834.4										

Appendix 19 DCF valuation of MSFT

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	5272	5688	5841	4803	8482	8788	8234	9073	16358	16192	12399	20322
EBIT	350	-280	-1595	-1675	1589	755	-612	236	3087	2998	168	5868
Net income	408	-320	-1619	-1835	1900	190	-1031	1194	3079	2899	-275	5090
Income taxes	18	30	18	2	19	203	17	8	128	157	19	114
Depreciation & amortization	1281	1718	2060	2139	1922	2105	2141	1804	2103	2667	2980	3861
Cash & cash equivalents	1431	2192	1243	1485	2913	2160	2459	2880	4150	2287	4140	5109
Current asset	5101	5234	3779	3344	6333	5832	5758	8911	10254	8596	9495	12457
Operating current asset	3670	3042	2536	1859	3420	3672	3299	6031	6104	6309	5355	7348
Long-term debt	405	1987	2451	2674	1648	1861	3038	4452	4893	6252	9154	9872
Current liabilities	1661	2026	1589	1892	2702	2480	2243	4125	4791	3905	4835	5334
Non-cash working capital	2009	1016	947	-33	718	1192	1056	1906	1313	2404	520	2014
Changes in non-cash working capital		-993	-69	-980	751	474	-136	850	-593	1091	-1884	1494
Free cash flow		2401	516	1442	2741	2183	1648	1182	5655	4417	5013	8121
Free cash flow growth rate			-0.7851	1.79457	0.90083	-0.2036	-0.2451	-0.2828	3.78426	-0.2189	0.13493	0.61999
FCF estimated growth rate	0.54992											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	12586.9	19508.6	30236.7	46864.3	72635.8	112579	174489	270443	419164	649668	1006932	

Calculating WACC	
Beta	1.57894
MU average return	0.001
MU annualized return	0.28375
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.18236
Jensen alpha	0.10139
For the fiscal year 2017	
Market cap / Market value	50910
Total debt	15206
Coporate tax rate	35.00%
Interest expenses	601
Cost of debt Kd	0.03952
WACC	0.14633

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	10980.1	14845.9	20072.6	27139.5	36694.5	49613.4	67080.7	90697.6	122629	165803	224177
Total present value of the firm free c	829733										
Market value of the firm	66116										

Appendix 20 DCF valuation of MU

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	4,582	4,970	5,315	4,599	4,810	5,443	5,730	6,123	6,591	6,373	6,543	6,516
EBIT	154	219	322	103	106	65	748	666	353	135	599	676
Net income	382	274	228	-30	137	52	481	447	195	-174	274	235
Income taxes	8	61	58	-3	-26	51	223	98	-48	55	92	242
Depreciation & amortization	104	110	109	128	138	168	166	208	284	308	344	354
Cash & cash equivalents	947	952	711	451	496	398	1,069	528	511	328	498	537
Current asset	3332	3,088	2,557	2299	2,478	2,515	3,406	4,339	3,088	2,549	2,757	2,830
Operating current asset	2385	2136	1846	1848	1982	2117	2337	3811	2577	2221	2259	2293
Long-term debt	306	307	7	11	10	852	1,891	3,320	3,472	3,239	3,001	2,939
Current liabilities	1,770	1,530	1,693	1,382	1,416	1,565	1,742	1,881	2,070	1,781	1,965	1,889
Non-cash working capital	615	606	153	466	566	552	595	1930	507	440	294	404
Changes in non-cash working capital		-9	-453	313	100	-14	43	1335	-1423	-67	-146	110
Free cash flow		277	826	-79	170	196	648	-559	2108	455	997	678
Free cash flow growth rate			1.98195	-1.0956	-3.1519	0.15294	2.30612	-1.8627	-4.771	-0.7842	1.19121	-0.32
FCF estimated growth rate	-0.6353											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	247.259	90.1728	32.885	11.9928	4.37365	1.59502	0.58169	0.21214	0.07736	0.02821	0.01029	

Calculating WACC	
Beta	1.05804
NCR average return	0.00028
NCR annualized return	0.07152
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.13022
Jensen alpha	-0.0587
For the fiscal year 2017	
Market value of equity	4320
Total debt	4828
Coporate tax rate	35.00%
Interest expenses	163
Cost of debt Kd	0.03376
WACC	0.07308

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	230.421	78.3096	26.6139	9.04484	3.07393	1.04469	0.35504	0.12066	0.04101	0.01394	0.00474
Total present value of the firm free ca	349.044										
Market value of the firm	9148										

Appendix 21 DCF valuation of NCR

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	388.5	602	868.5	950.4	1,118.90	1,318.70	1,651.50	1,855.30	1,923.50	1,931.10	1,948.90	1,939.40
EBIT	8.4	39	32.6	57.6	32.9	52.6	126.2	48.5	-21.4	54.9	138.5	51.9
Net income	-22.9	-14.9	-37	-19.4	-19.1	38.2	207.1	-115.2	-150.3	-115	-12.5	-150.9
Income taxes	15.1	22.5	14.6	40.4	18	-8.2	-141.8	18.6	-4.7	34.5	14.2	31.9
Depreciation & amortization	38.5	49.8	99	134.059	157.156	170.933	187.183	208.659	221.776	231	231.474	243.4
Cash & cash equivalents	112	184.335	261.54	527.038	516.63	447.224	1,129.80	846.8	588.2	568.8	608.1	592.3
Current asset	263.321	421.616	515.283	795.827	841.642	854.927	1701.31	1,410	1164.5	986.625	1038.59	1327.9
Operating current asset	151.321	237.281	253.743	268.789	325.012	407.703	571.506	563.2	576.3	417.825	430.49	735.6
Long-term debt	350	846.1	847.3	848.9	851	853	1,735.80	2,084.10	2,108.40	2,103.10	2,433.20	2,241.30
Current liabilities	212.048	256.743	381.764	419.225	382.472	475.07	964.763	805.234	642.009	626.384	690.899	1111.5
Non-cash working capital	-60.727	-19.462	-128.02	-150.44	-57.46	-67.367	-393.26	-242.03	-65.709	-208.56	-260.41	-375.9
Changes in non-cash working capital		41.265	-108.56	-22.415	92.976	-9.907	-325.89	151.223	176.325	-142.85	-51.85	-115.49
Free cash flow		25.035	225.559	173.674	79.08	241.64	781.073	87.336	28.751	394.25	407.624	378.891
Free cash flow growth rate			8.00975	-0.23	-0.5447	2.05564	2.23238	-0.8882	-0.6708	12.7126	0.03392	-0.0705
FCF estimated growth rate	0.23972		outlier									
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	469.72	582.322	721.918	894.977	1109.52	1375.5	1705.24	2114.02	2620.8	3249.07	4027.94	

Calculating WACC	
Beta	1.15079
NUAN average return	0.00044
NUAN annualized return	0.11681
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.1395
Jensen alpha	-0.0227
For the fiscal year 2017	
Market value of equity	4840
Total debt	3352.8
Coporate tax rate	35.00%
Interest expenses	156.9
Cost of debt Kd	0.0468
WACC	0.09486

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	429.022	485.786	550.06	622.839	705.246	798.558	904.215	1023.85	1159.32	1312.71	1486.39
Total present value of the firm free c	9477.99										
Market value of the firm	8192.8										

Appendix 22 DCF valuation of NUAN

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	3067	4098	3425	3326	3543	3998	4289	4130	4682	5010	6910	9714
EBIT	453	836	-71	-99	256	648	648	496	759	747	1934	3210
Net income	448	798	-30	-68	253	581	563	440	631	614	1666	3047
Income taxes	46	104	13	14	18	82	100	70	124	129	239	149
Depreciation & amortization	117	133	185	197	187	204	226	239	220	197	187	199
Cash & cash equivalents	544	727	417	447	665	668	733	1512	497	596	1766	4002
Current asset	2032	2889	2168	2480	3227	3905	4775	5625	5713	6053	8536	93255
Operating current asset	1488	2162	1751	2033	2562	3237	4042	4113	5216	5457	6770	89253
Long-term debt	0	0	0	0	0	0	0	1356	1384	0	1983	1985
Current liabilities	639	967	779	784	943	930	976	945	896	2351	1788	1153
Non-cash working capital	849	1195	972	1249	1619	2307	3066	3168	4320	3106	4982	88100
Changes in non-cash working capital		346	-223	277	370	688	759	102	1152	-1214	1876	83118
Free cash flow		519	324	-193	55	82	15	563	-297	2029	6	-79858
Free cash flow growth rate			-0.3757	-1.5957	-1.285	0.49091	-0.8171	36.5333	-1.5275	-7.8316	-0.997	-13311
FCF estimated growth rate	-1.7423											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	-230.35	170.999	-126.94	94.2336	-69.954	51.93	-38.55	28.6174	-21.244	15.7704	-11.707	

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	-198.35	126.783	-81.04	51.8014	-33.112	21.1652	-13.529	8.64771	-5.5277	3.53331	-2.2585
Total present value of the firm free c	-121.88										
Market value of the firm	124968										

Calculating WACC	
Beta	1.40753
NVDA average return	0.00121
NVDA annualized return	0.35164
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.1652
Jensen alpha	0.18644
For the fiscal year 2017	
Market value of equity	121830
Total debt	3138
Coporate tax rate	35.00%
Interest expenses	58
Cost of debt Kd	0.01848
WACC	0.16136

310.3

Appendix 23 DCF valuation of NVDA

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	14380	17996	22430	23252	26820	35622	37121	37180	38275	38226	37047	37728
EBIT	4736	5974	7844	8321	9062	12033	13706	14684	14759	13871	12604	12710
Net income	3381	4274	5521	5593	6135	8547	9981	10925	10955	9938	8901	9335
Income taxes	1429	1712	2313	2241	2108	2864	2981	2973	2749	2896	2541	2182
Depreciation & amortization	806	1127	1480	1976	2271	2796	2916	2931	2908	2861	2554	2451
Cash & cash equivalents	6659	6218	8262	8995	9914	16163	14955	14613	17769	21716	20152	21784
Current asset	11947	12883	18103	18581	27004	39174	40023	41692	48128	63183	64313	74515
Operating current asset	5288	6665	9841	9586	17090	23011	25068	27079	30359	41467	44161	52731
Long-term debt	5735	6235	10235	9237	11510	14772	13524	18494	22589	39959	40105	48112
Current liabilities	6930	9387	10029	9149	14691	14192	15388	12872	14389	15291	17208	24178
Non-cash working capital	-1642	-2722	-188	437	2399	8819	9680	14207	15970	26176	26953	28553
Changes in non-cash working capital		-1080	2534	625	1962	6420	861	4527	1763	10206	777	1600
Free cash flow		6469	4477	7431	7263	5545	12780	10115	13155	3630	11840	11379
Free cash flow growth rate			-0.3079	0.65982	-0.0226	-0.2365	1.30478	-0.2085	0.30054	-0.7241	2.26171	-0.0389
FCF estimated growth rate	0.29882											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future cash flow	14779.3	19195.75	24931.9	32382.2	42058.7	54626.9	70950.8	92152.6	119690	155456	201911	

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	13521.8	16068.14	19094	22689.6	26962.4	32039.7	38073.2	45242.9	53762.7	63887	75917.7
Total present value of the firm free ca	407259										
Market value of the firm	262590										

Calculating WACC	
Beta	0.9778
ORCL average return	0.00051
ORCL annualized return	0.13701
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.12219
Jensen alpha	0.01483
For the fiscal year 2017	
Market value of equity	190300
Total debt	72290
Coporate tax rate	35.00%
Interest expenses	1798
Cost of debt Kd	0.02487
WACC	0.093

Appendix 24 DCF valuation of ORCL

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	7526	8871	11142	10387	10982	14957	19121	24866	26487	25281	23554	22291
EBIT	2690	2883	3730	2542	3727	5026	5682	7230	7550	5776	6495	2614
Net income	2470	3303	3160	1592	3247	4242	6509	6840	7964	5268	5702	2465
Income taxes	686	323	666	611	973	1132	1279	1349	1244	1219	1131	555
Depreciation & amortization	272	383	456	635	666	1061	897	1017	1150	1214	1428	1461
Cash & cash equivalents	1607	2411	1840	2717	3547	5462	3807	6142	7907	7560	5946	35029
Current asset	7049	8821	11872	12570	12133	14293	15645	19555	22413	22099	22981	43593
Operating current asset	5442	6410	10032	9853	8586	8831	11838	13413	14506	14539	17035	8564
Long-term debt	0	0	0	0	0	0	0	0	0	9969	10008	19398
Current liabilities	1422	2258	2440	2813	5468	5289	5302	5213	6013	6100	7311	10907
Non-cash working capital	4020	4152	7592	7040	3118	3542	6536	8200	8493	8439	9724	-2343
Changes in non-cash working capital		132	3440	-552	-3922	424	2994	1664	293	-54	1285	-12067
Free cash flow		2811	80	3118	7342	4531	2306	5234	7163	5825	5507	15587
Free cash flow growth rate			-0.9715	37.975	1.35471	-0.3829	-0.4911	1.26973	0.36855	-0.1868	-0.0546	1.8304
FCF estimated growth rate	0.304060219											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	20326.38664	26506.8	34566.5	45076.8	58782.9	76656.4	99964.6	130360	169997	221686	289092	

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	18597.79507	22190.2	26476.4	31590.6	37692.7	44973.4	53660.5	64025.6	76392.9	91149	108755
Total present value of the firm free c	575504.5041										
Market value of the firm	119355										

Calculating WACC	
Beta	0.96567
QCOM average return	0.00038
QCOM annualized return	0.10071
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.12097
Jensen alpha	-0.0203
For the fiscal year 2017	
Market value of equity	89050
Total debt	30305
Coporate tax rate	35.00%
Interest expenses	494
Cost of debt Kd	0.0163
WACC	0.09295

Appendix 25 DCF valuation of QCOM

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	278	401	523	653	748	909	1133	1329	1535	1789	2052	2412
EBIT	58	52	70	83	100	146	200	201	232	250	288	332
Net income	80	60	77	79	87	107	147	150	178	180	199	254
Income taxes	2	30	48	43	34	46	61	60	61	75	75	66
Depreciation & amortization	15	24	33	40	46	48	51	62	74	76	76	85
Cash & cash equivalents	267	527	678	516	388	643	549	487	647	1047	928	1091
Current asset	881	1007	1192	891	1003	1185		1369	1571	1970	1872	2316
Operating current asset												
Long-term debt	0	0	0	0	0	0	0	0	0	0	0	0
Current liabilities	201	300	970	447	566	680		986	1148	1335	1559	1891
Non-cash working capital	-201	-300	-970	-447	-566	-680	395	-986	-1148	-1335	-1559	-1891
Changes in non-cash working capital		-99	-670	523	-119	-114	1075	-1381	-162	-187	-224	-332
Free cash flow		145	725	-443	231	262	-885	1584	407	438	513	683
Free cash flow growth rate			4	-1.611	-1.5214	0.1342	-4.3779	-2.7898	-0.7431	0.07617	0.17123	0.33138
FCF estimated growth rate	-0.633											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	250.644	91.9803	33.7545	12.3871	4.54576	1.66818	0.61218	0.22466	0.08244	0.03025	0.0111	

Calculating WACC	
Beta	1.10831
RHT average return	0.00087
RHT annualized return	0.24423
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.13525
Jensen alpha	0.10898
For the fiscal year 2017	
Market value of equity	22170
Total debt	1891
Coporate tax rate	35.00%
Interest expenses	23.8
Cost of debt Kd	0.01259
WACC	0.12526

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	222.743	72.6417	23.6902	7.72594	2.51962	0.82171	0.26798	0.08739	0.0285	0.00929	0.00303
Total present value of the firm free ca	330.538										
Market value of the firm	24061										

Appendix 26 DCF valuation of RHT

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	1096	1212	1337	1360	1381	1536	1756	1962	2057	2242	2423	2725
EBIT	29	118	219	208	184	213	190	246	249	266	317	348
Net income	25	130	190	168	237	221	182	248	259	226	267	137
Income taxes	19	35	29	65	38	2	19	28	13	57	63	247
Depreciation & amortization	114	105	97	101	101	129	157	187	193	212	207	189
Cash & cash equivalents	331	579	578	702	775	855	700	1022	986	836	977	1048
Current asset	894	1328	1322	1464	1248	1338	1141	1448	1505	1564	1717	1683
Operating current asset	563	749	744	762	473	483	441	426	519	728	740	635
Long-term debt	0	0	0	0	0	0	105	75	45	0	0	134
Current liabilities	871	1031	909	815	922	1009	1253	1223	1387	1578	1715	1614
Non-cash working capital	-308	-282	-165	-53	-449	-526	-812	-797	-868	-850	-975	-979
Changes in non-cash working capital		26	117	112	-396	-77	-286	15	-71	18	-125	-4
Free cash flow		162	170	132	643	417	614	390	500	403	586	294
Free cash flow growth rate			0.04938	-0.2235	3.87121	-0.3515	0.47242	-0.3648	0.28205	-0.194	0.45409	-0.4983
FCF estimated growth rate	0.3497											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	396.813	535.58	722.875	975.667	1316.86	1777.37	2398.93	3237.84	4370.13	5898.38	7961.07	

Calculating WACC	
Beta	0.73255
SNPS average return	0.00054
SNPS annualized return	0.14309
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.09763
Jensen alpha	0.04546
For the fiscal year 2017	
Market value of equity	12740
Total debt	1748
Coporate tax rate	35.00%
Interest expenses	7.3
Cost of debt Kd	0.00418
WACC	0.08618

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	365.328	453.962	564.099	700.957	871.019	1082.34	1344.93	1671.23	2076.69	2580.52	3206.59
Total present value of the firm free c	14917.7										
Market value of the firm	14488										

Appendix 27 DCF valuation of SNPS

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	4,143.39	5,199.00	5,874.00	6,150.00	5,985.00	6,190.00	6,730.00	6,906.00	6,676.00	6,508.00	3,600.00	4,019.00
EBIT	273.965	520	602	-6,470	933	880	1,079	1,106	1,183	1,149	457	-100
Net income	156.852	404	464	($6,729)	714	597	$1,172	755	898	878	2,488	-106
Income taxes	205	227	183	112	105	298	308	251	258	215	1,213	-26
Depreciation & amortization	639	811	824	837.358	733	647	656	698	498	355	304	530
Cash & cash equivalents	2,315	2,559	1,890	1,793	3,029	2,950	3,162	4,685	3,707	2,874	5,983	4,247
Current asset	3907.932	4,071	3,730	3,300	4,351	4,486	4,633	6,416	5,652	5,422	6,959	5,324
Operating current asset	1,593	1,512	1,840	1,507	1,322	1,536	1,471	1,731	1,945	2,548	976	1,077
Long-term debt	0	$2,100	$2,100	$2,100	1,871	1,987	2,039	2,094	2,095	1,746	2,207	6,876
Current liabilities	3477.567	3,318	3,799	3,514	3,771	4,893	4,505	5,567	4,306	4,453	4,033	4,622
Non-cash working capital	-1884.64	-1806	-1959.08	-2007	-2449	-3357	-3034	-3836	-2361	-1905	-3057	-3545
Changes in non-cash working capital		78.635	-153.082	-47.918	-442	-908	323	-802	1475	456	-1152	-488
Free cash flow		1025.365	1396.082	-5696.724	2003	2137	1104	2355	-52	833	700	944
Free cash flow growth rate			0.361546	-5.080508	-1.35161	0.0669	-0.48339	1.133152	-1.02208	-17.0192	-0.15966	0.348571
FCF estimated growth rate	-0.68745											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	295.0444	92.21526	28.82161	9.0081079	2.815458	0.879963	0.27503	0.08596	0.026866	0.008397	0.002624	

Calculating WACC	
Beta	0.93518
SYMC average return	0.00032
SYMC annualized return	0.08204
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.11792
Jensen alpha	-0.0359
For the fiscal year 2017	
Market value of equity	18410
Total debt	11498
Coporate tax rate	35.00%
Interest expenses	208
Cost of debt Kd	0.01809
WACC	0.07711

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	273.9234	79.48518	23.06446	6.6926835	1.942036	0.563527	0.16352	0.047449	0.013768	0.003995	0.001159
Total present value of the firm free ca	385.9011										
Market value of the firm	29908										

Appendix 28 DCF valuation of SYMC

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	4341	5468	8074	7453	9850	9526	12478	15351	15130	14572	12994	10093
EBIT	366	415	1006	519	1525	781	1771	1266	1791	1611	466	1954
Net income	395	564	867	470	1382	726	1612	980	1617	1465	242	397
Income taxes	13	121	114	31	138	54	145	242	135	112	89	372
Depreciation & amortization	160	210	413	479	510	602	825	1233	1244	1114	1154	2128
Cash & cash equivalents	551	700	1104	1794	2734	3490	3208	4309	4804	5204	8151	6354
Current asset	1505	2029	2731	3230	4720	5487	7141	7598	8720	8517	12584	11056
Operating current asset	954	1329	1627	1436	1986	1997	3933	3289	3916	3313	4433	4702
Long-term debt	19	10	482	400	294	150	1955	1725	2313	2156	13660	12918
Current liabilities	872	1130	1564	1525	2023	2170	4032	3973	3845	3242	6949	4344
Non-cash working capital	82	199	63	-89	-37	-173	-99	-684	71	71	-2516	358
Changes in non-cash working capital		117	-136	-152	52	-136	74	-585	755	0	-2587	2874
Free cash flow		387	1441	1119	1845	1465	2377	2842	2145	2613	4118	836
Free cash flow growth rate			2.72351	-0.2235	0.64879	-0.206	0.62253	0.19562	-0.2452	0.21818	0.57597	-0.797
FCF estimated growth rate	0.35129											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	2602.84	3517.2	4752.78	6422.41	8678.57	11727.3	15847	21414	28936.7	39102	52838.3	

Calculating WACC	
Beta	1.24892
WDC average return	0.00087
WDC annualized return	0.24206
Nasdaq average return	0.00047
Nasdaq annualized return	0.12441
Risk free rate	2.43%
Cost of equity Ke	0.14933
Jensen alpha	0.09274
For the fiscal year 2017	
Market value of equity	22750
Total debt	17262
Coporate tax rate	35.00%
Interest expenses	847
Cost of debt Kd	0.04907
WACC	0.09866

1926.18

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	2369.1	2913.86	3583.88	4407.97	5421.56	6668.22	8201.53	10087.4	12407	15259.9	18768.8
Total present value of the firm free ca	90089.2										
Market value of the firm	40012										

Appendix 29 DCF valuation of WDC

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	1726.2	1842.7	1841.4	1825.2	1833.5	2369.4	2240.7	2168.6	2382.3	2377.3	2213.8	2349.3
EBIT	412	347.7	424.2	429.5	432.2	795.4	627.8	580.7	748.9	755	669.9	669.4
Net income	354.2	350.7	374	375.6	357.5	641.9	530	487.5	630.4	648.2	550.9	622.5
Income taxes	102.4	80.5	100	122.5	64.3	129.2	66.9	59.5	79.2	91.8	85.9	68.6
Depreciation & amortization	69.5	73.8	71.9	71.4	65.1	58.9	72.4	73.5	75.3	74.9	68.4	62.6
Cash & cash equivalents	783.4	635.9	866.9	1065.9	1031.5	1222.4	788.8	623.6	973.7	892.6	503.8	966.7
Current asset	1628.3	1700.1	1820.2	1752.5	1907	2622.8	2450.3	2297.6	3067.2	3935	3916.6	3880
Operating current asset	844.9	1064.2	953.3	686.6	875.5	1400.4	1661.5	1674	2093.5	3042.4	3412.8	2913.3
Long-term debt	0	0	0	0	0	0	0	0	993.9	994.8	993.6	955.3
Current liabilities	345	303.4	340.6	233	357.2	368.1	342.8	386.8	989.4	963.2	944.4	897.2
Non-cash working capital	499.9	760.8	612.7	453.6	518.3	1032.3	1318.7	1287.2	1104.1	2079.2	2468.4	2016.1
Changes in non-cash working capital		260.9	-148.1	-159.1	64.7	514	286.4	-31.5	-183.1	975.1	389.2	-452.3
Free cash flow		80.1	544.2	537.5	368.3	211.1	346.9	626.2	928.1	-237	263.2	1115.7
Free cash flow growth rate			5.794007	-0.01231	-0.31479	-0.42683	0.643297	0.805131	0.482114	-1.25536	-2.11055	3.238982
FCF estimated growth rate	0.684369											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated free cash flow	1879.251	3165.353	5331.624	8980.424	15126.35	25478.37	42914.98	72284.68	121754.1	205078.9	345428.7	

Calculating WACC	
Beta	0.952936
XLNX average return	0.000551
XLNX annualized return	0.147639
Nasdaq average return	0.000469
Nasdaq annualized return	0.124408
Risk free rate	2.43%
Cost of equity Ke	0.119696
Jensen alpha	0.027943
For the fiscal year 2017	
Market value of equity	16750
Total debt	1852.5
Coporate tax rate	35.00%
Interest expenses	53.9
Cost of debt Kd	0.029096
WACC	0.10966

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	1693.538	2570.647	3902.023	5922.939	8990.519	13646.84	20714.75	31443.23	47728.15	72447.28	109968.8
Total present value of the firm free c	319028.7										
Market value of the firm	18602.5										

Appendix 30 DCF valuation of XLNX

Estimating cash flow												
In millions dollar												
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Revenues	15895	17228	17608	15197	21633	22626	21737	21435	19540	18045	10771	10265
EBIT	808	1438	-79	627	2076	2211	1332	1312	1206	412	568	570
Net income	1210	1135	265	516	637	1328	1223	1179	1036	492	-460	207
Income taxes	288	400	231	152	256	386	272	276	215	23	62	481
Depreciation & amortization	636	656	669	698	1097	1251	1301	1358	1426	1190	563	527
Cash & cash equivalents	1399	1099	1229	3799	1211	902	1246	1764	1411	1368	2223	1293
Current asset	8754	8540	8150	9731	8639	7912	8273	8511	8874	6685	6992	6230
Operating current asset	7355	7441	6921	5932	7428	7010	7027	6747	7463	5317	4769	4937
Long-term debt	5660	6939	6774	8276	7237	7088	7447	6904	6314	6382	5305	5235
Current liabilities	4698	4077	5450	4461	6417	6381	5910	5686	6076	5254	4654	2741
Non-cash working capital	2657	3364	1471	1471	1011	629	1117	1061	1387	63	115	2196
Changes in non-cash working capital		707	-1893	0	-460	-382	488	-56	326	-1324	52	2081
Free cash flow		987	2252	1173	3377	3458	1873	2450	2091	2903	1017	-1465
Free cash flow growth rate			1.28166	-0.4791	1.87894	0.02399	-0.4584	0.30806	-0.1465	0.38833	-0.6497	-2.4405
FCF estimated growth rate	-0.0293											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
Estimated future free cash flow	1775.11	1723.06	1672.53	1623.49	1575.89	1529.68	1484.83	1441.29	1399.03	1358.01	1318.19	

Calculating WACC	
Beta	1.119484454
XRX average return	9.48901E-05
XRX annualized return	0.024005002
Nasdaq average return	0.000469136
Nasdaq annualized return	0.124407777
Risk free rate	2.43%
Cost of equity Ke	0.136369101
Jensen alpha	-0.1123641
For the fiscal year 2017	
Market value of equity	7120
Total debt	7976
Coporate tax rate	35.00%
Interest expenses	481
Cost of debt Kd	0.060305918
WACC	0.085029014

1828.73

Discounting future free cash flow											
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Year of cash flow	1	2	3	4	5	6	7	8	9	10	11
Present value (2017)	1636	1463.58	1309.33	1171.34	1047.9	937.459	838.661	750.274	671.203	600.465	537.182
Total present value of the firm free c	10963.4										
Market value of the firm	15096										

Appendix 31 DCF valuation of XRX

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	9.27	169.23	18.26

2016	8.35	115.82	13.87
2015	9.28	105.26	11.34
2014	6.49	110.38	17.01
2013	5.72	80.15	14.01
2012	44.64	76.02	1.70
2011	28.05	57.86	2.06
2010	15.41	46.08	2.99
2009	9.22	30.10	3.26
2008	6.94	12.19	1.76
2007	4.04	28.30	7.00
2006	2.36	12.12	5.14
2005	1.64	10.27	6.26
2004	0.36	4.60	12.78
2003	0.08	1.53	19.13
2002	0.18	1.02	5.67
2001	-0.07	1.56	-22.29
2000	2.42	1.06	0.44
1999	2.10	3.67	1.75
1998	1.17	1.46	1.25
1997	-8.29	0.47	-0.06

Appendix 32 Price to earnings ratio of AAPL

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	2.74	85.54	31.22
2016	2.12	62.14	29.31
2015	1.49	55.48	37.23
2014	2.66	46.45	17.46
2013	2.61	37.41	14.33
2012	2.02	26.71	13.22
2011	2.73	25.96	9.51
2010	2.13	27.91	13.10
2009	1.63	30.48	18.70
2008	1	19.44	19.44
2007	1.44	35.6	24.72
2006	1.21	29.86	24.68
2005	1.13	26.15	23.14
2004	0.76	26.72	35.16
2003	0.7	27.37	39.10
2002	1.45	25.85	17.83
2001	1.38	33.13	24.01

Appendix 33 Price to earnings ratio of MSFT

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	6.17	153.42	24.87
2016	12.43	165.99	13.35

2015	13.48	137.62	10.21
2014	15.68	160.44	10.23
2013	15.06	187.57	12.45
2012	14.53	191.55	13.18
2011	13.25	183.88	13.88
2010	11.69	146.76	12.55
2009	13.66	130.9	9.58
2008	15.68	84.16	5.37
2007	7.32	108.1	14.77
2006	6.2	97.15	15.67
2005	4.96	82.2	16.57
2004	4.47	98.58	22.05
2003	3.81	92.68	24.33
2002	2.1	77.5	36.90
2001	4.45	120.96	27.18
2000	4.58	85	18.56
1999	5.35	107.875	20.16
1998	6.75	92.1875	13.66
1997	6.18	52.3125	8.46

Appendix 34 Price to earnings ratio of IBM

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	2.04	46.16	22.63
2016	2.18	36.27	16.64
2015	2.41	34.45	14.29
2014	2.39	36.29	15.18
2013	1.94	25.96	13.38
2012	2.2	20.62	9.37
2011	2.46	24.25	9.86
2010	2.06	21.03	10.21
2009	0.79	20.4	25.82
2008	0.93	14.66	15.76
2007	1.2	26.66	22.22
2006	0.87	20.25	23.28
2005	1.42	24.96	17.58
2004	1.17	23.39	19.99
2003	0.86	32.05	37.27
2002	0.47	15.57	33.13
2001	0.19	31.45	165.53
2000	1.57	30.0625	19.15
1999	1.1	41.15625	37.41
1998	0.91	29.64063	32.57
1997	1.06	17.5625	16.57

Appendix 35 Price to earnings ratio of INTC

	Basic EPS	Closing price per share at the end of the year	P/E ratio

2017	5.01	38.3	7.64
2016	5.053	30.22	5.98
2015	5.104	27.16	5.32
2014	1.5	27.82	18.55
2013	1.87	22.43	11.99
2012	1.5	19.65	13.10
2011	1.17	18.08	15.45
2010	1.33	20.23	15.21
2009	1.05	23.94	22.80
2008	1.35	16.3	12.07
2007	1.21	27.07	22.37
2006	0.91	27.33	30.03
2005	0.88	17.12	19.45
2004	0.64	19.32	30.19
2003	0.5	24.23	48.46
2002	0.26	13.1	50.38
2001	-0.14	18.11	-129.36
2000	0.39	38.25	98.08
1999	0.65	53.5625	82.40
1998	0.44	23.20313	52.73
1997	0.35	9.291667	26.55

Appendix 36 Price to earnings ratio of CSCO

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	2.27	47.28	20.83
2016	2.11	38.45	18.22
2015	2.26	36.53	16.16
2014	2.42	44.97	18.58
2013	2.29	38.26	16.71
2012	1.99	33.32	16.74
2011	1.69	25.65	15.18
2010	1.22	31.30	25.66
2009	1.1	24.53	22.30
2008	1.08	17.73	16.42
2007	0.83	22.58	27.20
2006	0.65	17.14	26.37
2005	0.56	12.21	21.80
2004	0.51	13.72	26.90
2003	0.44	13.23	30.07
2002	0.4	10.80	27.00
2001	0.46	13.81	30.02
2000	1.11	29.06	26.18
1999	0.89	28.02	31.48
1998	0.55	7.19	13.07
1997	0.55	3.72	6.76

Appendix 37 Price to earnings ratio of ORCL

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	3.78	157.78	41.74
2016	3.73	114.61	30.73
2015	1.3	96.50	74.23
2014	3.18	92.19	28.99
2013	2.89	76.32	26.41
2012	2.67	59.48	22.28
2011	2.06	52.59	25.53
2010	1.82	49.30	27.09
2009	1.39	30.73	22.11
2008	1.45	23.79	16.41
2007	1.28	31.61	24.70
2006	1.2	30.51	25.43
2005	1.03	26.65	25.87
2004	1.62	22.00	13.58
2003	1.67	26.43	15.83
2002	0.66	23.46	35.55
2001	-0.4	21.39	-53.47
2000	1.52	19.72	12.97
1999	2.02	29.97	14.84
1998	-0.08	12.08	-151.04
1997	0.49	6.88	14.03

Appendix 38 Price to earnings ratio of INTU

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	6.32	1169.47	185.04
2016	5.01	768.66	153.43
2015	1.28	675.89	528.04
2014	-0.52	310.35	-596.83
2013	0.6	398.79	664.65
2012	-0.09	250.87	-2787.44
2011	1.39	173.10	124.53
2010	2.58	180.00	69.77
2009	2.08	134.52	64.67
2008	1.52	51.28	33.74
2007	1.15	92.64	80.56
2006	0.46	39.46	85.78
2005	0.87	47.15	54.20
2004	1.45	44.29	30.54
2003	0.09	52.62	584.67
2002	-0.39	18.89	-48.44
2001	-1.56	10.82	-6.94
2000	-4.02	15.56	-3.87
1999	-2.2	76.13	-34.60

1998	-0.42	53.54	-127.48
1997	-0.12	5.02	-41.84

Appendix 39 Price to earnings ratio of AMZN

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	3.43	175.24	51.09
2016	2.35	102.95	43.81
2015	1.26	93.94	74.56
2014	0.54	72.70	134.63
2013	0.58	59.88	103.24
2012	1.68	37.68	22.43
2011	1.67	28.27	16.93
2010	1.49	30.78	20.66
2009	0.74	36.78	49.70
2008	1.62	21.29	13.14
2007	1.24	42.73	34.46
2006	0.85	41.12	48.38
2005	1.23	36.96	30.05
2004	1.89	31.37	16.60
2003	1.14	19.54	17.14
2002	0.81	12.40	15.31
2001	0.86	15.53	18.05
2000	1.21	29.09	24.04
1999	1.97	16.81	8.53
1998	0.79	5.84	7.40
1997	1.3	5.16	3.97

Appendix 40 Price to earnings ratio of ADBE

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	2.47	67.42	27.30
2016	2.14	60.37	28.21
2015	2.44	46.97	19.25
2014	2.47	43.29	17.53
2013	1.86	45.92	24.69
2012	2.01	35.86	17.84
2011	2.43	32.06	13.19
2010	1.3	28.98	22.29
2009	1.31	25.06	19.13
2008	1.27	17.82	14.03
2007	1.04	21.87	21.03
2006	1.01	23.81	23.57
2005	0.9	25.21	28.01
2004	0.89	29.67	33.34
2003	0.37	38.63	104.41
2002	-0.34	20.6	-60.59
2001	0.11	39.05	355.00

2000	2.06	46.13	22.39
1999	0.35	45.47	129.91
1998	0.43	16.28	37.86
1997	0.38	8.77	23.08

Appendix 41 Price to earnings ratio of XLNX

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	3.78	11.63	3.08
2016	3.73	10.33	2.77
2015	1.3	10.18	7.83
2014	0.37	9.11	24.62
2013	0.38	9.87	25.97
2012	0.43	7.76	18.05
2011	0.29	9.45	32.59
2010	0.23	6.77	29.43
2009	0.12	6.00	50.00
2008	0.26	4.70	18.08
2007	0.34	8.50	25.00
2006	0.21	6.93	33.00
2005	0.14	6.54	46.71
2004	0.25	6.03	24.12
2003	0.34	7.16	21.06
2002	0.82	2.75	3.35
2001	-0.99	2.32	-2.34
2000	-0.06	1.38	-22.92
1999	-1.48	10.25	-6.93
1998	0.34	2.13	6.25

Appendix 42 Price to earnings ratio of AMSWA

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	1.09	41.12	37.76
2016	1.04	21.92	21.16
2015	1.07	14.16	13.23
2014	2.87	35.01	12.20
2013	1.16	21.75	18.75
2012	-1.04	6.34	-6.10
2011	0.17	6.29	37.00
2010	2.09	8.02	3.84
2009	-2.29	10.56	-4.61
2008	-2.10	2.64	-1.26
2007	-0.42	7.25	-17.26
2006	0.59	13.96	23.66
2005	0.29	13.31	45.90
2004	0.24	12.35	51.46
2003	-2.11	13.47	-6.38
2002	-1.51	9.74	-6.45

2001	-0.88	31.00	-35.23
2000	2.73	35.50	13.00
1999	-0.13	39.06	-300.48
1998	-0.57	25.28	-44.35
1997	1.54	12.97	8.42

Appendix 43 Price to earnings ratio of MU

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	3.19	105.06	32.93
2016	3.73	78.76	21.12
2015	2.81	68.72	24.46
2014	0.03	47.02	1567.33
2013	0.32	22.94	71.69
2012	0.23	14.52	63.13
2011	-0.84	20.60	-24.52
2010	-2.08	16.38	-7.87
2009	-3.40	17.75	-5.22
2008	-1.45	16.04	-11.06
2007	0.25	58.41	233.64
2006	0.78	50.36	64.56
2005	1.65	52.31	31.70
2004	1.95	61.68	31.63
2003	1.17	47.68	40.75
2002	0.91	24.89	27.35
2001	0.09	29.98	333.06
2000	1.86	21.31	11.46
1999	1.20	21.00	17.50
1998	1.23	14.03	11.41
1997	0.89	9.45	10.62

Appendix 44 Price to earnings ratio of EA

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	1.67	64.02	38.34
2016	3.84	65.20	16.98
2015	3.26	49.99	15.33
2014	4.73	74.33	15.71
2013	3.99	74.25	18.61
2012	3.59	61.86	17.23
2011	2.57	54.70	21.28
2010	1.98	49.49	24.99
2009	0.96	46.26	48.19
2008	1.90	35.83	18.86
2007	1.95	39.35	20.18
2006	1.44	37.79	26.24
2005	1.31	43.08	32.89
2004	1.06	42.40	40.00

2003	0.52	26.97	51.86
2002	0.23	18.20	79.11
2001	-0.38	25.25	-66.45
2000	0.93	41.09	44.18
1999	1.35	88.06	65.23
1998	0.78	3.24	4.15
1997	0.68	3.16	4.64

Appendix 45 Price to earnings ratio of QCOM

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	0.36	63.32	175.89
2016	1.30	36.79	28.30
2015	1.21	38.71	31.99
2014	1.14	20.15	17.68
2013	0.96	17.83	18.57
2012	1.01	10.62	10.51
2011	0.93	12.32	13.25
2010	0.34	12.44	36.59
2009	0.09	11.11	123.44
2008	-0.11	8.64	-78.55
2007	0.38	14.85	39.08
2006	0.15	8.62	57.47
2005	0.55	6.87	12.49
2004	0.33	5.68	17.20
2003	0.26	3.41	13.13
2002	0.26	1.82	7.01
2001	0.82	3.25	3.96
2000	0.80	1.26	1.58
1999	0.65	1.28	1.96
1998	0.22	0.93	4.21
1997	0.36	1.49	4.14

Appendix 46 Price to earnings ratio of ATVI

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	0.71	29.15	41.06
2016	-1.95	23.00	-11.80
2015	1.59	28.01	17.62
2014	0.82	36.52	44.54
2013	0.93	32.07	34.48
2012	0.90	17.97	19.97
2011	0.92	20.97	22.80
2010	0.44	30.36	68.99
2009	0.56	22.29	39.81
2008	0.26	21.00	80.77
2007	1.21	42.66	35.26
2006	1.25	44.66	35.73

2005	0.96	38.60	40.21
2004	0.94	44.82	47.68
2003	0.38	36.36	95.69
2002	0.02	21.21	1060.61
2001	-0.15	27.46	-183.05
2000	-0.48	12.19	-25.39

Appendix 47 Price to earnings ratio of XRX

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	1.41	41.12	29.16
2016	1.09	21.92	20.11
2015	0.97	14.16	14.60
2014	0.94	35.01	37.24
2013	0.78	21.75	27.88
2012	0.76	6.34	8.34
2011	0.56	6.29	11.23
2010	0.46	8.02	17.43
2009	0.39	10.56	27.08
2008	0.36	2.64	7.33
2007	0.29	7.25	25.00
2006	0.41	13.96	34.05
2005	0.24	13.31	55.46
2004	0.25	12.35	49.40
2003	0.08	13.47	168.38
2002	-0.04	9.74	-243.50
2001	-0.83	31.00	-37.35
2000	-0.53	35.50	-66.98
1999	-0.41	39.06	-95.27
1998	-0.11	25.28	-229.83
1997	-0.08	12.97	-162.11

Appendix 48 Price to earnings ratio of RHT

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	-0.13	88.00	-676.92
2016	3.46	71.12	20.55
2015	2.01	60.24	29.97
2014	1.48	50.80	34.33
2013	1.82	50.37	27.67
2012	1.89	52.25	27.65
2011	1.87	48.35	25.86
2010	1.46	54.48	37.31
2009	1.03	33.13	32.17
2008	0.96	18.77	19.55
2007	1.14	30.27	26.55
2006	0.97	21.54	22.21
2005	0.93	22.88	24.60

2004	0.75	19.48	25.97
2003	0.77	16.85	21.88
2002	0.53	9.81	18.51
2001	0.57	18.04	31.66
2000	0.51	17.92	35.13
1999	0.66	48.97	74.20
1998	0.36	19.32	53.67

Appendix 49 Price to earnings ratio of CTXS

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	1.38	79.53	57.63
2016	1.01	67.95	67.28
2015	6.31	60.05	9.52
2014	6.88	110.70	16.09
2013	4.07	83.90	20.61
2012	6.69	42.49	6.35
2011	3.14	30.95	9.86
2010	6.06	33.90	5.59
2009	2.12	44.15	20.83
2008	3.92	11.45	2.92
2007	2.57	30.21	11.75
2006	1.84	20.46	11.12
2005	0.94	18.61	19.80
2004	0.74	10.84	14.65
2003	0.93	11.79	12.68
2002	0.35	6.39	18.26
2001	-0.59	6.27	-10.63
2000	-1.53	2.44	-1.59
1999	-5.51	4.19	-0.76
1998	-3.32	15.06	-4.54
1997	3.07	16.00	5.21

Appendix 50 Price to earnings ratio of WDC

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	3.05	147.59	48.39
2016	3.05	92.49	30.32
2015	2.82	92.50	32.80
2014	2.77	82.00	29.60
2013	2.65	87.20	32.91
2012	2.20	67.34	30.61
2011	1.96	57.28	29.22
2010	1.69	52.07	30.81
2009	1.32	43.46	32.92
2008	1.35	27.89	20.66
2007	1.06	41.46	39.11
2006	0.19	21.75	114.45

2005	0.69	21.34	30.93
2004	1.12	16.03	14.31
2003	0.71	9.93	13.98
2002	0.65	5.05	7.77
2001	0.47	6.16	13.11
2000	0.52	2.81	5.41
1999	0.90	2.75	3.06
1998	0.71	2.75	3.87
1997	0.45	1.81	4.03

Appendix 51 Price to earnings ratio of ANSS

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	0.91	85.24	93.67
2016	1.76	58.86	33.44
2015	1.46	45.61	31.24
2014	1.67	43.47	26.03
2013	1.62	40.57	25.04
2012	1.24	31.84	25.68
2011	1.51	27.20	18.01
2010	1.60	26.91	16.82
2009	1.17	22.28	19.04
2008	1.33	18.52	13.92
2007	0.91	25.93	28.49
2006	-0.12	26.73	-222.75
2005	0.49	20.06	40.94
2004	0.48	19.55	40.73
2003	0.99	33.86	34.20
2002	-1.50	23.08	-15.38
2001	0.47	29.54	62.84
2000	0.71	23.72	33.41
1999	1.15	33.38	29.02
1998	1.34	27.13	20.24
1997	1.30	17.88	13.75

Appendix 52 Price to earnings ratio of SNPS

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	0.75	41.82	55.76
2016	0.71	25.22	35.52
2015	0.88	20.81	23.65
2014	0.56	18.97	33.87
2013	0.59	14.02	23.76
2012	1.63	13.51	8.29
2011	0.27	10.34	38.30
2010	0.49	8.26	16.86
2009	-0.58	5.99	-10.33
2008	-7.29	3.66	-0.50

2007	1.09	17.03	15.62
2006	0.51	17.91	35.12
2005	0.18	16.92	94.00
2004	0.27	13.81	51.15
2003	-0.07	17.98	-256.86
2002	0.28	11.79	42.11
2001	0.57	21.92	38.46
2000	0.20	27.50	137.50
1999	-0.06	24.00	-400.00
1998	0.10	29.75	297.50
1997	0.73	24.50	33.56

Appendix 53 Price to earnings ratio of CDNS

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	3.08	147.59	47.92
2016	1.13	92.49	81.85
2015	1.14	92.50	81.14
2014	0.75	82.00	109.33
2013	0.91	87.20	95.82
2012	0.96	67.34	70.15
2011	0.40	57.28	143.20
2010	-0.12	52.07	-433.92
2009	-0.05	43.46	-869.20
2008	1.45	27.89	19.23
2007	0.85	41.46	48.78
2006	1.77	21.75	12.29
2005	0.60	21.34	35.57
2004	0.46	16.03	34.85
2003	0.59	9.93	16.82
2002	1.24	5.05	4.07
2001	0.75	6.16	8.22

Appendix 54 Price to earnings ratio of NVDA

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	-2.61	104.83	-40.16
2016	-1.46	74.01	-50.69
2015	0.36	60.93	169.25
2014	1.02	60.06	58.88
2013	1.09	50.32	46.17
2012	1.25	35.35	28.28
2011	0.93	30.33	32.61
2010	0.25	38.20	152.80
2009	0.81	25.41	31.37
2008	1.55	19.65	12.68
2007	1.26	49.76	39.49
2006	1.46	40.46	27.71

2005	0.97	42.95	44.28
2004	1.08	37.95	35.14
2003	0.28	12.29	43.89
2002	0.83	7.15	8.61
2001	0.83	9.32	11.23
2000	0.08	6.73	84.18
1999	1.72	8.44	4.91
1998	1.00	10.67	10.67
1997	0.07	9.25	132.14

Appendix 55 Price to earnings ratio of ADSK

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	2.62	67.39	25.72
2016	1.88	47.37	25.20
2015	1.57	60.17	38.32
2014	1.54	64.66	41.99
2013	1.16	55.74	48.05
2012	1.16	38.76	33.41
2011	0.91	30.63	33.65
2010	0.72	23.68	32.90
2009	2.39	20.61	8.62
2008	2.34	9.61	4.11
2007	1.60	14.10	8.81
2006	1.41	11.38	8.07
2005	1.16	11.36	9.80
2004	1.73	6.65	3.84
2003	1.21	4.73	3.91
2002	1.36	3.91	2.87
2001	0.98	6.24	6.37
2000	0.60	5.78	9.64
1999	0.16	2.46	15.38
1998	0.72	3.34	4.64
1997	0.46	2.64	5.74

Appendix 56 Price to earnings ratio of CERN

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	-0.52	16.35	-31.44
2016	-0.04	14.90	-372.50
2015	-0.36	19.89	-55.25
2014	-0.47	14.27	-30.36
2013	-0.37	15.20	-41.08
2012	0.67	22.32	33.31
2011	0.13	25.16	193.54
2010	-0.07	18.18	-259.71
2009	-0.05	15.53	-310.60
2008	-0.14	10.36	-74.00

2007	-0.08	18.68	-233.50
2006	-0.14	11.46	-81.86
2005	-0.05	7.63	-152.60
2004	-0.09	4.19	-46.56
2003	-0.07	5.32	-76.00
2002	0.09	5.20	57.78
2001	-0.34	4.30	-12.65
2000	-1.26	0.47	-0.37
1999	-0.04	4.00	-100.00
1998	-0.07	1.19	-16.96
1997	-1.20	1.63	-1.35

Appendix 57 Price to earnings ratio of NUAN

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	1.01	33.99	33.65
2016	1.76	41.16	23.39
2015	-1.09	24.46	-22.44
2014	1.14	29.14	25.56
2013	2.68	34.06	12.71
2012	3.02	25.48	8.44
2011	0.34	16.46	48.41
2010	0.84	15.37	18.30
2009	-0.21	11.13	-53.00
2008	1.38	14.14	10.25
2007	1.52	25.10	16.51
2006	2.12	42.76	20.17
2005	2.86	33.94	11.87
2004	1.55	34.62	22.33
2003	0.31	19.40	62.58
2002	-1.13	11.87	-10.50
2001	2.25	18.43	8.19
2000	1.87	24.56	13.14
1999	3.45	18.94	5.49
1998	1.21	20.88	17.25

Appendix 58 Price to earnings ratio of NCR

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	-0.17	28.06	-165.06
2016	3.71	23.89	6.44
2015	1.27	21.00	16.54
2014	1.29	25.66	19.89
2013	1.08	23.58	21.83
2012	1.60	18.82	11.76
2011	0.80	15.65	19.56
2010	0.88	16.74	19.02

2009	-8.10	17.89	-2.21
2008	0.53	13.52	25.51
2007	0.42	16.14	38.43
2006	0.16	20.85	130.31
2005	0.81	17.50	21.60
2004	1.21	25.76	21.29
2003	0.85	17.25	20.29
2002	0.58	10.13	17.46
2001	0.99	8.29	8.38
2000	2.94	4.17	1.42
1999	0.89	7.33	8.23
1998	1.52	2.72	1.79
1997	0.48	2.74	5.71

Appendix 59 Price to earnings ratio of SYMC

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	10.47	184.07	17.58
2016	5.75	105.73	18.39
2015	4.11	79.42	19.32
2014	3.84	79.34	20.66
2013	0.67	54.45	81.27
2012	1.36	36.13	26.57
2011	5.86	37.02	6.32
2010	2.73	51.78	18.97
2009	-2.41	39.21	-16.27
2008	3.52	21.28	6.05
2007	4.94	43.23	8.75
2006	2.42	50.62	20.92
2005	2.17	35.68	16.44
2004	0.63	28.91	45.89
2003	-0.06	32.30	-538.33
2002	-0.71	10.80	-15.21
2001	1.41	23.22	16.47

Appendix 60 Price to earnings ratio of LRCX

	Basic EPS	Closing price per share at the end of the year	P/E ratio
2017	2.54	71.02	27.96
2016	2.56	55.84	21.81
2015	2.67	60.02	22.48
2014	2.37	52.66	22.22
2013	2.03	50.49	24.87
2012	1.74	36.94	21.23
2011	2.91	32.15	11.05
2010	2.44	36.65	15.02
2009	1.82	22.67	12.45

2008	1.49	9.03	6.06
2007	1.22	16.97	13.91
2006	0.83	19.29	23.24
2005	1.22	12.57	10.30
2004	0.77	10.58	13.74
2003	0.46	5.71	12.40
2002	0.58	3.01	5.19
2001	0.39	1.71	4.38
2000	0.32	1.51	4.73
1999	0.08	2.28	28.47
1998	0.38	0.63	1.67

Appendix 61 Price to earnings ratio of CTSH