NVIDIA Corporation Equity Valuation Report

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Abstract

The main objective of this dissertation is to determine what the fair price of an *NVIDIA Corporation* share will be on January 29, 2023.

After reviewing several articles on the different techniques for valuing a company's equity, the Discounted Cash Flow method based on the WACC discount rate was deemed the most appropriate method for the objective of this dissertation. In a complementary way, the results of the chosen method were compared with those of a relative valuation method.

The application of the first method resulted in a fair price of $252.57, which is 10.58% above the closing price on January 30, 2022, and as a result a **BUY** recommendation was presented to investors. The results of the second method proved inconclusive, showing that the company on that same day was trading at a discount in the case of the P/E multiple and at a premium in the case of the EV/EBITDA multiple. The application of both methods was supported by a comprehensive analysis of the semiconductor industry, NVIDIA's historical performance, and thorough knowledge of the markets in which the company is positioned.

In the end, a comparative analysis of the methods adopted as well as of the assumptions made in an Equity Report published by J.P. Morgan with those of this dissertation was performed. It was possible to conclude that although different approaches have been considered, the investment recommendation presented by the Report points in the same direction as that of this dissertation.

Dissertation Title: NVIDIA Corporation – Equity Valuation Report

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Resumo

Esta dissertação tem como objectivo principal determinar o preço justo de uma acção da *NVIDIA Corporation* ao dia 29 de Janeiro de 2023.

Após uma análise dos diversos artigos sobre técnicas de avaliação do capital de uma empresa, o método do Fluxo de Caixa Descontado com base na taxa de desconto WACC foi considerado o mais adequado para o propósito desta dissertação. De forma complementar, os resultados do método escolhido foram comparados com os obtidos através de uma avaliação relativa da empresa.

A aplicação do primeiro método resultou num preço justo de $252.57. Por se encontrar 10.58% acima do preço de fecho do dia 30 de Janeiro de 2022, foi apresentada aos investidores uma recomendação de **COMPRA**. Os resultados do segundo método revelaram-se inconclusivos, mostrando que a empresa nesse mesmo dia negociava com desconto no caso do múltiplo P/E e com um prémio no caso do múltiplo EV/EBITDA. Ambos os processos de avaliação se encontram suportados por uma análise minuciosa da indústria dos semicondutores, da performance histórica da empresa e um conhecimento aprofundado dos mercados em que a NVIDIA se posiciona.

No final, foi realizada uma análise comparativa dos métodos adotados bem como dos pressupostos assumidos num "Equity Report" publicado pela J.P. Morgan com os desta dissertação. Conclui-se que apesar de terem sido consideradas diferentes abordagens, a recomendação de investimento apresentada aponta no mesmo sentido que a desta dissertação.

Título da Dissertação: NVIDIA Corporation – Equity Valuation Report

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Palavras-Chave: Semicondutores; Avaliação Intrínseca e Relativa; Avaliação de Empresas; NVIDIA Corporation

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The conclusion of this dissertation marks the end of a long journey, a journey with many obstacles but also with great achievements and one that has made me the person I am today. It was years of dedication and hard work, but it was worth it for the people I got to know along the way and to whom I leave my deepest gratitude today.

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List of Abbreviation

AI	Artificial Intelligence
AMD	Advanced Micro Devices, Inc.
APV	Adjusted Present Value
AV	Autonomous Vehicles
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CAPM	Capital Asset Pricing Model
CEO	Chief Executive Officer
CES	Consumer Electronics Show
CF	Cash Flow
CMP	Cryptocurrency Mining Processor
CPU	Central Processing Unit
D	Market Value of Debt
D&A	Depreciation & Amortization
DAO	Discrete, Analog, and Other
DCF	Discounted Cash Flow
DDM	Dividend Discount Model
DPS	Dividends per Share
E	Market Value of Equity
EBIT	Earnings before Interest and Taxes
EBITDA	Earnings before Interest, Taxes, Depreciation and Amortization
EDA	Electronic Design Automation
ERP	Equity Risk Premium
EV	Enterprise Value
FCFE	Free Cash Flow to Equity
FCFF	Free Cash Flow to Firm
FSLI	Financial Statement Line Item
FY	Fiscal Year
FY20__	The company's fiscal year ended on the last Sunday in January of the stated year
g	Growth Rate
GPU	Graphics Processing Unit
hg	High growth stage

HPC	High-Performance Computing
IDMs	Integrated Device Manufactures
Intel	Intel Corporation
IoT	Internet of Things
IP	Intellectual Property
kd	Cost of debt
ke	Cost of equity
NVIDIA	NVIDIA Corporation
OEM	Original Equipment Manufacturer
OSATs	Outsourced Assembly and Test Companies
PC	Personal Computer
pp	Percentage Point
PPE	Property, Plant & Equipment
PV	Present Value
r	Discount Rate
R&D	Research & Development
rf	Risk-free rate
ROIC	Return on Invested Capital
sg	Stable growth stage
T-Note	Treasury Note
UK	United Kingdom
US	United States of America
VR	Virtual Reality
WACC	Weighted Average Cost of Capital
WSTS	World Semiconductor Trade Statistics
YTC	Yield to Call
YTM	Yield to Maturity

1 Introduction

The value of an asset is more than just a number, it is about its ability to generate stable and predictable cash flows. This valuable information to stakeholders can only be acquired through a properly conducted valuation process.

The main objective of this dissertation is to establish what the fair value of an NVIDIA share will be on January 29, 2023. At the end, an investment recommendation – **BUY**, **HOLD**, or **SELL** – is also presented, which resulted from the observed difference between the estimated price and the current market price[1].

The remainder of this dissertation is structured as follows: Section 2 presents the literature review with a critical description of the techniques used in the valuation process; Section 3 provides a description of both the company and the semiconductor industry; Section 4 contains the results of the valuation process along with the assumptions made; Section 5 compares the results of this dissertation with those of an investment bank report; Section 6 concludes this dissertation by presenting the main conclusions.

2 Literature Review

Not a year goes by without the development of new valuation models. All these new models are created around the same general principles for the purpose of valuing an asset. However, each new model uses a slightly different set of fundamental value drivers resulting in an alarmingly meaningless message as the list of models continues to grow (Young et al., 1999).

Luehrman (1997a) believes that three major factors guide any valuation model: **cash**, **timing**, and **risk**. Therefore, the choice of how to proceed simply becomes a question of how robust models are in dealing with data imperfections because, mathematically, most of them only represent a different perspective on how to express the same underlying model (Young et al., 1999).

Damodaran (2012) also recognizes this similarity between models and therefore presents four majors but not mutually exclusive valuation techniques. This dissertation focuses on only two of these techniques, which are presented below. The two unconsidered techniques are described in *Appendices 7.1* and *7.2* for future reference.

[1] January 30, 2022 was considered the reference day for the development of this dissertation.

2.1 Discounted Cash Flow Valuation

According to this technique, the value of an asset is estimated as the sum of the present value of all its expected future cash flows (Damodaran, 2012). Schill (2013) describes the technique as forward-looking because it is grounded on the present value rule and also flexible because it is able to incorporate private information into the valuation process.

This technique distinguishes itself from others because it produces its estimates always based on fundamental value drivers. For this reason, Damodaran (2012) believes that all other valuation techniques should have their foundations within this technique. Fernández (2007) is a little more radical in his words, saying that this is the only conceptually correct valuation technique.

Within this technique there are two main comprehensive approaches, the **equity** approach and the **firm** approach, with the main difference between them being the cash flows used in the valuation process. This dissertation focuses on the second approach while a description of the first approach is presented in *Appendix 7.3* for future reference.

2.1.1 Firm Valuation

In a firm valuation approach analysts estimate the value of a company as a whole. To do so, they need to use inputs in accordance with those required by the model. These are the FCFF and correspond to the cash flows available to all the company's claim holders (i.e., debt and equity holders).

$$FCFF = EBIT \times (1 - Tax\ Rate) + Depreciation\ \&\ Amortization - Capital\ Expenditure - \Delta Working\ Capital \quad (1)$$

Currently, the two models most used by analysts to perform a firm valuation are the cost of capital model, also known as the Weighted Average Cost of Capital model, and the Adjusted Present Value model.

2.1.1.1 WACC

The WACC model became the benchmark after the DCF technique grew in popularity during the 1970s (Luehrman, 1997a). The model discounts each FCFF using the cost of capital and then adds them together.

$$Firm\ Value = \sum_{t=1}^{t=n} \frac{FCFF_t}{(1 + WACC_{hg})^t} + \frac{FCFF_{n+1}/(WACC_{sg} - g_n)}{(1 + WACC_{hg})^n} \quad (2)$$

In the literature, the WACC is presented as the cost of the different sources of financing that the company can use (i.e., equity and debt), weighted by their market values. While Damodaran (2012) agrees with this definition, Fernández (2010) disagrees and presents it as one of the most common misunderstandings about the model. For him, the WACC is a weighted average of a cost and a return, not just a cost or a return.

$$WACC = \frac{E}{E+D} \times k_e + \frac{D}{E+D} \times (1 - Tax\ Rate) \times k_d \qquad (3)$$

According to *Equation 3*, the WACC is computed by using the after-tax and not the pre-tax cost of debt. To avoid a double counting issue, the CFs computed in *Equation 1* do not consider any tax benefits due to interest payments (Damodaran, 2012). In the real world there are also costs associated with debt (e.g., bankruptcy costs), which are not considered in both the WACC and the model. In this regard, Luehrman (1997b) asserts that the WACC has always had issues in dealing with financial side effects.

2.1.1.2 APV

In a natural way the WACC model is losing its reputation as the benchmark and is being replaced by a much more versatile and reliable one, the APV model (Luehrman 1997b). Unlike the WACC model, the APV model does not focus exclusively on a single type of cash flows and discount rates. Instead, it applies the DCF technique to all kinds of cash flows and uses a specific discount rate for each of them. In the end, the company's value is simply the sum of the parts (Luehrman, 1997a).

Damodaran (2012) proposes three steps that must be followed for the model to be properly applied. First, compute the company's value as if it had no leverage by discounting the FCFFs at the unlevered cost of equity. Then, estimate the value of the company's expected tax benefits. Finally, estimate the negative impact of debt on company value, by estimating the company's probability of default and both the direct and indirect costs of bankruptcy.

$$\begin{aligned} Firm\ Value = {} & Unlevered\ Firm\ Value + PV\ of\ Tax\ Shield \\ & - PV\ of\ Expected\ Bankruptcy\ Costs \end{aligned} \qquad (4)$$

Despite its clear superiority over the WACC model, the real power of the APV model lies in the information it can provide to managers. By valuing assets individually, the model helps them understand where the value of the business is coming from (Luehrman, 1997b) and this information is the most relevant when allocating resources within the company.

2.1.2 Inputs

2.1.2.1 Cost of Equity

The cost of equity represents the required return demanded by shareholders. According to the CAPM, its value is a function of the risk-free rate, the beta, and an equity risk premium.

$$k_e = r_f + \beta \times ERP \quad (5)$$

Risk-free Rate

Theoretically speaking, an asset with no default and reinvestment risk associated with it is perceived as riskless (Damodaran, 2012). In the financial world, securities issued by governments are the only ones which best fit this definition.

Fernández and Bilan (2007) observe that in many valuation processes the estimation of the cost of equity is performed with an inappropriate risk-free rate. For them, the appropriate risk-free rate should correspond to the rate of long-term government bonds, have a similar maturity as the investment horizon and be an actual rate. Furthermore, the risk-free rate should also reflect the currency in which the cash flows are measured.

Beta

According to Zenner et al. (2008), the beta works as a calibration tool factor. It plays an important role in adjusting the cost of equity upwards (downwards) in the case that the stock presents a non-diversifiable risk higher (lower) that the market one. It is also characterized by showing a natural tendency to converge towards the market beta of one (Blume, 1975).

The right value of beta is not easy to estimate and analysts often make decisions that make the task even more difficult, such as the use of historical industry betas, the use of an average beta computed with betas of similar companies or even the use of the wrong formulae to lever or "unlever" the beta (Fernández and Bilan, 2007).

Equity Risk Premium

The ERP represents the additional premium, relative to the risk-free rate, required by investors to invest in a well-diversified portfolio rather than a risk-free asset.

In the literature there is no universal agreement on how to better estimate this premium. According to Zenner et al. (2008), the best choice is to define it in a range rather than a unique value. Despite this recommendation, most of the analysis either decide to use historical values, arguing that everything reverts to historical norms or decide to use implied values, arguing that it reflects the broader picture investors have of the future of the world economy.

2.1.2.2 Cost of Debt

The cost of debt represents the cost a company must bear when it finances its operations with debt and usually changes whenever companies adjust their capital structures (Damodaran, 2012). In practical terms, this cost is a positive function of the risk-free rate and the company's default risk, and a negative function of its tax advantage of debt.

General speaking there are two ways to estimate a company's cost of debt. For a company with liquid long-term bonds outstanding with no option attached, the bonds' weighted average YTM can be directly used as the cost of debt. For a company with illiquid bonds the alternative is to use the rating of its bonds to estimate the respective default spread and then use it along with the other two variables to estimate the company's cost of debt. In the extreme case of a company with no rating issued for its bonds, the cost of debt can still be estimated by using the default spread of the company's recent borrowing history or by computing a synthetic rating from financial ratios, whereby the interest coverage ratio is the most common.

2.1.2.3 Terminal Stage

The terminal value is certainly the most important input that needs to be estimated in any valuation process but, surprisingly, it is the one where the least amount of time is spent (Young et al., 1999).

Companies reach their steady state stage when they are no longer capable of maintaining both abnormal profitability and growth, and no longer present excess returns (Schill, 2013). According to Damodaran (2012), there are three ways to estimate the terminal value. In the first, companies are expected to have a finite life and the estimated terminal value is simply the value investors would be willing to pay for the assets the company would has been able to accumulate by that point in time (see *Appendix 7.2*). In the other two alternatives, companies always have the possibility to reinvest some of their cash flows back into new assets and so they are expected to remain in operation forever. The terminal value is then estimated using some sort of multiple or through the stable growth model. Despite its simplicity, the use of multiples is not coherent with an intrinsic valuation process since it mixes two distinct approaches to valuation. For this reason, the author considers the stable growth model as the best option of the two.

Equation 6 shows the model in its simplest form. Note that both cash flows and discount rates need to be adjusted depending on whether the objective is to value the company or just its equity stake.

$$Terminal\ value_t = \frac{Cash\ flow_t \times (1+g)}{(r-g)} \tag{6}$$

The estimation of the stable growth rate is probably where most of the friction is created. While zero is assumed as the lower boundary in terms of growth rate, the upper boundary is not that simple to define. In the literature, the growth rate of the world economy is seen as the best alternative for the upper boundary value since it is not possible for a company to outgrow the world economy without eventually becoming it. This assumption also ensures that the stable growth rate will never be higher than the discount rate used in the valuation (Damodaran, 2012).

2.2 Relative Valuation

While the first technique attempts to estimate the intrinsic value of any asset, the relative valuation technique tries to estimate value by using the current market price of similar assets (Damodaran, 2012).

A well-executed relative valuation comprises two major phases. Initially, the peer group needs to be defined and the price of these companies needs to be standardized in the form of multiples. These multiples are then compared with those of the target company and an estimated value is computed.

Due to its less restrictive assumptions and simplicity, this technique is widely used by practitioners. Although Fernández (2001) acknowledges its relevance, he sees the technique as a comparison tool that should only be used in a second stage of the valuation process.

2.2.1 Peer Group

The peer group consists of companies with similar characteristics to the target company, however, the fact that in the real world no two companies are identical makes the concept only theoretical.

For Damodaran (2012), companies must have similar risks, growth, and cash flows potential to be seen as comparable whereas for Goedhart et al. (2005), they must have similar growth and ROIC expectations. Factors such as the company's size and its debt-to-equity ratio are also considered in the literature.

In essence, what matters for a good relative valuation is the thorough examination of all the companies on the potential peer list, which ultimately leads to the right peer group (Goedhart et al., 2005).

2.2.2 Multiples

Even though multiples are basically a ratio between two numbers, there needs to be some consistency in the way they are defined to avoid possible errors in the valuation process (Damodaran, 2012). If there is an equity (firm) value in the numerator, then this should correspond to an equity (firm) value in the denominator as well.

According to Damodaran (2012), multiples can be classified into four distinct categories: earnings, book value, revenue, and sector specific. Fernández (2001) suggests a different way of organizing them, presenting only three categories: multiples based on the company's capitalization, value, and growth-reference multiples.

Multiples by themselves are not good enough, they need to be contextualized by using relative multiples[2] (Fernández, 2001). The use of the right multiple is more straightforward for Goedhart et al. (2005), who only recommend the use of enterprise value multiples (e.g., EV/EBITDA) because these are less dependent on accounting rules as is the case of earnings and book value multiples. Based on empirical evidence, they also recommend the use of forward-looking multiples rather than historical ones. When not possible, the use of the most recent information available is suggested to avoid one-time events.

2.3 Final Considerations

After assessing the research on the different techniques used in valuation, those described above were perceived as the most appropriate to estimate NVIDIA's fair value.

Within the DCF technique a firm approach was considered because when investors acquire a company they not only acquire its equity stake but also all its liabilities. The model chosen was the WACC as it is the most widely used by analysts, and thus easier to make comparisons between different estimates.

The relative valuation technique was performed using two multiples. Following the recommendations of Fernández (2001) and Goedhart et al. (2005) the P/E and EV/EBITDA multiples were chosen.

[2] The exercise of comparing multiples of the target company across its history, market, or industry.

3 NVIDIA Corporation

3.1 Company Overview

Headquartered in Santa Clara, California, NVIDIA was founded in 1993 with the purpose of helping to solve some of the most challenging and complex problems in computer science. Six years after its inception, the company launched the world's first GPU[3] – the GeForce 256 – and positioned itself as the leader in the visual computing market. Over the years, NVIDIA has been able to leverage its GPU architecture into new platforms (e.g., scientific computing, AI, data science, etc.), which has allowed the company to progress along a favorable path.

3.1.1 Stock Performance

On January 22, 1999, NVIDIA went public under the symbol "NVDA" on the Nasdaq stock market. On that day, it offered 3,500,000 shares of common stock priced at $12.00 each. By the end of the first trading day the stock had reached a price of $19.69, an increase of 64.08% on its offer price.

According to *Exhibit 1*, NVIDIA shares have appreciated impressively over the last few years. On November 29, 2021, the closing price reached $333.76, the highest ever recorded. Two months later (January 30, 2022), the price had dropped to $228.40 but the company still held its position as one of the most valuable semiconductor companies with a market capitalization of $571 billion.

Exhibit 1 – Evolution of NVIDIA's share price (left) and the S&P 500 index price (right) over the last two FYs.

3.1.2 Business Segments

At the beginning of FY2021 NVIDIA adopted two new reportable segments. The ***Graphics*** segment focuses mainly on its GPU products aimed at the gaming industry, PCs, and enterprise design. It also includes the GeForce Now game streaming service and all its related infrastructure, the GRID and the Omniverse software, and the automotive platforms for

[3] "Single-chip processor with integrated transform, lighting, triangle setup/clipping, and rendering engines that is capable of processing a minimum of 10 million polygons per second".

infotainment systems. In FY2022 the segment accounted for $15.868 billion of revenue, an increase of 61.36% on FY2021. This increase was the result of the strong demand for NVIDIA's products, the launch of the new RTX 30 series GPUs, and the rising popularity of gaming. The ***Compute & Networking*** segment comprises all the business related to NVIDIA's data center platforms, its systems for AI, and both high-performance and accelerated computing. It also comprises Mellanox networking and interconnect solutions, Jetson for robotics and other embedded platforms, CMP, and all business related to the future of the automotive industry. In FY2022 the segment was responsible for $11.046 billion of revenue, representing a 61.47% increase compared to FY2021. Behind this growth were strong sales of networking products[4] and the sale of products to hyperscale customers for cloud computing and workloads.

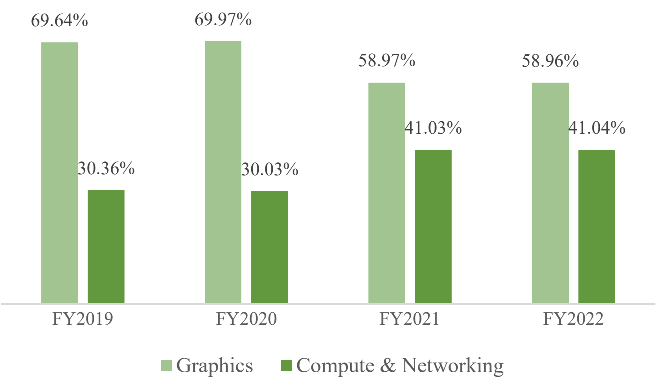

Exhibit 2 – Percentage of each business segment in terms of total revenue for the last four FYs.

3.1.3 Business Markets

As part of its business strategy, NVIDIA has specialized in four markets – **gaming**, **professional visualization**, **data center**, and **automotive**. The company has used its expertise accumulated over the years to develop a diversified family of products (e.g., GeForce, RTX, Tegra, Drive, and BlueField) that has allowed it to offer unique value propositions to its customers.

In terms of importance, the gaming business has accounted for the largest share of NVIDIA's revenue, however, over the last five FYs its share has decreased by more than 10pp. The opposite has occurred with the data center business, which saw its share increased by almost 20pp during the same period. This increase became more significant after the company acquired

[4] FY2022 was the first full year of networking revenue since Mellanox was acquired in April 2020 (FY2021).

Mellanox Technologies, Ltd. in FY2021. The share of the other two businesses has remained fairly stable over the past five FYs.

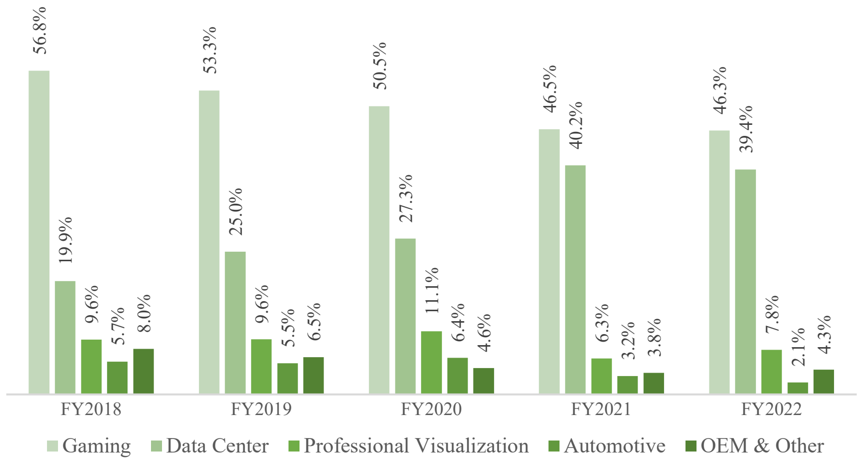

Exhibit 3 – Percentage of each business market in terms of total revenue for the last five FYs.

3.1.4 Geographical Presence

Geographically, the company allocates revenue to individual countries based on the location of the orders placed by its customers. This way, NVIDIA divides its operations between four main geographic regions: **Taiwan**, **China** (including Hong Kong), **United States**, and **other countries**. In the last five FYs, Taiwan and China accounted for about 50% of the company's total revenue. A little behind is the United States but it is worth noting the increase in its share during the years of the pandemic. The other countries still represent about 25% of the company's total revenue, but their share has been decreasing over the years and the trend is likely to continue.

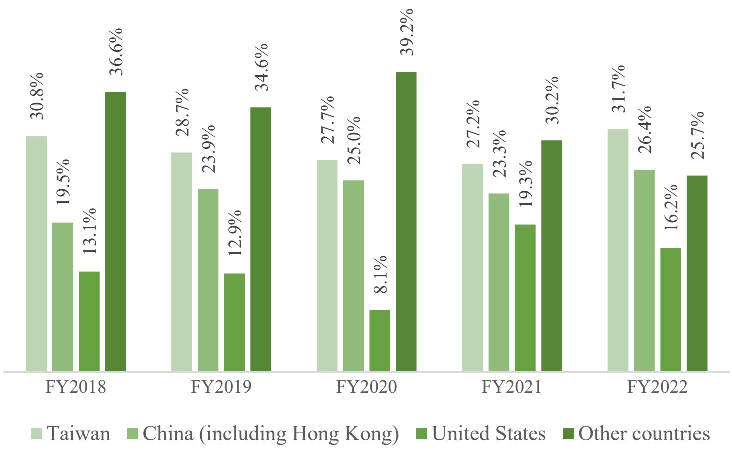

Exhibit 4 – Percentage of each geographic region in terms of total revenue for the last five FYs.

3.1.5 SWOT Analysis

To secure its position as one of the most important providers of visual computing technologies and GPUs, it is crucial that NVIDIA knows its strengths and weaknesses and understands the opportunities and threats it faces.

At this point NVIDIA may benefit from the anticipated growth for some of its key markets (e.g., semiconductor, data center, gaming, and cryptocurrency markets). Given its tremendous volatility, the cryptocurrency market could pose a potential threat to the company as well. In addition, the company faces fierce competition from its peers and a shortage in the semiconductor market, which could translate into a loss of revenue and ultimately lead to a decline in the company's financial results.

To expand its portfolio of offerings, NVIDIA builds strategic partnerships. At the same time, the company focuses on R&D as a way to strengthen its presence in key markets. These markets are then exploited through the company's wide geographic presence and loyal customers. NVIDIA's main weaknesses are its fabless manufacturing operation, the seasonality of its revenues, and the recent increases in accounts receivable. All in all, these can create liquidity problems as the company is forced to put up cash to cover potential losses.

A more detailed SWOT analysis can be found in *Appendix 7.5*.

3.1.6 Acquisitions

In recent years, the market has witnessed many acquisitions as companies try to maintain or even increase their market position by taking ownership of new innovative technologies. NVIDIA is no exception, and thus two acquisition deals are of interest.

Mellanox Technologies, Ltd.

On April 27, 2020, NVIDIA completed the acquisition of all Mellanox's outstanding shares for a total purchase consideration of $7.13 billion. By using Mellanox's high-performance interconnect products, NVIDIA believes it will be able to optimize data center workloads and have the potential to increase performance, deliver greater utilization of computing resources and lower operating costs. At the same time, the company expects to grow its business across the entire computing, networking, and storage stack.

Arm, Ltd.

On September 13, 2020, NVIDIA entered into a share purchase agreement with Arm Limited, SoftBank Group Capital Limited, and

SVF Holdco (UK) Limited to acquire all allotted and issued ordinary shares of Arm in a transaction valued at $40 billion. Despite all the efforts made by the company, on February 7, 2022, the parties agreed to terminate the deal. The decision is the culmination of the significant regulatory challenges raised during the process which ultimately blocked the consummation of the deal.

For Jensen Huang – founder and CEO of NVIDIA – the deal would have combined NVIDIA's leading AI computing platform with Arm's vast ecosystem and created the "world's premier computing company for the age of artificial intelligence". He also believed the deal would have accelerated innovation within the industry while also allowing NVIDIA to expand its presence into large and high-growth markets.

3.2 Industry Overview

3.2.1 Semiconductors

Semiconductors appeared in 1874 with the invention of the first rectifier (AC-DC converter[5]) but remained somewhat forgotten by the industry until the beginning of the second half of the twentieth century. Everything changed with the invention of the integrated circuit and semiconductors became an indispensable component of any modern electronic device. Today's semiconductors are compact, reliable, energy efficient, have low production costs, and are used in innumerous applications markets (e.g., consumer electronics, heavy industry, and automotive).

In terms of product categorization, while the industry defines more than 30 different categories, semiconductors can be organized into three broad categories: **logic**, **memory**, and **DAO**. In 2019, logic semiconductors accounted for 42% of total semiconductor sales while DAO and memory semiconductors accounted for 32% and 26% respectively.

For a detailed description of each category refer to *Appendix 7.6*.

3.2.2 Historical Performance

From 1990 to 2020 the semiconductor market grew at a 7.5% CAGR. In this period, the world witnessed some of the technological leaps with the greatest economic impact (e.g., the evolution from mainframes to PCs, the emergence of the Web, and the rise of smartphones).

The market peaked in 2018 with a value of $468.78 billion. In the year that followed and even before the pandemic hit the world, the market contracted by 12.05%, the largest in recent years,

[5] Electrical circuits that transform alternating current (AC) input into direct current (DC) output.

to a value of $412.31 billion. In 2020 the market grew by 6.81%, which however was not enough to recover the value lost as a result of the contraction. It was necessary to wait one more year for the market to recover and reach a new peak in value ($555.89 billion), owing to an astonishing 26.23% growth on the 2020 value. Measures imposed by governments around the world to prevent the spread of the virus have caused demand for chips to skyrocket in some end markets (e.g., consumer electronics), thus allowing the market to recover the value lost in 2019.

3.2.3 Future Performance

In the coming years, the market is expected to continue its current growth path. It is estimated that by 2025 the global semiconductor market will be worth $708.7 billion, a 27.49% increase on 2021. This growth will be mainly driven by the emergence of new technologies (e.g., AI, 5G networks, AV, and IoT), which will boost the demand for chips. Geographically, the Asia-Pacific, US, and European markets are expected to grow by CAGRs of 11.3%, 7.6%, and 4.6% respectively, and reach values of $530.60, $108.10, and $41.00 billion in 2025.

For 2022 *WSTS* anticipates a 10.37% growth in the global market, reaching a value of $613.52 billion. However, significant differences are expected in the growth of the various regional markets. More specifically, it is expected that the Americas will grow the most (16.4%), followed by Europe (10.8%), Japan (9.7%), and the Asia-Pacific region (8.3%).

3.2.4 Global Demand

Demand for semiconductors is spread around the world. Together, China and the United States represent almost 50% of world demand while the remaining 50% is distributed over several countries, including Taiwan, South Korea, Japan, and European countries.

In reality, there is no objective way to allocate a market share to each country since it always depends on how the point of origin of demand is defined. Nevertheless, from an economic point of view and given the fact that semiconductors are components of electronic devices, the most meaningful way to measure and allocate demand to each country is to use the location of the end users who purchase these devices (BCG & SIA, 2021). Following this reasoning, the United States is the country with the highest demand (25%), followed very closely by China (24%), and Europe (20%). For the coming years, expectations are that these percentages will change as the Chinese domestic market for electronic devices grows faster than that of other countries.

Also noteworthy is the fact that countries such as Japan, South Korea, and Taiwan, which play a leading role in the production of the most advanced semiconductors, represent a small fraction of the global demand for devices that incorporate these components with 6%, 2%, and 1% respectively. The remaining 22% are spread over several countries around the world.

3.2.5 Global Supply

The global supply chain of semiconductors is very specialized and is controlled by six major regions – United States, mainland China, South Korea, Japan, Taiwan, and Europe. According to its comparative advantage, each region plays a specific role in it.

The most intense activities in R&D (e.g., EDA, core IP, chip design, and advanced manufacturing equipment) are led by the United States, where companies get the most out of engineers who graduate from the country's top universities. East Asia is at the forefront of wafer manufacturing because companies can take advantage of the various government incentives to build "fabs" while benefiting from robust infrastructures and a skilled workforce. The last phase in semiconductor manufacturing (i.e., assembly, packaging, and testing) takes place mainly in China due to its less skill- and capital-intensive nature. More recently, countries such as Malaysia, Vietnam, and Philippines have also become involved in this phase of semiconductor manufacturing.

Over the years, various international trade agreements have allowed the free circulation of materials, equipment, products, and IP around the world, creating massive economic value. Unfortunately, as tensions between countries escalate, this integrated global supply chain is at risk. In fact, many countries are already hypothesizing the creation of a fully "self-sufficient" local supply chain to meet their current levels of semiconductor consumption. If countries decide to go ahead with this decision, it will be a severe setback for the industry as well as costly. It is estimated that it may cost at least $1 trillion in upfront investment, which will be reflected in a generalized increase in the price of semiconductors in the order of 35% to 65% and ultimately in higher consumer prices for electronic devices.

3.2.6 Business Models

In the early decades of its existence, the semiconductor industry consisted only of vertically integrated companies carrying out all stages of production. More recently, companies have been confronted with a dramatic increase in technology complexity and a need for scale to innovation in both design and manufacturing. As a result, companies started to focus on just one layer of the supply chain or vertically integrate across some of its layers. Today, no company or even an entire nation is vertically integrated across all layers of the supply chain.

According to their level of integration and business model, semiconductor companies can be categorized into four different types of companies, namely: **IDMs**, **fabless companies**, **foundries**, and **OSATs**. While IDMs are vertically integrated companies, fabless companies focus exclusively on semiconductor design, while foundries manufacture the semiconductors, and OSATs assemble, package, and test them.

With the exception of OSATs, all the other types of companies present impressive gross margins and modest operating cash flows. Fabless companies are the ones that spend most of their revenue on R&D while foundries spend it on CAPEX.

For a more in-depth description of each type of business model refer to *Appendix 7.7*.

3.2.7 Porter's Five Forces Analysis

Overall, competition in the semiconductor industry is considered to be moderate. This conclusion is supported by an in-depth analysis of the industry using Porter's five forces as a lens. The full analysis can be found in *Appendix 7.8*.

The bargaining power of both suppliers and buyers was assessed as strong and moderate, respectively. In the case of suppliers, the main factor influencing their bargaining power is the fairly small number of companies supplying raw materials and essential equipment for semiconductor manufacturing. Under these circumstances, suppliers dictate the price of their products without losing customers. In the case of buyers, their bargaining power is reduced mainly because there are a large number of companies that use semiconductors in their end-products but also because there is a great diversity in the size of those companies. On the other hand, their bargaining power is expected to increase once the number of semiconductor manufactures increases as a result of government incentives, particularly within the Chinese market.

There are currently two potential substitutes that threaten to replace semiconductors. The first is counterfeiting, which over the past few years has become more real as counterfeiters have been able to refine their products so that they cannot be distinguished from legitimate ones. The second threat is easier to fight since it is related to the evolution of technology. To protect themselves from the emergence of devices with better features than semiconductors, manufacturers need to stay ahead of the competition through a strong investment in R&D. All in all, the threat of substitutes was assessed as moderate.

As far as the threat of new entrants is concerned, this was assessed as weak since the barriers to entry in the industry are colossal, both in terms of the initial infrastructure investment and in terms of R&D.

Finally, the degree of rivalry was assessed as moderate given the trend that has been observed in the industry of large companies absorbing smaller ones. Nevertheless, to become independent from the United States and produce its own chips, the Chinese government intends to increase the number of semiconductor manufacturers in the market which can lead to greater rivalry between manufacturers.

4 Valuation

To achieve the main objective of this dissertation, I started by performing an intrinsic valuation of NVIDIA. This valuation was based on key value drivers that in my opinion support the company's potential growth in the coming years. Afterwards, I assessed the accuracy of my estimate by comparing it with the value estimated through a relative valuation. This comparison allowed me to draw my final conclusions about the fair value of NVIDIA's stock.

4.1 Intrinsic Valuation

As stated before, the model chosen to estimate NVIDIA's fair value was the WACC. The model was built using a ten-year explicit period during which the company was assumed to evolve towards its steady state stage.

Below is a description of the main steps taken to build the model. First I describe the process of extracting the key inputs for the model, then I present the main assumptions made for the fundamental variables for the estimation of the FCFFs. I end with the application of the model and a description of the results obtained.

4.1.1 Key Inputs

4.1.1.1 Cost of Equity

According to *Equation 5*, the cost of equity depends on only three variables. As such, I used different sources (e.g., Refinitiv and Damodaran's website[6]) in order to gather all the information needed. During the extraction process it was always necessary to consider the fact that NVIDIA is not yet at its steady state stage.

Risk-free Rate

Following on from what was presented in *Subsection 2.1.2.1*, I decided to use the YTM of the ten-year Treasury Note as my risk-free rate. On January 30, 2022, its value was 1.7844% (Refinitiv).

In my view, this T-Note is a good approximation of a riskless asset because it is issued by the United States, which according to Moody's has an Aaa rating and therefore no default risk. It also reflects the currency (US$) of the estimated cash flows, and its maturity equals the estimation period, thus eliminating any reinvestment risk.

[6] https://pages.stern.nyu.edu/~adamodar/

Beta

One of the most commonly used methods to estimate a company's beta is to regress its returns against the returns of a market index, where the value of the beta is given by the slope of the regression.

$$R_i = \alpha + \beta_i \times R_m \quad (7)$$

To avoid the use of misleading betas, Damodaran (2012) recommends the use of monthly returns rather than daily or weekly ones, the use of a time window in which the company's risk situation remains unchanged, and the use of a market index that includes the company without it representing a significant percentage of the index.

Following this recommendation, I decided to estimate NVIDIA's beta using monthly returns for a five-year window and the S&P 500 as a proxy for the market. From the regression, I obtained a value for the company's beta of 1.31, having assumed that it would remain constant throughout the entire estimation period.

Equity Risk Premium

Since the objective of this valuation process is to value future cash flows, I think the most logical approach involves the use of implied ERPs instead of historical ERPs.

In this case, the estimation process required two files from Damodaran's website. One of the files contained the value of the implied ERP for the US market (4.56%), which was estimated for the S&P 500 using data for February 1, 2022. By combining this value with the information in the other file, I was able to estimate the implied ERP for the main countries where NVIDIA does business. To do so, the file uses the country's rating (Moody's) to estimate an adjusted default spread that is then converted into a country risk premium. This premium is then added to the previously extracted ERP value to arrive at the implied ERP for each country. The final value obtained was 5.34% and it corresponds to the weighted average of the countries' ERP, using the reported revenues for FY2022 as weights.

Country	Equity Risk Premium	Revenue (in million $)
Taiwan	5.16%	8,544
China + Hong Kong	5.25%	7,111
United States	4.56%	4,349
Other Countries	6.14%	6,910

Exhibit 5 – Value of the estimated implied ERPs for the countries in which NVIDIA does business.

4.1.1.2 Cost of Debt

To estimate NVIDIA's cost of debt it was necessary to analyze not only its interest-bearing debt but also its operating lease commitments and its different tax incentives.

4.1.1.2.1 Company's Debt

At the end of FY2022 NVIDIA's debt had a total fair value of $12,285 million. This value corresponds to the sum of both the fair value of its bonds and its operating lease commitments.

Financial Instrument	Fair Values (in million $)
0.309% Due 2023	1,236
0.584% Due 2024	1,224
3.200% Due 2026	1,055
1.55% Due 2028	1,200
2.85% Due 2030	1,542
2.00% Due 2031	1,200
3.50% Due 2040	1,066
3.50% Due 2050	2,147
3.70% Due 2060	551
Operating Lease	1,064
Total	**12,285**

Exhibit 6 – Fair value of the financial instruments considered as NVIDIA's debt.

Bonds

According to the most recent 10-K report[7], the company currently has a total of nine public traded bonds. All these bonds include call provisions through which the company can repurchase and retire them before maturity. On January 30, 2022, the total fair value of these bonds was $11,221 million.

Operating Leases

An operating lease represents a contractual commitment whereby companies agree to make regular payments for the right to use an asset. In case of payment failure by companies, their right is revoked and they may even face a potential bankruptcy situation.

Given the characteristics of these contracts, it is my opinion that they should be recognized as company's debt as well. Therefore, I converted NVIDIA's commitments into debt and obtained an estimated total fair value of $1,064 million. For a description of the conversion process refer to *Appendix 7.10*.

[7] Published on March 18, 2022.

4.1.1.2.2 After-Tax Cost of Debt

Interest-bearing debt allows companies to benefit from a reduction in taxable income because they have the possibility to deduct the interests paid on it. As such, the only way to incorporate this benefit into the valuation process is by using an after-tax instead of a pre-tax cost of debt.

Pre-Tax Cost of Debt

To estimate NVIDIA's pre-tax cost of debt I started by extracting from Refinitiv the values of the YTC rates of the company's outstanding bonds. I chose these rates over the YTM rates because I wanted to use a rate that reflected the company's possibility to exercise the call provisions of the bonds. It was also necessary to consider the value of the discount rate used in the conversion process of the operating lease commitments into debt.

In the end, to estimate the value of the pre-tax cost of debt I computed a weighted average of the rates shown in *Exhibit 7*, using the fair value of both the notes and the operating lease commitments as weights (see *Exhibit 6*). The result was a pre-tax cost of debt of 2.67%.

Financial Instrument	Rate
0.309% Due 2023	3.45%
0.584% Due 2024	2.14%
3.200% Due 2026	1.93%
1.55% Due 2028	2.24%
2.85% Due 2030	2.47%
2.00% Due 2031	2.51%
3.50% Due 2040	3.03%
3.50% Due 2050	3.11%
3.70% Due 2060	3.24%
Operating Lease	2.51%

Exhibit 7 – Rates of the financial instruments used in the estimation process of NVIDIA's pre-tax cost of debt.

Marginal Tax Rate

Throughout its history, NVIDIA has reported an effective tax rate much lower than the US corporate tax rate (21%). According to the information provided by the company in its financial reports, the low rate is due to the fact that the company has income that is taxed in jurisdictions other than the United States (e.g., British Virgin Islands) and the fact that the company enjoys several tax incentives (e.g., benefits from foreign-derived intangible income deductions, US federal research tax credits, and tax benefits related to stock-based compensation).

Based on these facts, I think it will be very unlikely that NVIDIA, in the next years, will report an effective tax rate equal to or higher than that of the United Sates. As such, I had to project the income tax expense for each year of the estimation period so that I could get an estimate of the effective tax rate in each year. The results obtained are summarized in *Exhibit 8*, and a more detailed description of them can be found in *Appendix 7.11*.

(in million $)	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	Terminal Year
Revenue	33,643	41,313	49,823	58,991	68,548	78,144	87,365	95,752	102,838	108,185	111,431
Income Before Income Tax	10,815	13,281	16,017	18,964	22,036	25,122	28,086	30,782	33,060	34,779	35,823
Tax Expense (Fed. Rate 21%)	2,271	2,789	3,364	3,982	4,628	5,276	5,898	6,464	6,943	7,304	7,523
Tax Benefits	(1,618)	(1,872)	(2,154)	(2,457)	(2,773)	(3,090)	(3,395)	(3,673)	(3,909)	(4,089)	(4,200)
Income Tax Expense	653	917	1,210	1,525	1,855	2,186	2,503	2,791	3,034	3,215	3,323
Effective Tax Rate	6.04%	6.90%	7.55%	8.04%	8.42%	8.70%	8.91%	9.07%	9.18%	9.25%	9.28%

Exhibit 8 – Summary of the results obtained from NVIDIA's effective tax rate estimation process.

4.1.1.3 Debt-to-Capital Ratio

Throughout their lives, companies may choose to finance their projects using different sources of capital. The debt-to-capital ratio is a measure that allows both analysts and investors to understand how dependent or not a company is on debt to finance these projects.

According to the values in *Exhibit 9*, NVIDIA's debt-to-capital ratio was estimated at 2.11%. Due to its business structure and its recent debt history, I do not anticipate a significant increase in the value of the company's debt-to-capital ratio. Therefore, I assumed that the company's ratio would remain constant throughout the entire estimation period.

(in million $)	
Debt Market Value	12,285
Equity Market Value	571,000

Exhibit 9 – Values used to compute NVIDIA's debt-to-equity ratio.

4.1.1.4 Cost of Capital

With all the inputs estimated so far, it was then possible to proceed with the estimation of the WACC. In this process, the main challenge was having to also consider some of the assumptions made previously so that they would also be reflected in the WACC value itself. It was then necessary to estimate the WACC for all the years of the estimation period. The values were obtained through *Equation 3* and can be found in *Exhibit 10*.

(in %)	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	Terminal Year
Cost of Equity	8.79%	8.79%	8.79%	8.79%	8.79%	8.79%	8.79%	8.79%	8.79%	8.79%	8.79%
After-Tax Cost of Debt	2.51%	2.48%	2.47%	2.45%	2.44%	2.44%	2.43%	2.43%	2.42%	2.42%	2.42%
Debt-to-Capital Ratio	2.11%	2.11%	2.11%	2.11%	2.11%	2.11%	2.11%	2.11%	2.11%	2.11%	2.11%
WACC	8.66%	8.65%	8.65%	8.65%	8.65%	8.65%	8.65%	8.65%	8.65%	8.65%	8.65%
Cumulative WACC	1.00	1.09	1.18	1.28	1.39	1.51	1.65	1.79	1.94	2.11	-

Exhibit 10 – Value of the different components of the WACC and its own estimated value for each year of the estimation period.

4.1.2 Key Variables

4.1.2.1 Revenue

As mentioned before, NVIDIA's business activity is primarily focused on four markets. These markets represent the company's main source of revenue and as such I think the best way to project NVIDIA's total revenue is through an analysis of each of these markets. To do so, I analyzed the main projections both in terms of growth and value for the coming years. With all the information I could gather, I made my projections for the value of total revenues as well as the growth rates per year, which can be seen in *Exhibit 11*.

(in million $)	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	Terminal Year
Revenue	33,643	41,313	49,823	58,991	68,548	78,144	87,365	95,752	102,838	108,185	111,431
Growth Rate	25.00%	22.80%	20.60%	18.40%	16.20%	14.00%	11.80%	9.60%	7.40%	5.20%	3.00%

Exhibit 11 – Projected revenue values and their respective growth rates for each year of the estimation period.

Gaming

According to some experts, NVIDIA currently controls more than 80% of the discrete GPU market with the remaining 20% being mostly controlled by AMD. This dominant position results from the company's strategy of flooding the market with lots of notebooks and laptops powered by its GPUs. This strategy has translated into impressive revenues, which over the last five FYs have grown at a 22.62% CAGR.

For the coming years, analysts estimate that the GPU market could grow at an impressive CAGR of 33.6%, reaching a value of over $200 billion by 2027. Because of its technological competitive advantage over its rivals, NVIDIA is unlikely to lose control over the market space it already dominates. Later this year, the company is expected to announce its next generation of gaming GPU (RTX 40 series), which is anticipated to deliver twice as much computing power as the current generation. The combination of these two factors puts the company in the best position to take advantage of the accelerated growth expected in this market.

Data Center

In NVIDIA's most recent past, the data center segment has taken on a new importance for its business. In terms of revenue growth, the segment grew at an impressive CAGR of 53.09% in the last five FYs. This growth is no surprise to analysts as they believe that NVIDIA already controls more than 80% of the data center GPU market as well.

For the next five years analysts anticipate an annual growth rate of around 42%, thus projecting that the data center GPU market will reach an overall value of more than $20 billion by the end of 2027. If NVIDIA is able to take advantage of its dominant position while being able to respond in a timely manner to the high demand from hyperscale and cloud companies looking to acquire its high-quality GPUs, the company will be in the best position to continue with the growth trajectory it has been experiencing in the last years.

Professional Visualization

In FY2022 the segment registered a revenue of $2,111 million, an increase of more than 100% compared to FY2021. This astonishing growth was largely due to the increased need of many companies to create hybrid work environments and their choice was NVIDIA's expensive workstations.

With the rise of the metaverse, specialists believe that more and more companies will want to digitize their physical operations. As such, they expect that the metaverse market could reach a global value of $596 billion by 2027, meaning that the segment will be on a clear growth trajectory in the years ahead.

Automotive

Autonomous vehicles will be the next generation of vehicles and NVIDIA is already investing heavily in this space. The company currently has several solutions under the DRIVE brand (e.g., advanced driver assistance systems and infotainment solutions) and is also developing partnerships with auto manufactures (e.g., Mercedes Benz and Jaguar Land Rover) to equip their new fleets with NVIDIA DRIVE technology.

In FY2022 the segment accounted for only 2.10% of the company's total revenue. However, NVIDIA believes that over the next few years the automotive industry will face several inflection points that could create the company's next multibillion-dollar business.

New Markets

Earlier this year NVIDIA introduced the Grace CPU Superchip which the company says is aimed at the HPC and AI data center markets. The company is currently working with leading players in these markets so that they can integrate the Superchip into their applications. In a statement, NVIDIA says it expects the product to be launched in the first few months of 2023.

With this launch, the company intends to enter a market that has so far been controlled by its rivals Intel and AMD and make the most of a market that is valued at more than $15 billion. This foray has all the potential to become one of NVIDIA's biggest sources of revenue in the years to come.

4.1.2.2 EBITDA Margin

Over the past few years, NVIDIA has proven to be more efficient at running its business than a typical semiconductor company. By using the same architecture in the development of the vast majority of its product offering, NVIDIA is able to substantially reduce its production and product development costs. This strategy translates into higher profitability margins than its competitors.

Anticipating that NVIDIA will be able to maintain this competitive advantage, I assumed that over the next years the company will report an EBITDA margin of 65%, which corresponds to the average value over the last five FYs.

$$EBITDA = Revenue - (Cost\ of\ Revenue + SG\&A) \tag{8}$$

4.1.2.3 Net CAPEX

Net CAPEX represents the amount companies use to acquire, upgrade, and maintain their assets after deducting depreciation and amortization, and its value is often linked to the growth phase that the company is in.

Since I expect NVIDIA to significantly expand its business over the next years, I have estimated the amount of Net CAPEX so that the company can do so sustainably. As the company approaches its steady state stage the amount declines and becomes stable.

(in million $)	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	Terminal Year
Net Capex	2,780	3,155	3,492	3,766	3,946	4,010	3,936	3,714	3,345	2,841	2,229

Exhibit 12 – Net CAPEX values estimated for each year of the estimation period.

CAPEX

Unlike the company, which defines CAPEX as simply the amount spent on the acquisition of PPE, I have defined it in such a way that it also includes the amount spent on acquiring new businesses as well as the amount of R&D expenses.

Looking only at the last five FYs, R&D expenses represented more than 50% of total CAPEX. By spending heavily on R&D, NVIDIA has been able to maintain its competitive advantage while delivering impressive results.

In the coming years, I expect the company to continue to follow this strategy and as such, I anticipate that R&D expenses will continue to be the main driver behind the growth in the amount spent on CAPEX.

(in million $)	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	Terminal Year
CAPEX	6,933	8,158	9,410	10,633	11,766	12,741	13,492	13,963	14,111	13,914	13,372

Exhibit 13 – CAPEX values estimated for each year of the estimation period.

Depreciation & Amortization

For consistency reasons I had to subtract from CAPEX the amounts of both depreciation and amortization. The values used did not match those reported by the company in its financial statements because of the way I had reclassified the R&D expenses (see *Appendix 7.12*).

To model the evolution of the amount of D&A I decided to use the CAPEX-to-D&A ratio. Compared to the value of a typical US semiconductor company (1.15), NVIDIA's ratio value for the last FY was 1.71, almost 1.5 times higher. As such, I assumed that the amount of D&A would evolve so that the company's ratio would approach that of a typical US company, while remaining slightly above (1.20).

(in million $)	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	Terminal Year
Depreciation & Amortization	4,153	5,004	5,917	6,868	7,820	8,731	9,556	10,249	10,766	11,072	11,143

Exhibit 14 – Depreciation & Amortization values estimated for each year of the estimation period.

4.1.2.4 Working Capital

In this valuation process I decided to work with the non-cash working capital because cash is generally invested by companies in short-term assets that tend to earn a fair return, and thus is not needed to run a company's daily operations. Furthermore, working capital includes only those FSLIs that do not represent a financial item on the balance sheet. *Appendix 7.13* contains a list of all the FSLIs considered.

$$NonCash\ Working\ Capital = Operating\ Assets - Operating\ Liabilities \quad (9)$$

With the emergence of the pandemic and after acquiring Mellanox in FY2021, NVIDIA experienced a significant increase in its working capital needs. The increase of more than 200% is largely justified by the increase observed in the accounts receivable and inventories items. Given the current situation of the world economy, namely, the existing problems in the various supply chains, I foresee that the company will maintain a high value for its working capital needs as a percentage of revenue during the next few years, decreasing its value as the company approaches its steady state stage.

(in million $)	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	Terminal Year
Working Capital	6,729	8,263	9,965	11,430	12,853	14,164	15,289	16,158	16,711	16,904	16,715
Δ Working Capital	199	1,534	1,702	1,465	1,423	1,311	1,125	869	553	193	189
WC as % of Revenue	20.00%	20.00%	20.00%	19.38%	18.75%	18.13%	17.50%	16.88%	16.25%	15.63%	15.00%

Exhibit 15 – Working Capital values estimated for each year of the estimation period.

4.1.3 FCFF

Having estimated the values for all the variables, which according to *Equation 1* determine the value of the FCFFs, it was then possible to estimate their value. Subsequently, a different discount factor was applied to each of the FCFFs to obtain their present value. The sum of these present values totaled $200,223 million.

(in million $)	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032
FCFF	13,666	15,653	19,274	23,715	28,275	33,083	37,961	42,693	47,035	50,737
Present Value	13,666	14,406	16,326	18,487	20,287	21,846	23,071	23,880	24,214	24,039

Exhibit 16 – Value of the estimated FCFFs as well as their respective present value.

4.1.4 Terminal Value

Closure is an indispensable part of any valuation process. As such, I decided to estimate the terminal value of NVIDIA's valuation process using Equation 6. According to this equation, in addition to the FCFF and the discount rate already estimated, a growth rate is also required.

Based on what was said in *Subsection 2.1.2.3*, I decided to use the GDP projections of the main countries where NVIDIA operates for the next twelve years to get an estimate of the company's growth rate in perpetuity. To do so, I started by collecting the GDP values for the years 2021 and 2033 (see *Exhibit 17*). With the values found I computed the CAGR between the two years for each of the countries. In the end, the value used as the perpetuity growth rate was estimated at 3% and it corresponds to the weighted average of the countries' CAGRs where the revenues for FY2022 were used as the weights.

Country	CAGR (2021-20233)	Revenue (in million $)	GDP 2021 (in billion $)	GDP 2033 (in billion $)
Taiwan	2.22%	8,544	650	846
China + Hong Kong	4.83%	7,111	16,228	28,571
United States	2.07%	4,349	20,387	26,056
Other Countries	2.77%	6,910	48,289	67,003

Exhibit 17 – Estimated growth rates for the countries where NVIDIA does business.
Source: US Department of Agriculture

With all the necessary information I proceeded with the valuation process and computed the terminal value of NVIDIA. The value was estimated at $947,795 million, which corresponds to a present value of $449,068 million.

4.1.5 Share Price

To estimate NVIDIA's share price, it was necessary to perform a few more steps. First, the entire company value was estimated by adding the present value of both the FCFFs and the terminal value, resulting in a total value of $649,291 million. Second, the fair value of NVIDIA's debt ($12,285 million) was subtracted from this value to arrive at NVIDIA's equity value ($637,007 million). Third, the value of the outstanding options ($3,492 million[8]) was subtracted to get the value of equity in common stock ($633,515 million). Fourth, it was necessary to project the number of outstanding shares the company will own at the end of FY2023. This process was done in line with the historical growth rate, and a value of 2,508 million shares was obtained. Finally, NVIDIA's share price was estimated by dividing the estimated equity value by the number of shares projected, and an estimated share price of $252.57 was obtained.

On January 30, 2022, the closing price of NVIDIA's stock was $228.40, 10.58% below the price estimated in this dissertation for one year later (i.e., January 29, 2023). This suggests that NVIDIA is currently trading at a discount so my final recommendation is a **BUY** given the real possibility that investors could realize a gain if they are looking for a medium to long term investment.

4.1.6 Sensitivity Analysis

Due to the possibility that my assumptions may not reflect NVIDIA's exact reality I decided to perform a sensitivity analysis on the variables and inputs that I considered as the most relevant to the valuation process. In this analysis, I evaluated the impact that small changes in the value of these variables and inputs could have on the value of the estimated share price.

Revenue & EBITDA Margin

As expected and confirmed by *Exhibit 18*, when both variables increase/decrease so does the estimated share price. This relationship is also observed in the case where only one of the variables is held constant, however, the impact on the value of the estimated share price is slightly lower.

[8] Value reported by NVIDIA in its most recent 10-K report.

Exhibit 18 also shows relevant information regarding the range of values that the estimated share price can take. Under the conditions in which the analysis was conducted, a 2.5pp increase (decrease) in both variable leads the estimated share price to a maximum (minimum) of $294.83 ($215.53).

EBITDA Margin \ Revenue Growth Rate (FY2023)	22.5%	23.0%	23.5%	24.0%	24.5%	25.0%	25.5%	26.0%	26.5%	27.0%	27.5%
62.5%	215.53	220.20	224.96	229.82	234.77	239.81	244.96	250.20	255.55	261.00	266.56
63.0%	217.83	222.55	227.36	232.27	237.27	242.36	247.56	252.86	258.26	263.77	269.38
63.5%	220.13	224.90	229.76	234.71	239.77	244.91	250.17	255.52	260.98	266.54	272.21
64.0%	222.43	227.25	232.15	237.16	242.26	247.47	252.77	258.18	263.69	269.31	275.04
64.5%	224.73	229.59	234.55	239.61	244.76	250.02	255.38	260.84	266.40	272.08	277.87
65.0%	227.03	231.94	236.95	242.06	247.26	252.57	257.98	263.49	269.12	274.85	280.70
65.5%	229.33	234.29	239.35	244.50	249.76	255.12	260.58	266.15	271.83	277.62	283.52
66.0%	231.63	236.64	241.74	246.95	252.26	257.67	263.19	268.81	274.54	280.39	286.35
66.5%	233.93	238.98	244.14	249.40	254.76	260.22	265.79	271.47	277.26	283.16	289.18
67.0%	236.23	241.33	246.54	251.85	257.26	262.77	268.40	274.13	279.97	285.93	292.01
67.5%	238.53	243.68	248.93	254.29	259.76	265.32	271.00	276.79	282.69	288.70	294.83

Exhibit 18 – Results of the sensitivity analysis to the variables revenue growth rate (FY2023) and EBITDA margin.

Perpetuity Growth Rate

According to *Equation 6*, NVIDIA's terminal value is a positive function of the perpetuity growth rate. In this case, positive (negative) changes in the value of the growth rate will increase (decrease) the terminal value through both the numerator and the denominator.

While confirming my expectations, *Exhibit 19* also shows that positive changes in the value of the growth rate have a greater impact on the value of the estimated share price than negative changes of the same order. Just as an example, if the growth rate was to increase from 3% to 4% the value of the estimated share price would increase by $38.47, while if the growth rate was to decrease from 3% to 2% the value of the estimated share price would decrease by $26.91.

Perpetuity Growth Rate										
1.75%	2.00%	2.25%	2.50%	2.75%	3.00%	3.25%	3.50%	3.75%	4.00%	4.25%
220.15	225.66	231.60	238.02	244.99	252.57	260.85	269.94	279.95	291.04	303.39

Exhibit 19 – Results of the sensitivity analysis to the input perpetuity growth rate.

4.2 Relative Valuation

Following on from what was done in NVIDIA's intrinsic valuation, I carried out a relative forward valuation process as well. For this, I gathered all the necessary information as of January 30, 2022, for the next 12 months. In this process, I assumed that the twelve-month period would end at the same time as NVIDIA's FY2023.

4.2.1 Peer Group

Every year, NVIDIA releases an updated list of companies it considers to be its peers. According to the company, these are companies that possess an established business, a strong market presence and a similar size in terms of revenue and/or market capitalization, among other characteristics.

The most recent list, published on April 19, 2022, consists of fifteen companies which I took as a starting point to find my list of NVIDIA peers (see *Appendix 7.15*).

After an analysis of the different variables that determine the value of the multiples used in the valuation process, I ended up finding a list of peers for each of the multiples.

4.2.2 P/E

According to Damodaran (2012), three main variables determine the value of a company's P/E multiple: its payout ratio, its beta, and the expected growth rate of its earnings. In addition to these variables, it was also considered that the value of the debt-to-equity ratio would be preponderant for the selection process.

Based on NVIDIA's values for these variables, I kept only the companies that had a debt-to-equity ratio lower than 5%, a beta between 1 and 1.75, and a non-negative value for both the expected growth rate of earnings and dividends. The final result was a peer list consisting of two companies. Finally, the only thing missing was the estimation of the P/E multiple of the peer list, which was estimated through a weighted average of the forward P/E multiple of each company in which the market capitalization of each was used as weight. According to the information in *Exhibit 20*, it can be concluded that on January 30, 2022, NVIDIA was trading at a slight discount.

Company	Forward P/E	Market Capitalization *(in million $)*
Adobe Inc.	46.61	244,416
Intuit Inc.	65.26	151,443
NVIDIA Corp.	51.85	571,000
Weighted Average	53.75	

Exhibit 20 – Results of the relative valuation for the P/E multiple.

4.2.3 EV/EBITDA

Following the same line of thought used for the P/E multiple, I analyzed the values of the variables that according to Damodaran (2012) determine the value of the EV/EBITDA multiple. In this case, the variables are the companies' cost of capital, their reinvestment needs, and their expected EBITDA growth rates. In addition to these variables, I also found it relevant to analyze a profitability indicator, so I chose to consider the EBITDA margin.

Starting from the same initial list of peers, this time I kept only the companies that had an EBITDA margin between 35% and 50%, a WACC between 7.5% and 12.5%, an expected EBITDA growth rate between 30% and 45%, and both the D&A-to-EBITDA ratio and CAPEX-to-EBITDA ratio between 5% and 15%. The final result was a peer list consisting of only one company. By comparing the value of NVIDIA's forward EV/EBITDA multiple with that of the company on the peer list (see *Exhibit 21*), it is possible to conclude that on January 30, 2022, NVIDIA was trading at a premium.

Company	Forward EV/EBITDA	Market Capitalization *(in million $)*
Adobe Inc.	27.90	244,416
NVIDIA Corp.	39.47	571,000

Exhibit 21 – Results of the relative valuation for the EV/EBITDA multiple.

5 Investment Bank Report Comparison

As a way to ascertain the quality of my results, they were compared with those of an Equity Report published by J.P. Morgan ("the Report") on August 19, 2021. Unfortunately, the information disclosed by the authors about the main assumptions made in the valuation process is quite limited. Nevertheless, it was possible to identify three major differences.

The first, and perhaps the biggest difference of all, is the fact that the authors of the Report only used a relative valuation, whereas in this dissertation both an intrinsic and a relative valuation were used. Likewise, the way in which NVIDIA's share price is estimated differs as a result of the different techniques used.

The second difference identified is related to dates. In the case of the Report, its date of preparation is almost six months before the date of preparation of this dissertation. This discrepancy could possibly justify the difference observed in the value of the estimated target prices since NVIDIA's situation during these months developed more favorably than anticipated by the authors of the report. The target price dates also differ but in this case the difference is only one month. However, this difference is not expected to have any real effect on the estimated target prices.

The third and last difference identified is related to the explicit period used in both cases. While the authors of the Report only used two years into the future, this dissertation was more ambitious and looked ten years into the future. As a result, this dissertation assumes that the company grows towards reaching its steady state stage whereas in the case of the Report the company is still a long way from this stage.

Despite all the differences pointed out, it was nevertheless possible to find something similar and positive. Both documents present a target price above NVIDIA's share price on the reference day of both. As such, the recommendation issued by both is positive, being "Overweight[9]" in the case of the Report and BUY in the case of this dissertation.

All in all, it can be said that both documents have a positive view of the evolution of NVIDIA's value, yet I believe that the results found in this dissertation are much more credible since they are supported by a thorough analysis of the company and its market prospects.

[9] J.P. Morgan rating system: "over the next six to twelve months, we expect this stock will outperform the average total return of the stocks in the analyst's coverage universe."

6 Conclusions

The sole purpose of this dissertation was to estimate the fair value of an NVIDIA share and to present an investment recommendation. In order to make the estimated share price as credible as possible, several steps had to be taken.

First, I conducted a review of the literature published over recent decades with the purpose of understanding which techniques would be most suitable to value NVIDIA. From this review, I concluded that the best approach would be to use the DCF technique and apply the WACC model. This first technique would later be complemented with a relative valuation technique.

Second, I analyzed both NVIDIA's performance and business and the current state of the semiconductor industry. From this analysis, I learned that NVIDIA has a clear dominant position in the market for gaming and data center GPUs, and the company is also expected to achieve a dominant position in the professional visualization market in the coming years. Regarding the semiconductor industry, I realized that the current shortage of components represents the biggest threat to the industry's continued development. Nevertheless, companies are doing everything in their power to overcome this situation as quickly as possible.

With all the knowledge acquired through the different research, it was then possible to proceed to the construction of the model. To do so, it was necessary to project the value of the main variables of the model which proved to be quite a difficult process given the uncertainty I had regarding the sustainability of NVIDIA's dominant position. After reading many analysts reports I could conclude that there is currently a consensus that the competitive advantage that the company currently possesses is unlikely to be overcome by the competition in the coming years.

The result of the valuation process was an estimated target price of $252.57, with a recommendation to BUY the stock. To a certain extent, this result is corroborated by the J.P. Morgan report analyzed and with which the results of this dissertation were compared.

The validation of the results by the Equity Report was somewhat anticipated, considering that the different models chosen in both cases, mathematically, represent only a different perspective of the same underlying model (Luehrman, 1997a). Even so, it is not possible to guarantee absolutely that if a different perspective had been taken, the conclusions and the results obtained would be the same.

7 Appendix

7.1 Contingent Claim Valuation

Every day, companies are faced with new challenges and opportunities (Luehrman, 1997a) and managers need to have the flexibility to adjust their companies' operations and strategies in the best possible way. Goedhart et al. (2010) argue that flexibility is also responsibility since every decision taken can have a significant impact on the company's value.

A similar concept of uncertainty can also be identified when the value of an asset is contingent on the occurrence or not of a particular event (Damodaran, 2012). A classic example of this concept is the theory that values equity as a call option on the company's assets with the face value of debt as the strike price.

In the literature there is a consensus on the role that option-pricing models should play in any asset valuation process and that is, to complement and not to replace existing valuation methodologies (Goedhart et al., 2010; Luehrman, 1997a). To date, only two models have been presented by the literature as the most suitable to fulfil this role, the Black & Scholes model (1973) and the binomial option pricing model. Unfortunately, there is no agreement as to which model is the best.

For Luehrman (1997a) the first model presents itself as the best option since he believes that what managers wish is a tool that not only shares some of its inputs with those of a DCF model, but also uses as its inputs some of the outputs of the DCF model. On the other hand, Goedhart et al. (2010) argue that managers should learn both models for the simple reason that, despite its theoretical superiority, the Black & Scholes model is not always the right choice. For them, the binomial model is much more malleable and provides managers with reliable results more often.

All in all, contingent valuation is not meant to be performed alone. Its goal is to change the way managers see and value opportunities so that they can consciously question decisions imposed by traditional DCF models (Leslie & Michaels, 1997). This is clearly a different objective than this dissertation, so I did not find it appropriate to apply this technique to NVIDIA's valuation process.

7.2 Asset-Based Valuation Technique

Generally speaking, in an asset-based valuation technique the value of a company is estimated as the sum of the values of the individual assets owned by it. Although there are several variants, analysts tend to use mainly three of these variants. The first variant is the liquidation value where the company is valued as the sum of all the estimated proceeds from the sale of the company's assets. The second variant is the replacement cost whereby the value of the company corresponds to the estimated cost of immediately replacing all the company's assets. The third variant uses the assets' accounting book values, adjusting them whenever necessary, to estimate the value of a company.

Even though many authors (e.g., Fernández (2007), Damodaran (2012) and Schill (2013)) propose this valuation technique as an alternative to the more traditional one (i.e., the DCF valuation technique) I decided not to use it in my valuation process. The main reason for my decision was the fact that the necessary information to apply the technique would be difficult to obtain since most of NVIDIA's assets are intangible, and it is not easy to assign a fair value with a high degree of accuracy.

7.3 Equity Valuation

The focus of any DCF model is not on profits but rather on cash flows (Schill, 2013). In an equity valuation approach analysts use companies' residual cash flows (i.e., cash flows available to equity investors after all expenses have been paid) and discount them with the appropriate discount rate (i.e., the cost of equity) to estimate the value of the company's equity stake (Damodaran, 2012).

In terms of methodologies, there are two that stand out as the most widely used by analysts to estimate the value of equity. While the dividend discount method (DDM) is viewed as the simpler of the two, the free cash flow to equity (FCFE) discount method is considered as a more expansive version of the first.

7.3.1 Dividend Discount Method

Dividends are only offered to investors who own shares of a public traded company. When investors decide to buy these shares not only do they expect to receive the dividends but also the expected selling price at the end of the holding period, which in turn is determined by future dividends as well (Damodaran, 2012). Therefore, in the DDM the value of a share is simply the sum of the present value of all the expected dividends through infinity.

$$Value\ per\ share\ of\ stock = \sum_{t=1}^{t=\infty} \frac{E(DPS_t)}{(1+k_e)^t} \tag{10}$$

Equation 10 shows how simple and intuitive the method is by requiring no more than two inputs. The required rate of return demanded by investors measures the riskiness of the stock while the expected dividends are simply a function of both earnings and payout ratios growth rates (Damodaran, 2012). The relevance given to these growth rates is pointed out as one of the major downsides of this method. Over the years, several models have been proposed to deal with this problem differently. Of all of them, the most used are the Gordon growth, the two-stage, and the three-stage models.

In the literature these models are seen as quite specific since they are only valid for valuing mature companies with high payout policy levels. Furthermore, these models do not recognize the possibility of companies returning cash flows to their shareholders through stock buybacks. Despite these criticisms, Damodaran (2012) defends that this method is the only one that can provide equity investors with an accurate and realistic value of their investment because it uses the only cash flows available for them to demand.

In its recent past, NVIDIA has not had a very stable and long-lasting dividend policy, and for this reason I considered the use of this method inappropriate for my valuation process.

7.3.2 Free Cash Flow to Equity Method

Companies, through dividends and stock repurchases, have the opportunity to return all the cash available to their shareholders after meeting all their reinvestment needs and debt repayments. However, they may choose not to and thus accumulate cash in the company. As such, Damodaran (2012) advocates that the equity stake should be valued using a broader definition of cash flows available to shareholders known as the FCFE.

$$FCFE = Net\ Income - (Capital\ Expenditure - Depreciation) - (\Delta NonCash\ Working\ Capital) + (New\ Debt\ issued - Debt\ Repayments) \qquad (11)$$

What distinguishes a FCFE method from a DDM is that in the case of the former the value of equity is estimated using potential dividends while in the case of the latter actual dividends are used instead. Nevertheless, Damodaran (2012) sees these two methods as quite similar and therefore suggests the same models presented for the DDM with minor adjustments as the most correct ones to estimate the value of equity in this case as well. *Equation 12* shows the simplest version of these models.

$$Value\ of\ equity = \sum_{t=1}^{t=\infty} \frac{FCFE_t}{(1+k_e)^t} \qquad (12)$$

In the end, I chose not to use this method either since in my opinion it represents just a variation of the previous method, not adding anything more to the valuation process.

7.4 Shareholder Structure

Like many other US companies, NVIDIA follows an Anglo-Saxon corporate model with regard to its shareholder structure. On January 30, 2022, the vast majority of the company's shares were owned by three types of investors: institutional investors (66.66%), general public (29.27%), and strategic entities (4.07%).

Institutional Investors		Strategic Entites	
The Vanguard Group, Inc.	7.84%	Huang (Jen-Hsun)	3.42%
Fidelity Management & Research Company LLC	6.15%	Stevens (Mark A)	0.26%
BlackRock Institutional Trust Company, N.A.	4.59%	Coxe (Tench C)	0.18%
State Street Global Advisors (US)	3.90%	SoftBank Group Corp	0.04%
T. Rowe Price Associates, Inc.	1.84%	Jones (Harvey C Jr.)	0.04%
Geode Capital Management, L.L.C.	1.68%	Milestone Resources Group, Ltd.	0.02%
Jennison Associates LLC	1.10%	Seawell (A Brooke)	0.02%
Norges Bank Investment Management (NBIM)	0.85%	Puri (Ajay K)	0.02%
Northern Trust Investments, Inc.	0.77%	Banco Santander SA	0.01%
Baillie Gifford & Co.	0.73%	Kress (Colette M.)	0.01%
Other	37.21%	Other	0.04%

Exhibit 22 – Name and percentage of shares held by the top ten institutional investors and strategic entities.

7.5 SWOT Analysis

Strengths

i. **Wide Geographic Presence:** Over the years NVIDIA has been able to maintain a strong market position as well as a large customer base, all thanks to its innovative and powerful products. At the same time, NVIDIA has been able to reduce its exposure to a specific region through its wide and diverse customer network. As a result, no customer represented more than 10% of total revenue in FY2022.

ii. **R&D Focus:** As part of its business strategy, NVIDIA invests tremendous amounts of resources in R&D. Just in the last five FYs the company invested an average of 17.55% of its annual revenue in R&D. As a result of this strategy, the company has been able to improve its product offering and meet customer expectations. Currently the company has a total of 8190 patents of which 3854 were granted and 4336 were pending (November 6, 2021).

iii. **Strategic Partnerships:** Through the various partnerships developed over the years NVIDIA has been able to expand its portfolio of offerings and create a competitive advantage over its competitors. Currently, the company partners with other companies to offer, among others, better cloud and professional services. In that sense, it is worth mentioning the fact that NVIDIA recruits expert AI consultants who are then responsible for the business transformation of the company's customers through the use of AI.

Weaknesses

i. **Accounts Receivable:** In the more recent past, NVIDIA has been reporting significant increases in its accounts receivable. In the last five FYs alone, its value has increased by 267.59%, which puts the company in a fragile position. In FY2022 this FSLI already represented 16.13% of current assets and the tendency is for it to continue increasing. If the company is not able to stop this trend it could negatively affect the company's results and even endanger its liquidity position.

ii. **Fabless Manufacturing Process:** By depending on third parties and their technology to manufacture, assemble, test and/or package its products, NVIDIA has almost no control over its product quality, quantity, and delivery schedule. As a result, the company has no capacity to immediately scale up its supply chain to meet any surge in customer demand. This situation could negatively impact its business operations, revenues, and ultimately its financial results.

iii. **Revenue Seasonality:** In FY2022 the gaming market accounted for the largest share of NVIDIA's revenue (46.30%). This market is part of the consumer industry, which tends to be more active during the second half of the year. Furthermore, the company usually sees stronger revenues during the second and third quarters of its FY, resulting from a greater number of orders from its customers. Going forward, if this seasonality continues and the company is not able to accurately quantify the demand for its products, its financial position might be jeopardized.

Opportunities

i. **New Product Launches:** At the CES 2022 event NVIDIA reinforced its commitment to the continued improvement of PC gaming on both laptops and desktops by launching new versions of its GeForce RTX 30 series. At the same event the company also announced the launch, later this year, of its next series generation, the GeForce RTX 40 series, its 4^{th} generation Max-Q technology that uses AI to improve the allocation of power between GPU and CPU, resulting in better image quality, frame rate and battery life. The company hopes that these new products will make some of the experiences that today are only science fiction a reality in the near future.

ii. **Semiconductor Market:** Over the next few years, the global semiconductor market is expected to grow at a CAGR of 10% to reach a value of $708.7 billion by 2025. For the same period, the Asia-Pacific region and the US markets are expected to grow at a CAGR of 11.3% and 7.6% respectively. Given the relevance of both markets to NVIDIA's operation (i.e., they represented nearly 75% of NVIDIA's revenue in FY2022), their projected growth could mean a great opportunity for NVIDIA to increase its market share as well as grow its revenue.

iii. **Data Center Market:** NVIDIA's acquisition of Mellanox Technologies, Ltd. made it possible to merge two of the world's leading companies in the high performance and data center computing markets. Given the indications that the data center market is on a high growth trajectory, this strategic move could lead to an expansion of NVIDIA's customer base. These new customers may be attracted by the low operating costs, the greater utilization of computing resources, and the higher performance that results from combining the technologies of both companies.

iv. **Automotive Market:** The global automotive manufacturing market is estimated to be worth $1,733.1 billion by the end of 2024, an 8% increase over the 2019 figure (MarketLine). NVIDIA designs and sells technologies that focus on self-driving cars. This type of car has undergone heavy investment in recent years and the trend is for this to continue as new technologies are launched that bring us closer to having a fully autonomous vehicle. The recent agreement (June 2020) with Mercedes-Benz (Daimler AG) is a clear sign that the company does not intend to waste this opportunity to establish itself in a clearly growing market. The main objective of this partnership is the development of the most advanced and sophisticated computing architecture ever deployed in a vehicle, with the potential that it can later be incorporated by more manufacturers into their vehicles.

v. **Cryptocurrency Market:** In early 2021, NVIDIA announced its first CMP. This new processor is based on the same architecture of its GPUs and capable of delivering the best professional mining performance and efficiency. With this new product line, the company aims to reduce the current demand for GPUs by professional miners and allow gamers to purchase them, thus taking advantage of the cryptocurrency market while satisfying its loyal customers.

Threats

i. **Intense Competition:** NVIDIA operates in markets which have shown strong growth potential over the years. As such the company faces competition not only from existing but also from potential new players. In addition to this there is also the possibility of alliances being created between NVIDIA's competitors with the aim of weakening the company's position. Both situations could cause pressure on prices and ultimately lead to a reduction in NVIDIA's profitability.

ii. **Cryptocurrency Market:** Besides representing a great opportunity for the company, the cryptocurrency market also represents a great threat to NVIDIA business. Currently, the company's GPUs are used by professional miners to solve the mathematical puzzle known as "proof-of-work" but if there is a sharp decline in the value of cryptocurrencies, miners will try to get rid of their GPUs which will eventually flood the market with second-hand GPUs. This situation could translate into reduced sales of new GPUs, creating an inventory build-up problem.

iii. **Semiconductor Chip Shortage:** With the emergence of the pandemic the market became unbalanced. The immediate result was an excessive demand for chips, which in turn led to a shortage in the market. At the moment, foundries are trying to increase their factories' capacity to soften the impact on fabless companies' operations. Despite all efforts, NVIDIA's CEO (Jensen Huang) believes that the shortage will last until 2023.

7.6 Semiconductors Categories

Logic semiconductors are integrated circuits that operate using binary code and work as the "brains" of electronic devices. This category comprises four different types of products:

i. **Microprocessors** are responsible for processing fixed instructions, essential for executing complex computing operations stored on memory devices. They can be CPUs, GPUs, and application processors. They can be found in mobile phones, PCs, AI systems, and supercomputers.

ii. **General purpose logic** products allow users to program custom logic operations since these are sold without any pre-fixed set of instructions. The best known of all is the Field Programmable Gate Arrays, invented by Xilinx, Inc. in 1985.

iii. **Microcontrollers** consist of one or more processor cores along with both memory and programmable input/output peripherals. They can be described as tiny computers on a single chip that perform basic computing tasks on a multitude of electronic devices.

iv. **Connectivity** products such as cellular modems, Wi-Fi, Bluetooth chips, and Ethernet controllers allow devices to connect together in order to transmit and receive data.

Memory semiconductors are used by computers to store the information necessary to perform computations. Today, the most widely used semiconductor memories are:

i. **Dynamic Random-Access Memory** (DRAM) are responsible for temporarily storing the data or program code needed by a computer processor to function. This type of memory semiconductors is normally found in PCs but there is a growing demand for DRAM in the smartphone and automotive industry.

ii. **NAND** is used for permanent storage since it does not require power to preserve data. It is the most common type of flash memory and it can be found in applications such as solid-state drives (SSDs) and secure digital (SD).

Discrete, Analog, and Other (DAO) are semiconductors responsible for transmitting, receiving, and transforming the information regarding the continuous parameters (e.g., temperature and voltage).

i. **Discrete** products perform a single electrical function. These can be found as diodes and transistors.

ii. **Analog** products translate analog signals into digital ones. This category includes voltage regulators, data converters, power management integrated circuits, and radio frequency semiconductors.

iii. **Other** products include optical sensors used in cameras to sense light, a wide variety of non-optical sensors and actuators found in IoT devices.

7.7 Semiconductor Business Models

Depending on the level of integration and business model, it is possible to identify four different types of semiconductor companies:

i. **Integrated Device Manufacturers** (IDMs) are companies that still maintain the business model that was predominant in the early years of the industry. These companies design, manufacture, assemble, pack, and test all of their devices (e.g., memory and DAO products) in-house. The most recognized company in the industry that uses this business model is Intel Corporation.

ii. **Fabless** companies became more predominant in the industry after the 1990s. This change resulted from the inability of companies to manage both the capital intensity of manufacturing and the high levels of R&D spending on design. Unlike IDMs, these companies focus solely on one layer of the supply chain (i.e., the design of semiconductors), and outsource the remaining layers (i.e., manufacturing, assembly, packaging, and testing processes) to specialized companies. During the last 20 years, with the migration to smaller manufacturing nodes, these companies were able to triple their share of the total semiconductor sales, increasing from 10 to 30%. In terms of companies, the most recognized worldwide are NVIDIA Corporation and Advanced Micro Devices, Inc..

iii. **Foundries** mainly address the manufacturing needs of fabless companies, however, they can also address some of IDMs' production needs, as these companies may not have sufficient installed manufacturing capacity in-house to cover all of their needs. With such a large customer base, foundries manage to diversify the risk linked to the large upfront capital expenditure required to build modern "fabs". More recently, they have been responsible for a significant increase in the production capacity of the industry and are currently the only companies capable of producing at the leading 5 nanometer node. With more than 50% market share, Taiwan Semiconductor Manufacturing Company, Limited is the most technologically advanced foundry in the world.

iv. **Outsourced Assembly and Test** (OSATs) companies provide services such as assembly, packaging, and testing which require lower-skilled labor. These companies emerged during the 1960s, and with the implementation of the fabless-foundry model specialized OSAT companies were created. One of the most relevant companies offering this type of service is Advanced Semiconductor Engineering, Inc..

7.8 Porter's Five Forces Analysis

In this analysis, semiconductor manufacturers were considered as the players of the market, electronic manufacturers as buyers, and both material producers and wafer fabrication plants as the suppliers.

<u>Buyer Power</u> – Moderate Low

i. **Buyer Presence:** Buyers in the semiconductor market range from large multinationals to small OEMs. With such a variety of buyers, their bargaining power is reduced as players have a wider range of possibilities to whom they can sell semiconductors.

ii. **Government Initiatives:** Recently the Chinese government launched a state-funded initiative that aims to increase the number of semiconductor manufacturers operating in the market. This initiative may result in increased competition among players and ultimately lead to an increase in the bargaining power of buyers. The growing trade tension between the United States and China is limiting the desired effect of this initiative and may even end up negating its intended effect.

iii. **Product Differentiation:** Buyers that use undifferentiated semiconductors have much more bargaining power than those that use differentiated semiconductors. In the first case, the market operates almost in perfect competition and buyers can easily switch players without incurring any additional costs. In the second case, given the uniqueness of the semiconductor, buyers have to buy it from the few players that exist and thus accept the terms imposed by them.

iv. **Consumer Pressure:** To remain competitive and offer consumers products that meet their expectations, buyers need to incorporate the latest technologies into their end-products. This pressure puts them in a position of dependence on players, which in turn translates into a reduction of their bargaining power. To make matters worse, as AI and VR become the norm in many industries, buyers may experience a further reduction of their bargaining power as they become even more dependent on players to continue to be competitive in their own markets.

v. **Price Sensitivity:** As part of their strategy to remain competitive, buyers always look for the best semiconductor at the cheapest price. As such, players try to slightly reduce the price of their semiconductors in order to attract the largest number of buyers and thus have the highest possible profit. In this situation, buyers have a high bargaining power given that they can choose the player that offers the best price-quality ratio.

Supplier Power – Strong High

i. **Raw Materials Suppliers:** To produce the best semiconductor device, manufacturers can need up to 300 different materials and perhaps one of the most difficult to obtain is the polysilicon used to build the silicon (*Si*) ingot that is sliced into wafers. This component requires a purity level 1,000 times higher than that required to build solar energy panels and very few companies are able to supply it. In fact, only four companies are responsible for 90% of its supply. On top of this, Japan and South Korea are in the middle of a trade conflict that involves chemicals indispensable to semiconductor production, which could result in a drop in production. All these factors combined give raw material suppliers enormous bargaining power over players.

ii. **Foundries:** The semiconductor industry is currently dominated by the fabless-foundry model. When fabless companies outsource the manufacturing of their chips to foundries, they put themselves in a very delicate position by becoming dependent on foundries to get their products to market. This dependency is aggravated by the fact that the number of foundries, with the technology to produce a given chip, is quite limited. As such, the manufacturing process is controlled by foundries, which can afford to choose the players they want to work with because of their tremendous bargaining power over fabless companies.

iii. **Manufacturers of Equipment for Fabs:** Building a "fab" is a very expensive process. According to some industry experts, it is estimated that a new semiconductor factory can cost between $5 to $20 billion (BCG & SIA, 2021). A large part of the cost is allocated to the purchase of manufacturing equipment, which not only needs to be purchased when the "fab" is built but also as both technology and the industry evolve. Under these circumstances, the bargaining power of manufacturing equipment suppliers is very high since few companies possess the technology needed to produce this kind of equipment and mainly because the price of changing all the equipment once a supplier is chosen is unimaginable.

New Entrants – Weak

i. **Cyclical Demand:** Since demand for semiconductors is quite cyclical, players need to estimate it as accurately as possible to survive in this market. In most cases, new entrants lack the resources to do so and for this reason their best decision is not to risk entering into such a volatile market.

ii. **Global Dominance:** Today, the global semiconductor market is dominated by a small number of large companies. These companies operate in top-notch manufacturing infrastructures and at the same time have superior R&D capabilities compared to potential new entrants. Without the resources to keep up with the investments made by incumbents, start-ups are prevented from entering the semiconductor market even if they possess innovative products.

iii. **Barriers to Entry:** The market for semiconductors is characterized by two main barriers to entry, which make the threat of new entrants rather low. On the one hand, there is the initial investment required to establish a “fab”, which can cost up to $20 billion. On the other hand, there is the level of R&D required to remain competitive in this market. All in all, start-ups do not have the capacity to raise such a large number of financial resources and so, they prefer to stay out of this market.

iv. **Chinese Market:** China is one of the largest consumers of semiconductors in the world, so access to its domestic market becomes vital for a company’s sustainable growth. Because of its attractiveness, the threat of new entrants is higher in the Chinese market than in any other market in the world. This threat became more real in 2019 when the Chinese government created a fund, worth $28.9 billion, with the goal of becoming independent from the United States in terms of its ability to produce chips. Additionally, the trade war between these two countries has further exacerbated this threat since China was prevented from importing semiconductors from the United States (e.g., the Huawei ban).

v. **Regulation:** For some years now, in the semiconductor market there has been a constant concern regarding environmental health and the safety of workers in countries at war. To address these concerns, governments as well as associations have taken measures and implemented legislation that may in some ways prevent new entrants to establish in this market as they will face tighter regulation.

vi. **Growing Markets:** Over the next few years the demand for semiconductors will be driven by fast-growing technology markets (e.g., AI, VR, IoT, and 5G networks). There is a great possibility that innovative semiconductors, capable of responding to the technological needs of these markets, will be introduced by start-ups which could result in a greater threat of new entrants.

<u>Threat of Substitutes</u> – Moderate

i. **Semiconductor Applications:** Given their enormous versatility, semiconductors are used in countless end-markets. In fact, with today’s technology, buyers cannot find a viable alternative. However, this comfortable position of players may be at risk as new devices, capable of offering improved characteristics, replace semiconductors in the near future. To protect themselves from this potential threat, players need to be at the forefront of technological innovation.

ii. **Counterfeiting:** The evolution of technology has made it possible to salvage old electronic equipment. By doing so, counterfeiters are able to reuse the semiconductors inside these devices and make them look like as if they were legitimate. Unable to distinguish the real from the counterfeit, inspection authorities have not been able to prevent the introduction of these devices into the supply chain, making this the most real threat that semiconductor manufacturers face today.

Degree of Rivalry – Moderate Low

i. **Chinese Market:** Rivalry in the global semiconductor market is expected to increase as China continues to modernize and develop its domestic market. The state-funded initiative, launched in 2019, aims to help Chinese players to compete directly with the market's leading players (e.g., Samsung and TSMC) and thus achieve a more dominant position in the global market.

ii. **Consolidation:** As mentioned before, surviving in the semiconductor market is no easy task. Survival has become even more difficult after the market contraction in 2019 and the pandemic outbreak in early 2020. Thus, and following the trend that has been observed over the years, small players were forced to merge with larger ones making the market more concentrated and with less rivalry between players.

iii. **Emerging Technologies:** As emerging technology markets (e.g., AI, VR, IoT, and 5G networks) move into a more mature stage, rivalry between players is expected to diminish. The sustainable growth of these markets will create room for all players to coexist more smoothly, without them colliding all the time.

iv. **Unfair Competition:** As mentioned before, the semiconductor market is very concentrated and has little rivalry between players. However, the situation seems to be changing but for the wrong reasons. In recent years, counterfeit semiconductors have managed to enter the market, competing directly with legitimate semiconductors. Since it is not easy to distinguish a legitimate from a non-legitimate semiconductor, the rivalry between players – legitimate and non-legitimate – becomes greater as there are more players operating in the same market space.

7.9 Regression Beta

Regression Statistics	
Multiple R	0.461500152
R Square	0.212982391
Adjusted R Square	0.199413121
Standard Error	0.113055277
Observations	60

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.200617547	0.200617547	15.69593679	0.000206123
Residual	58	0.741326744	0.012781496		
Total	59	0.941944291			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.030549916	0.015280069	1.999330972	0.050264832	-3.64661E-05	0.061136298	-3.64661E-05	0.061136298
Beta (NVDA)	1.312629416	0.331320656	3.961809787	0.000206123	0.649419067	1.975839765	0.649419067	1.975839765

Exhibit 23 – Results obtained in the estimation process of NVIDIA's beta.

7.10 Operating Leases

As stated before, NVIDIA's operating lease commitments were converted into debt. This process required the use of an excel file taken from Damodaran's website.

The file starts by computing the present value of NVIDIA's annual commitments, using the discount rate provided by the company in its most recent 10-K report (2.67%). Then, these values are added to obtain the total present value of NVIDIA's operating lease commitments. In the end, this value is summed to the value of the company's interest-bearing debt to arrive at the total fair value of NVIDIA's debt.

Exhibit 24 shows the values of these annual commitments and their present value for FY2022 as well. For FY2022, the total present value was estimated at $1,064 million.

Year	**Commitement** (in million $)	**Present Value** (in million $)
FY2023	200	195
FY2024	186	177
FY2025	160	149
FY2026	148	134
FY2027	138	122
FY2028 & beyond	168	286
Total	**1,001**	**1,064**

Exhibit 24 – NVIDIA's operating lease commitment values for the coming years.

After this conversion it was also necessary to make some adjustments, namely to the value of the operating income (EBIT), D&A, and the book value of NVIDIA's debt. *Exhibit 25* shows the values of these adjustments made for the last five FYs.

(in million $)	FY2018	FY2019	FY2020	FY2021	FY2022
Operating Income (EBIT)	8	4	30	34	16
Depreciation & Amortization	46	76	84	111	152
Book Value of Debt	228	605	670	779	1,064

Exhibit 25 – Values used to adjust the different items for the period between FY2018 and FY2022.

7.11 Marginal Tax Rate

(in million $)	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	Terminal Year
Revenue	33,643	41,313	49,823	58,991	68,548	78,144	87,365	95,752	102,838	108,185	111,431
Income Before Income Tax	10,815	13,281	16,017	18,964	22,036	25,122	28,086	30,782	33,060	34,779	35,823
% of Revenue	32.1%	32.1%	32.1%	32.1%	32.1%	32.1%	32.1%	32.1%	32.1%	32.1%	32.1%
Tax Expense (Fed. Rate 21%)	2,271	2,789	3,364	3,982	4,628	5,276	5,898	6,464	6,943	7,304	7,523
Benefit Resulting From:	1,618	1,872	2,154	2,457	2,773	3,090	3,395	3,673	3,909	4,089	4,200
State Income Taxes, Net of Federal Tax Effect	40	49	59	70	81	92	103	113	122	128	132
Foreign Tax Rate Differential	475	583	703	832	968	1,103	1,233	1,351	1,452	1,527	1,573
Stock-Based Compensation	371	456	550	651	756	862	964	1,056	1,134	1,193	1,229
US Federal R&D Tax Credit	328	403	486	575	668	762	852	934	1,003	1,055	1,087
Other	41	51	61	73	84	96	108	118	127	133	137
Tax Cuts and Job Act of 2017	0	0	0	0	0	0	0	0	0	0	0
Foreign-Derived Intangible Income	525	530	536	541	547	552	558	563	569	574	580
IP Domestication	0	0	0	0	0	0	0	0	0	0	0
Tax Expense Related to Intercompany Transaction	0	0	0	0	0	0	0	0	0	0	0
Restructuring and Expiration of Statute of Limitations	0	0	0	0	0	0	0	0	0	0	0
Income Tax Expense	653	917	1,210	1,525	1,855	2,186	2,503	2,791	3,034	3,215	3,323
Effective Tax Rate	6.04%	6.90%	7.55%	8.04%	8.42%	8.70%	8.91%	9.07%	9.18%	9.25%	9.28%

Exhibit 26 – Estimated values in NVIDIA's effective tax rate estimation process.

7.12 Reclassification of R&D Expenses

NVIDIA classifies R&D expenses as operating expenses because it considers them to be indispensable to the normal running of its business. I, on the other hand, consider them more as capital expenses since their purpose is to finance the development of products with the potential to become a profitable source of revenue for the company. For this reason, I decided to reclassify the R&D expenses.

With the reclassification of R&D expenses it was also necessary to adjust some items. The values of these adjustments, for the last five FYs, are presented in Exhibit 27.

(in million $)	FY2018	FY2019	FY2020	FY2021	FY2022
Operating Income (EBIT)	351	711	802	1,374	1,910
Depreciation & Amortization	1,227	1,329	1,487	1,690	2,060
CAPEX	1,578	2,040	2,289	3,064	3,970
Book Value of Capital	4,130	4,840	5,643	7,016	8,926

Exhibit 27 – Values used to adjust the different items for the period between FY2018 and FY2022.

7.13 Working Capital

Assets	Liabilities
Accounts Receivable	*Accounts Payable*
Inventories	*Accrued Expenses*
Prepaid Expenses	*Customer Advances*
Deferred Income Tax	*Income Taxes Payable*
Deferred Charges	*Deferred Income Tax*
Other Assets	*Other Payables*
	Other Liabilities

Exhibit 28 – List of all FSLIs considered in the estimation of NVIVIA's working capital needs.

7.14 Sensitivity Analysis

Beta

1.06	1.11	1.16	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.56
338.25	317.17	298.38	281.53	266.33	252.57	240.04	228.59	218.08	208.42	199.49

Exhibit 29 – Results of the sensitivity analysis to the input beta.

Working Capital as % of Revenue

15.0%	16.0%	17.0%	18.0%	19.0%	20.0%	21.0%	22.0%	23.0%	24.0%	25.0%
254.80	254.35	253.91	253.46	253.01	252.57	252.12	251.67	251.23	250.78	250.34

Exhibit 30 – Results of the sensitivity analysis to the variable Working Capital.

D&A as % of Revenue

2.5%	4.0%	5.5%	7.0%	8.5%	10.0%	11.5%	13.0%	14.5%	16.0%	17.5%
249.33	249.97	250.62	251.27	251.92	252.57	253.22	253.50	252.85	252.20	251.56

Exhibit 31 – Results of the sensitivity analysis to the variable Depreciation & Amortization.

CAPEX as % of Revenue

4.5%	6.0%	7.5%	9.0%	10.5%	12.0%	13.5%	15.0%	16.5%	18.0%	19.5%
288.01	280.92	273.83	266.74	259.65	252.57	245.48	238.39	231.30	224.21	217.13

Exhibit 32 – Results of the sensitivity analysis to the variable CAPEX.

7.15 Peer List

Adobe Inc.	International Business Machines Corp.	Salesforce Inc.
Advanced Micro Devices Inc.	Intuit Inc.	SAP SE
Broadcom Inc.	Oracle Corp.	Tesla Inc.
Cisco Systems Inc.	PayPal Holdings Inc.	Texas Instruments Inc.
Intel Corp.	Qualcomm Inc.	VMware Inc.

Exhibit 33 – Name of the fifteen companies NVIDIA considers as its peers for FY2022.

7.16 P/E Multiple

Company	Forward P/E	Debt-to-Equity Ratio *(FY0)*	Beta CAPM	Expected Growth Rate in EPS	Expected Growth Rate in DPS
Adobe Inc.	46.61	1.98%	1.02	10.90%	0.00%
Advanced Micro Devices Inc.	33.15	0.61%	1.99	23.41%	0.00%
Broadcom Inc.	24.88	19.03%	1.06	50.03%	10.62%
Cisco Systems Inc.	18.69	6.35%	0.98	18.99%	4.61%
Intel Corp.	15.18	22.09%	0.55	-35.28%	3.26%
International Business Machines Corp.	18.11	49.55%	1.02	45.29%	3.12%
Intuit Inc.	65.26	1.63%	1.11	8.50%	14.09%
NVIDIA Corp.	51.85	2.15%	1.42	14.51%	22.90%
Oracle Corp.	24.66	42.26%	0.80	-28.26%	12.32%
PayPal Holdings Inc.	43.07	5.28%	1.20	8.01%	0.00%
Qualcomm Inc.	16.92	9.69%	1.28	25.23%	-1.62%
Salesforce Inc.	291.03	6.49%	1.08	-48.52%	0.00%
SAP SE.	30.95	11.85%	1.02	-23.51%	-3.72%
Tesla Inc.	84.91	1.26%	2.05	103.39%	0.00%
Texas Instruments Inc.	19.45	4.92%	0.92	10.29%	11.44%
VMware Inc.	29.16	25.86%	0.59	2.78%	0.00%

Exhibit 34 – Data used in the relative valuation process for the P/E multiple.

7.17 EV/EBITDA Multiple

Company	Forward EV/EBITDA	EBITDA Margin	Expected Growth Rate in EBITDA	D&A / EBITDA	CAPEX / EBITDA
Adobe Inc.	27.90	41.75%	32.04%	11.96%	5.28%
Advanced Micro Devices Inc.	24.33	22.86%	48.82%	11.16%	8.51%
Broadcom Inc.	15.27	54.07%	14.21%	40.70%	2.98%
Cisco Systems Inc.	11.79	31.43%	17.24%	12.18%	4.03%
Intel Corp.	6.72	39.51%	-2.83%	37.77%	65.11%
International Business Machines Corp.	15.22	20.39%	-18.68%	47.49%	20.49%
Intuit Inc.	33.64	28.27%	53.08%	14.78%	4.42%
NVIDIA Corp.	39.47	42.38%	38.59%	11.21%	9.58%
Oracle Corp.	14.10	46.20%	2.33%	17.50%	16.30%
PayPal Holdings Inc.	24.30	22.05%	40.67%	22.89%	17.00%
Qualcomm Inc.	12.64	33.88%	32.86%	13.91%	16.60%
Salesforce Inc.	44.14	16.62%	20.00%	77.92%	16.83%
SAP SE.	17.48	25.75%	7.61%	24.76%	11.15%
Tesla Inc.	52.42	17.34%	72.41%	31.19%	85.87%
Texas Instruments Inc.	15.11	54.99%	6.08%	9.32%	24.41%
VMware Inc.	12.61	31.51%	4.30%	27.50%	8.68%

Exhibit 35 – Data used in the relative valuation process for the EV/EBITDA multiple.

7.18 Investment Report

	J.P. Morgan Report	Dissertation Report
Applied Technique	Relative Valuation	Intrinsic Valuation
Applied Method	P/E Multiple	WACC Model
Report Date	Aug. 2021	Jan. 2022
Price	$190.40	$228.40
Target Date	Dec. 22	Jan. 2023
Target Price	$220.00	$252.57
Appreciation	15.55%	10.58%
Recommendation	Overweight	Buy
Forecasted Period	2 Years (2022-2023)	10 Years (2023-2032)

Exhibit 36 – Main differences identified between the Equity Report published by J.P. Morgan and this dissertation.

7.19 Model Output

Output

(in million $)	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	Terminal Year
Revenue	33,643	41,313	49,823	58,991	68,548	78,144	87,365	95,752	102,838	108,185	111,431
- (Cost of Revenue + SG&A)	11,775	14,460	17,438	20,647	23,992	27,350	30,578	33,513	35,993	37,865	39,001
- Depreciation & Amortization	4,153	5,004	5,917	6,868	7,820	8,731	9,556	10,249	10,766	11,072	11,143
= EBIT	17,714	21,850	26,468	31,476	36,736	42,063	47,231	51,990	56,078	59,248	61,287
- EBIT x t	1,070	1,508	1,999	2,531	3,092	3,659	4,209	4,714	5,146	5,478	5,666
= EBIT x (1 - t)	16,644	20,342	24,469	28,945	33,644	38,403	43,022	47,276	50,932	53,771	55,621
+ Depreciation & Amortization	4,153	5,004	5,917	6,868	7,820	8,731	9,556	10,249	10,766	11,072	11,143
- CAPEX	6,933	8,158	9,410	10,633	11,766	12,741	13,492	13,963	14,111	13,914	13,372
- Δ Non-Cash Working Capital	199	1,534	1,702	1,465	1,423	1,311	1,125	869	553	193	189
= FCFF	13,666	15,653	19,274	23,715	28,275	33,083	37,961	42,693	47,035	50,737	53,582
Present Value	13,666	14,406	16,326	18,487	20,287	21,846	23,071	23,880	24,214	24,039	-

Cost of Capital Computation

	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	Terminal Year
Growth Rate	25.00%	22.80%	20.60%	18.40%	16.20%	14.00%	11.80%	9.60%	7.40%	5.20%	3.00%
Tax Rate	6.04%	6.90%	7.55%	8.04%	8.42%	8.70%	8.91%	9.07%	9.18%	9.25%	9.25%
Beta	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31
Cost of Equity	8.79%	8.79%	8.79%	8.79%	8.79%	8.79%	8.79%	8.79%	8.79%	8.79%	8.79%
After-Tax Cost of Debt	2.51%	2.48%	2.47%	2.45%	2.44%	2.44%	2.43%	2.43%	2.42%	2.42%	2.42%
Debt-to-Capital Ratio	2.11%	2.11%	2.11%	2.11%	2.11%	2.11%	2.11%	2.11%	2.11%	2.11%	2.11%
Cost of Capital	8.66%	8.65%	8.65%	8.65%	8.65%	8.65%	8.65%	8.65%	8.65%	8.65%	8.65%
Discount Factor	1.00	1.09	1.18	1.28	1.39	1.51	1.65	1.79	1.94	2.11	-

Exhibit 37 – Estimated values for the different inputs and variables relevant to the construction of the WACC model.

7.20 Financial Statements

7.20.1 Income Statement

Notes	(in million $)	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
(a)	Revenue	3,998	4,280	4,130	4,682	5,010	6,910	9,714	11,716	10,918	16,675	26,914
(b)	Cost of Revenue	1,941	2,054	1,862	2,083	2,199	2,847	3,892	4,545	4,150	6,279	9,439
	Gross Profit	**2,057**	**2,226**	**2,268**	**2,599**	**2,811**	**4,063**	**5,822**	**7,171**	**6,768**	**10,396**	**17,475**
	Operating Expenses	1,409	1,578	1,772	1,840	2,064	2,129	2,612	3,367	3,922	5,864	7,434
(b)	*Research & Developement*	*1,003*	*1,147*	*1,336*	*1,360*	*1,331*	*1,463*	*1,797*	*2,376*	*2,829*	*3,924*	*5,268*
(b)	*Sales, General & Administrative*	*406*	*431*	*436*	*480*	*602*	*663*	*815*	*991*	*1,093*	*1,940*	*2,166*
(c)	*Other Charges*	*0*	*0*	*0*	*0*	*131*	*3*	*0*	*0*	*0*	*0*	*0*
	Income from Operations	**648**	**648**	**496**	**759**	**747**	**1,934**	**3,210**	**3,804**	**2,846**	**4,532**	**10,041**
	Other Income (Expense)	15	14	14	(4)	(4)	(29)	(14)	92	124	(123)	(100)
(c)	*Interest Income*	*19*	*20*	*17*	*28*	*39*	*54*	*69*	*136*	*178*	*57*	*29*
(c)	*Interest Expense*	*(3)*	*(3)*	*(10)*	*(46)*	*(47)*	*(58)*	*(61)*	*(58)*	*(52)*	*(184)*	*(236)*
(c)	*Unsual Income (Expense)*	*(1)*	*(3)*	*7*	*14*	*4*	*(25)*	*(22)*	*14*	*(2)*	*4*	*107*
	Income Before Income Tax	**663**	**662**	**510**	**755**	**743**	**1,905**	**3,196**	**3,896**	**2,970**	**4,409**	**9,941**
(e)	Income Tax Expense (Benefit)	82	99	70	124	129	239	149	(245)	174	77	189
	Net Income	**581**	**563**	**440**	**631**	**614**	**1,666**	**3,047**	**4,141**	**2,796**	**4,332**	**9,752**

Exhibit 38 – Historical Income Statement.

(in million $)	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	Terminal Year
Revenue	33,643	41,313	49,823	58,991	68,548	78,144	87,365	95,752	102,838	108,185	111,431
Cost of Revenue	12,616	15,492	18,684	22,122	25,705	29,304	32,762	35,907	38,564	40,570	41,787
Gross Profit	**21,027**	**25,821**	**31,140**	**36,869**	**42,842**	**48,840**	**54,603**	**59,845**	**64,274**	**67,616**	**69,644**
Operating Expenses	10,093	12,394	14,947	17,697	20,564	23,443	26,210	28,726	30,851	32,456	33,429
Research & Developement	*7,065*	*8,676*	*10,463*	*12,388*	*14,395*	*16,410*	*18,347*	*20,108*	*21,596*	*22,719*	*23,401*
Sales, General & Administrative	*3,028*	*3,718*	*4,484*	*5,309*	*6,169*	*7,033*	*7,863*	*8,618*	*9,255*	*9,737*	*10,029*
Other Charges	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Income from Operations	**10,934**	**13,427**	**16,193**	**19,172**	**22,278**	**25,397**	**28,394**	**31,119**	**33,422**	**35,160**	**36,215**
Other Income (Expense)	(119)	(146)	(176)	(208)	(241)	(275)	(308)	(337)	(362)	(381)	(393)
Interest Income	*91*	*111*	*134*	*159*	*185*	*211*	*235*	*258*	*277*	*292*	*300*
Interest Expense	*(225)*	*(277)*	*(334)*	*(395)*	*(459)*	*(523)*	*(585)*	*(641)*	*(688)*	*(724)*	*(746)*
Unsual Income (Expense)	*16*	*20*	*24*	*28*	*33*	*37*	*42*	*46*	*49*	*51*	*53*
Income Before Income Tax	**10,815**	**13,281**	**16,017**	**18,964**	**22,036**	**25,122**	**28,086**	**30,782**	**33,060**	**34,779**	**35,823**
Income Tax Expense (Benefit)	653	917	1,210	1,525	1,855	2,186	2,503	2,791	3,034	3,215	3,323
Net Income	**10,162**	**12,365**	**14,807**	**17,439**	**20,182**	**22,936**	**25,583**	**27,991**	**30,026**	**31,564**	**32,499**

Exhibit 39 – Forecasted Income Statement.

7.20.2 Balance Sheet

Notes	(in millions $)	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
	Assets											
	Current Assets	**3,905**	**4,775**	**5,625**	**5,713**	**6,053**	**8,536**	**9,255**	**10,557**	**13,690**	**16,055**	**28,829**
	Cash and Cash Equivalents	668	733	1,152	497	596	1,766	4,002	782	10,896	847	1,990
	Marketable Securities	2,462	2,995	3,520	4,126	4,441	5,032	3,106	6,640	1	10,714	19,218
	Accounts Receivable	336	454	426	474	505	826	1,265	1,424	1,657	2,429	4,650
	Inventories	340	412	388	483	418	794	796	1,575	979	1,826	2,605
(a)	Prepaid Expenses & Other Current Assets	99	181	139	133	93	118	86	136	157	239	366
	Noncurrent Assets	**1,647**	**1,636**	**1,626**	**1,488**	**1,317**	**1,305**	**1,986**	**2,735**	**3,625**	**12,736**	**15,358**
(e)	Tangible Assets	560	576	583	557	466	521	997	1,404	1,674	2,149	2,778
	Operating Lease Assets	0	0	0	0	0	0	0	0	618	707	829
	Goodwill	641	641	643	618	618	618	618	618	618	4,193	4,349
(e)	Intangible Assets	326	312	296	222	166	104	52	45	49	2,737	2,339
(b)	Other Non-Current Assets	120	107	104	91	67	62	319	668	666	2,950	5,063
	Total Assets	**5,553**	**6,412**	**7,251**	**7,201**	**7,370**	**9,841**	**11,241**	**13,292**	**17,315**	**28,791**	**44,187**
	Liabilities											
	Current Liabilities	**930**	**976**	**945**	**896**	**2,351**	**1,788**	**1,153**	**1,329**	**1,784**	**3,925**	**4,335**
	Accounts Payable	335	356	324	293	296	485	596	511	687	1,149	1,783
	Short-Term Debt	0	0	0	0	1,413	796	15	0	0	999	0
(c)	Other Current Liabilities	595	620	621	603	642	507	542	818	1,097	1,777	2,552
	Noncurrent Liabilities	**477**	**608**	**1,849**	**1,887**	**550**	**2,291**	**2,617**	**2,621**	**3,327**	**7,973**	**13,240**
	Long-Term Debt	21	19	1,374	1,398	97	2,020	1,985	1,988	1,991	5,964	10,946
	Operating Lease Liabilities	0	0	0	0	0	0	0	0	561	634	741
(d)	Other Non-Current Liabilities	456	589	475	489	453	271	632	633	775	1,375	1,553
	Total Liabilities	**1,407**	**1,584**	**2,794**	**2,783**	**2,901**	**4,079**	**3,770**	**3,950**	**5,111**	**11,898**	**17,575**
	Shareholders' Equity											
	Preferred Stock	0	0	0	0	0	0	0	0	0	0	0
	Common Stock	1	1	1	1	1	1	1	1	1	1	3
	Additional paid-in Capital	2,901	3,194	3,483	3,855	4,170	4,708	5,351	6,051	7,045	8,721	10,385
	Treasury Stock, at cost	(1,497)	(1,623)	(2,537)	(3,395)	(4,048)	(5,039)	(6,650)	(9,263)	(9,814)	(10,756)	0
	Accumulated Other Comprehensive Income (Loss)	11	10	5	8	(4)	(16)	(18)	(12)	1	19	(11)
	Retained Earnings	2,730	3,246	3,505	3,949	4,350	6,108	8,787	12,565	14,971	18,908	16,235
	Total Shareholders' Equity	**4,146**	**4,828**	**4,457**	**4,418**	**4,469**	**5,762**	**7,471**	**9,342**	**12,204**	**16,893**	**26,612**
	Total Liabilities & Shareholders' Equity	**5,553**	**6,412**	**7,251**	**7,201**	**7,370**	**9,841**	**11,241**	**13,292**	**17,315**	**28,791**	**44,187**

Exhibit 40 – Historical Balance Sheet.

(in millions $)	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	FY2030	FY2031	FY2032	Terminal Year
Assets											
Current Assets	**31,739**	**35,682**	**40,015**	**44,228**	**48,592**	**53,034**	**57,482**	**61,865**	**66,133**	**70,256**	**74,236**
Cash and Cash Equivalents	2,259	2,563	2,909	3,302	3,747	4,253	4,827	5,478	6,218	7,057	8,009
Marketable Securities	20,743	22,390	24,167	26,085	28,156	30,390	32,803	35,406	38,217	41,250	44,524
Accounts Receivable	4,996	6,135	7,398	8,486	9,543	10,516	11,351	11,997	12,407	12,551	12,410
Inventories	3,297	4,048	4,882	5,600	6,297	6,939	7,491	7,917	8,188	8,282	8,189
Prepaid Expenses & Other Current Assets	444	546	658	755	849	935	1,010	1,067	1,104	1,116	1,104
Noncurrent Assets	**16,088**	**17,442**	**18,851**	**20,104**	**21,302**	**22,416**	**23,370**	**24,113**	**24,590**	**24,767**	**24,624**
Tangible Assets	2,464	2,621	2,542	2,581	2,562	2,572	2,567	2,569	2,568	2,569	2,568
Operating Lease Assets	842	855	869	883	897	911	925	940	955	970	985
Goodwill	4,349	4,349	4,349	4,349	4,349	4,349	4,349	4,349	4,349	4,349	4,349
Intangible Assets	2,538	2,439	2,488	2,463	2,476	2,470	2,473	2,471	2,472	2,472	2,472
Other Non-Current Assets	5,895	7,179	8,602	9,828	11,019	12,115	13,057	13,784	14,247	14,408	14,250
Total Assets	**47,826**	**53,124**	**58,866**	**64,332**	**69,894**	**75,451**	**80,852**	**85,979**	**90,723**	**95,023**	**98,860**
Liabilities											
Current Liabilities	**6,975**	**8,280**	**8,478**	**10,724**	**10,935**	**13,300**	**13,008**	**15,247**	**15,468**	**14,382**	**14,221**
Accounts Payable	2,148	2,638	3,182	3,650	4,104	4,523	4,882	5,159	5,336	5,398	5,337
Short-Term Debt	1,250	1,250	0	1,000	0	1,250	0	1,500	1,250	0	0
Other Current Liabilities	3,576	4,392	5,296	6,075	6,831	7,528	8,126	8,588	8,882	8,984	8,884
Noncurrent Liabilities	**12,361**	**11,558**	**14,053**	**13,481**	**15,897**	**15,032**	**15,364**	**16,123**	**15,043**	**16,610**	**16,569**
Long-Term Debt	9,696	8,446	10,446	9,446	11,446	10,196	10,196	10,696	9,446	10,946	10,946
Operating Lease Liabilities	752	763	775	786	798	810	822	834	847	859	872
Other Non-Current Liabilities	1,913	2,349	2,833	3,249	3,653	4,026	4,346	4,593	4,750	4,805	4,751
Total Liabilities	**19,335**	**19,838**	**22,531**	**24,205**	**26,833**	**28,332**	**28,372**	**31,371**	**30,511**	**30,992**	**30,790**
Shareholders' Equity											
Preferred Stock	0	0	0	0	0	0	0	0	0	0	0
Common Stock	3	3	3	3	3	3	3	3	3	3	3
Additional paid-in Capital	10,856	11,348	11,863	12,400	12,963	13,550	14,165	14,807	15,478	16,180	16,914
Treasury Stock, at cost	(2,034)	(2,376)	(2,593)	(2,864)	(3,074)	(3,363)	(3,746)	(3,898)	(4,298)	(4,570)	(4,859)
Accumulated Other Comprehensive Income (Loss)	(1)	(2)	(3)	(3)	(5)	(5)	(4)	(2)	(1)	(2)	(3)
Retained Earnings	19,666	24,313	27,065	30,591	33,173	36,933	42,062	43,698	49,030	52,419	56,015
Total Shareholders' Equity	**28,491**	**33,286**	**36,335**	**40,127**	**43,061**	**47,118**	**52,480**	**54,608**	**60,212**	**64,030**	**68,070**
Total Liabilities & Shareholders' Equity	**47,826**	**53,124**	**58,866**	**64,332**	**69,894**	**75,451**	**80,852**	**85,979**	**90,723**	**95,023**	**98,860**

Exhibit 41 – Forecasted Balance Sheet.

7.20.3 Cash Flow Statement

Notes	(in thousand $)	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
	Cash Flows - Operating Activities											
	Net Income	**581**	**563**	**440**	**631**	**614**	**1,666**	**3,047**	**4,141**	**2,796**	**4,332**	**9,752**
	Stock-based Compensation Expense	136	137	136	158	204	247	391	557	844	1,397	2,004
(a)	Depreciation & Amortization	204	226	239	220	197	187	199	262	381	1,098	1,174
(b)	Deferred Income Taxes	19	32	15	83	134	197	(359)	(315)	18	(282)	(406)
(b)	Non-Cash Items	(33)	(21)	(8)	17	77	54	39	(45)	5	(20)	(53)
(b)	Changes in Operating Assets and Liabilities, net of acquisitions	2	(112)	12	(203)	(51)	(679)	185	(857)	717	(703)	(3,363)
	Cash From Operating Activities	**909**	**824**	**835**	**906**	**1,175**	**1,672**	**3,502**	**3,743**	**4,761**	**5,822**	**9,108**
	Cash Flows - Investing Activities											
(c)	Purchases related to Property, Equipement & Intangible Assets	(139)	(183)	(255)	(122)	(86)	(176)	(593)	(600)	(489)	(1,128)	(976)
	Marketable Securities	(654)	(561)	(553)	(625)	(339)	(619)	1,905	(3,488)	6,648	(9,989)	(8,567)
	Purchases of Marketable Securities	*(1,965)*	*(2,378)*	*(3,065)*	*(2,862)*	*(3,477)*	*(3,134)*	*(36)*	*(11,148)*	*(1,461)*	*(19,308)*	*(24,787)*
	Proceeds from Maturities of Marketable Securities	*0*	*0*	*585*	*865*	*1,036*	*969*	*1,078*	*7,232*	*4,744*	*8,792*	*15,197*
	Proceeds from Sales of Marketable Securities	*1,311*	*1,817*	*1,927*	*1,372*	*2,102*	*1,546*	*863*	*428*	*3,365*	*527*	*1,023*
(c)	Acquisition of Business	(349)	0	(17)	0	0	0	0	0	0	(8,524)	(263)
	Proceeds from Sale of Long-Lived Assets	0	0	25	21	7	7	2	0	0	0	0
	Investments & Other	(1)	0	(6)	(1)	18	(5)	(36)	(9)	(14)	(34)	(24)
	Cash from Investing Activities	**(1,143)**	**(744)**	**(806)**	**(727)**	**(400)**	**(793)**	**1,278**	**(4,097)**	**6,145**	**(19,675)**	**(9,830)**
	Cash Flows - Financing Activities											
	Common Stock - Dividends	0	(47)	(181)	(186)	(213)	(261)	(341)	(371)	(390)	(395)	(399)
	Debt Issuance	0	0	1,478	0	0	1,988	0	0	0	4,968	4,977
	Debt (Retirement)	(12)	(2)	(174)	(3)	(6)	(681)	(821)	(16)	0	0	(1,000)
	Principal Payment on Property, Plant & Equipment	0	0	0	0	0	0	0	0	0	(17)	(83)
	Payments Related to Repurchases of Common Stock	0	(100)	(887)	(814)	(587)	(739)	(909)	(1,579)	0	0	0
	Payments Related to Tax on Restrited Stock Units	0	0	0	0	0	0	(612)	(1,032)	(551)	(942)	(1,904)
	Other Financing Cash Flows	249	134	154	169	130	(16)	139	132	149	190	274
	Cash from Financing Activities	**237**	**(15)**	**390**	**(834)**	**(676)**	**291**	**(2,544)**	**(2,866)**	**(792)**	**3,804**	**1,865**
	Net Change in Cash	**3**	**65**	**419**	**(655)**	**99**	**1,170**	**2,236**	**(3,220)**	**10,114**	**(10,049)**	**1,143**

Exhibit 42 – Historical Cash Flow Statement.

7.21 Financial Statements Notes

Notes	(in million $)	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
	Revenue											
(a)	Total Revenue	3,998	4,280	4,130	4,682	5,010	6,910	9,714	11,716	10,918	16,675	26,914
	Growth Rate (%)	-	*7.1%*	*(3.5%)*	*13.3%*	*7.0%*	*37.9%*	*40.6%*	*20.6%*	*(6.8%)*	*52.7%*	*61.4%*
	Cost of Revenue											
	Operating Expense	1,930	2,043	1,852	2,070	2,184	2,832	3,871	4,518	4,111	6,191	9,298
	% of Revenue	*48.3%*	*47.7%*	*44.8%*	*44.2%*	*43.6%*	*41.0%*	*39.8%*	*38.6%*	*37.7%*	*37.1%*	*34.5%*
	Stock-Based Compensation	11	10	11	12	15	15	21	27	39	88	141
	% of Revenue	*0.3%*	*0.2%*	*0.3%*	*0.3%*	*0.3%*	*0.2%*	*0.2%*	*0.2%*	*0.4%*	*0.5%*	*0.5%*
	Total	**1,941**	**2,054**	**1,862**	**2,083**	**2,199**	**2,847**	**3,892**	**4,545**	**4,150**	**6,279**	**9,439**
	Research & Development											
	Operating Expense	922	1,065	1,253	1,271	1,216	1,329	1,578	2,040	2,289	3,064	3,970
(b)	*% of Revenue*	*23.1%*	*24.9%*	*30.3%*	*27.2%*	*24.3%*	*19.2%*	*16.2%*	*17.4%*	*21.0%*	*18.4%*	*14.8%*
	Stock-Based Compensation	81	82	83	88	115	134	219	336	540	860	1,298
	% of Revenue	*2.0%*	*1.9%*	*2.0%*	*1.9%*	*2.3%*	*1.9%*	*2.3%*	*2.9%*	*4.9%*	*5.2%*	*4.8%*
	Total	**1,003**	**1,147**	**1,336**	**1,360**	**1,331**	**1,463**	**1,797**	**2,376**	**2,829**	**3,924**	**5,268**
	Sales, General & Administrative											
	Operating Expense	361	387	393	423	528	565	664	797	828	1,491	1,601
	% of Revenue	*9.0%*	*9.0%*	*9.5%*	*9.0%*	*10.5%*	*8.2%*	*6.8%*	*6.8%*	*7.6%*	*8.9%*	*5.9%*
	Stock-Based Compensation	45	44	43	57	74	98	151	194	265	449	565
	% of Revenue	*1.1%*	*1.0%*	*1.0%*	*1.2%*	*1.5%*	*1.4%*	*1.6%*	*1.7%*	*2.4%*	*2.7%*	*2.1%*
	Total	**406**	**431**	**436**	**480**	**602**	**663**	**815**	**991**	**1,093**	**1,940**	**2,166**
	Remaining Income Statement Lines											
	Other Charges	0.0	0.0	0.0	0.0	131.0	3.0	0.0	0.0	0.0	0.0	0.0
	% of Revenue	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*2.6%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*
	Interest Income	19	20	17	28	39	54	69	136	178	57	29
(c)	*% of Revenue*	*0.5%*	*0.5%*	*0.4%*	*0.6%*	*0.8%*	*0.8%*	*0.7%*	*1.2%*	*1.6%*	*0.3%*	*0.1%*
	Interest Expense	(3)	(3)	(10)	(46)	(47)	(58)	(61)	(58)	(52)	(184)	(236)
	% of Revenue	*(0.1%)*	*(0.1%)*	*(0.3%)*	*(1.0%)*	*(0.9%)*	*(0.8%)*	*(0.6%)*	*(0.5%)*	*(0.5%)*	*(1.1%)*	*(0.9%)*
	Unsual Income (Expense)	(1)	(3)	7	14	4	(25)	(22)	14	(2)	4	107
	% of Revenue	*(0.0%)*	*(0.1%)*	*0.2%*	*0.3%*	*0.1%*	*(0.4%)*	*(0.2%)*	*0.1%*	*(0.0%)*	*0.0%*	*0.4%*
	Tax Rate											
(e)	Income Tax Expense (Benefit)	82.3	99.5	70.2	124.3	129.0	239.0	149.0	(245.0)	174.0	77.0	189.0
	Effective Tax Rate (%)	*12.4%*	*15.0%*	*13.8%*	*16.5%*	*17.4%*	*12.5%*	*4.7%*	*(6.3%)*	*5.9%*	*1.7%*	*1.9%*

Exhibit 43 – Notes to the historical income statement.

Notes	(in millions $)	FY2012	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	FY2022
(a)	**Prepaid Expenses & Other Current Assets**											
	Prepaid Expenses	30	77	70	70	93	118	86	136	157	239	366
	Deferred Income Tax	50	104	69	63	0	0	0	0	0	0	0
	Other Assets	19	0	0	0	0	0	0	0	0	0	0
(b)	**Other Non-Current Assets**											
	Deferred Charges	84	0	0	0	0	0	0	0	0	440	2,156
	Deferred Income Tax	7	0	0	0	0	0	0	0	548	806	1,222
	Other Assets	19	107	104	91	67	62	319	668	118	1,704	1,419
	Long-Term Investment - Affiliate Companies	0	0	0	0	0	0	0	0	0	0	266
	Long-Term Investment - Other	10	0	0	0	0	0	0	0	0	0	0
(c)	**Other Current Liabilities**											
	Accrued Expenses	317	334	350	304	318	401	469	635	756	1,276	1,553
	Customer Advances	271	283	269	296	322	85	53	92	141	288	300
	Income Taxes Payable	7	3	2	3	2	21	20	91	61	61	0
	Other Payables	0	0	0	0	0	0	0	0	139	61	0
	Other Liabilities	0	0	0	0	0	0	0	0	0	91	699
(d)	**Other Non-Current Liabilities**											
	Deferred Income Tax	133	193	158	232	301	141	18	19	29	241	245
	Reserves	10	10	11	7	1	0	0	0	0	0	0
	Other Liabilities	313	386	306	250	151	130	614	614	746	1,134	1,308
(e)	**Tangible & Intangible Assets**											
	Tangible Assets	560	576	583	557	466	521	997	1,404	1,674	2,149	2,778
	Depreciation	*145*	*158*	*165*	*143*	*124*	*119*	*144*	*233*	*356*	*486*	*611*
	Intangible Assets	326	312	296	222	166	104	52	45	49	2,737	2,339
	Amortization	*59*	*69*	*74*	*77*	*73*	*69*	*55*	*29*	*26*	*612*	*563*

Exhibit 44 – Notes to the historical balance sheet.

Notes		FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022
(a)	**Depreciation & Amortization**											
	Depreciation & Amortization	204	226	239	220	197	187	199	262	381	1,098	1,174
	Adjustment to Depreciation & Amortization	*	*	*	*	*	*	1,272	1,405	1,571	1,802	2,212
	Total	*	*	*	*	*	*	**1,471**	**1,667**	**1,952**	**2,900**	**3,386**
(b)	**Operating Activities**											
	Deferred Income Taxes	19	32	15	83	134	197	(359)	(315)	18	(282)	(406)
	Non-Cash Items	(33)	(21)	(8)	17	77	54	39	(45)	5	(20)	(53)
	Accounting Change	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Unusual Items	*0*	*0*	*(11)*	*(17)*	*39*	*18*	*18*	*0*	*0*	*0*	*(100)*
	Purchased R&D	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Other Non-Cash Items	*(33)*	*(21)*	*3*	*34*	*38*	*36*	*21*	*(45)*	*5*	*(20)*	*47*
	Changes in Operating Assets and Liabilities, net of acquisitions	2	(112)	12	(203)	(51)	(679)	185	(857)	717	(703)	(3,363)
	Accounts Receivable	*26*	*(119)*	*29*	*(49)*	*(32)*	*(321)*	*(440)*	*(149)*	*(233)*	*(550)*	*(2,215)*
	Inventories	*19*	*(79)*	*25*	*(95)*	*66*	*(375)*	*0*	*(776)*	*597*	*(524)*	*(774)*
	Prepaid Expenses & Other Assets	*(86)*	*(12)*	*12*	*4*	*(16)*	*(18)*	*21*	*(55)*	*77*	*(394)*	*(1,715)*
	Accounts Payable	*36*	*11*	*(20)*	*(27)*	*(11)*	*184*	*90*	*(135)*	*194*	*363*	*568*
	Accrued & Other Current Liabilities	*7*	*86*	*(32)*	*5*	*39*	*(135)*	*33*	*256*	*54*	*239*	*581*
	Other Long-Term Liabilities	*0*	*0*	*0*	*(41)*	*(97)*	*(14)*	*481*	*2*	*28*	*163*	*192*
(c)	**Investing Activities**											
	Acquisition of PPE	(139)	(183)	(255)	(122)	(86)	(176)	(593)	(600)	(489)	(1,128)	(976)
	Acquisition of Business	(349)	0	(17)	0	0	0	0	0	0	(8,524)	(263)
	R&D Expense	(922)	(1,065)	(1,253)	(1,271)	(1,216)	(1,329)	(1,578)	(2,040)	(2,289)	(3,064)	(3,970)
	Expanded CAPEX	**(1,893)**	**(2,081)**	**(2,340)**	**(2,226)**	**(2,134)**	**(2,337)**	**(3,003)**	**(3,472)**	**(3,610)**	**(5,024)**	**(5,778)**

Exhibit 45 – Notes to the historical cash flow statement.

8 Reference

Altavilla, D. (2022, January 4). *NVIDIA launches salvo of gaming GPUs, new Omniverse and autonomous driving tech at CES 2022*. Forbes. https://www.forbes.com/sites/davealtavilla/2022/01/04/nvidia-launches-salvo-of-gaming-gpus-new-omniverse-and-autonomous-driving-tech-at-ces-2022/?sh=3f96b57f22a9

Ballard, J. (2022, April 8). *Why NVIDIA's largest business will keep growing*. The Motley Fool. https://www.fool.com/investing/2022/04/08/why-nvidia-largest-business-will-keep-growing/

Black, F., & Scholes, M. (1973, May). The pricing of options and corporate liabilities. *Journal of Political Economy*, *81*(3), 637-654.

Blume, M. E. (1975, June). Betas and their regression tendencies. *The Journal of Finance*, *30*(3), 785-795.

Chauhan, H. (2022, February 22). *Where will NVIDIA be in 5 years?* The Motley Fool. https://www.fool.com/investing/2022/02/22/where-will-nvidia-be-in-5-years/

Chauhan, H. (2022, March 28). *Is it too late to buy NVIDIA stock?* The Motley Fool. https://www.fool.com/investing/2022/03/28/is-it-too-late-to-buy-nvidia-stock/

Damodaran, A. (2012). *Investment valuation: Tools and techniques for determining the value of any asset* (3^{rd} ed.). John Wiley & Sons.

Fernández, P. (2001, June 4). Valuation using multiples. How do analysts reach their conclusions? *IESE Business School*, *1*, 1-13.

Fernández, P. (2007, February 2). Company valuation methods. The most common errors in valuations. *IESE Business School*, *449*, 1-27.

Fernández, P. (2010). WACC: definition, misconceptions, and errors. *Business Valuation Review*, *29*(4), 138-144.

Fernández, P., & Bilan, A. (2007, November). 110 common errors in company valuations. *International Journal of Economics and Business Administration*, *1*(1), 33-78.

Goedhart, M., Koller, T., & Wessels, D. (2005). The right role for multiples in valuation. *McKinsey on Finance*, (15), 7-11.

Goedhart, M., Koller, T., & Wessels, D. (2010). *Valuation: Measuring and managing the value of companies* (5^{th} ed.). John Wiley & Sons.

Leslie, K. J., & Michaels, M. P. (1997). The real power of real options. *The McKinsey Quarterly*, (3), 97-108.

Luehrman, T. A. (1997a, May). What's it worth? A general manager's guide to valuation. *Harvard Business Review*, *75*(3), 132-142.

Luehrman, T. A. (1997b, May). Using APV: A better tool for valuing operations. *Harvard Business* Review, 75(3), 145-154.

MarketLine. (2021, July 14). MarketLine industry profile: Global semiconductors. https://advantage.marketline.com/Analysis/ExportFullReportToPdf/global-semiconductors-136723

MarketLine. (2022, January 13). *NVIDIA corporation – SWOT analysis*. https://advantage.marketline.com/Company/ExportCompany/nvidia_corporation?SectionId=SWOTAnalysis&ExportType=Pdf

NVIDIA Corporation. (2020, April 27). *NVIDIA completes acquisition of Mellanox, creating major force driving next-gen data centers* [Press release]. https://nvidianews.nvidia.com/_gallery/download_pdf/5ea68917ed6ae5786e937860/

NVIDIA Corporation. (2020, April). *2020 NVIDIA corporation annual review*. https://s22.q4cdn.com/364334381/files/doc_financials/2020/ar/2020-nvidia-annualreport-content-r25-web-144dpi-combined.pdf

NVIDIA Corporation. (2020, September 13). *NVIDIA to acquire Arm for $40 billion, creating world's premier computing company for the age of AI* [Press release]. https://nvidianews.nvidia.com/_gallery/download_pdf/5f5ea9b0ed6ae55c1e37a8e9/

NVIDIA Corporation. (2021, April). *2021 NVIDIA corporation annual review*. https://s22.q4cdn.com/364334381/files/doc_downloads/2021/04/2021-Annual-Review.pdf

NVIDIA Corporation. (2022, February 7). *NVIDIA and SoftBank Group announce termination of NVIDIA's acquisition of Arm Limited* [Press release]. https://nvidianews.nvidia.com/_gallery/download_pdf/6201ff03b3aed31de199986b/

NVIDIA Corporation. (2022, March 22). *NVIDIA introduces Grace CPU Superchip* [Press release]. https://nvidianews.nvidia.com/_gallery/download_pdf/6239f11fed6ae52a60391c98/

NVIDIA Corporation. (2022, April). *2022 NVIDIA corporation annual review*. https://s22.q4cdn.com/364334381/files/doc_financials/2022/ar/2022-Annual-Review.pdf

Ridley, J. (2022, April 20). *NVIDIA's GPU-powered AI is creating chips with 'better than human design'*. PC Gamer. https://www.pcgamer.com/nvidias-gpu-powered-ai-is-creating-chips-with-better-than-human-design/

Schill, M. J. (2013, January 22). Business valuation: Standard approaches and applications. *Darden Business Publishing*.

Semiconductor Industry Association. (2021, September 24). *2021 State of the US semiconductor industry*. https://www.semiconductors.org/wp-content/uploads/2021/09/2021-SIA-State-of-the-Industry-Report.pdf

Sun, L. (2022, April 22). *Will NVIDIA be a trillion-dollar stock by 2025?* The Motley Fool. https://www.fool.com/investing/2022/04/22/will-nvidia-be-a-trillion-dollar-stock-by-2025/

Varas, A., Varadarajan, R., Goodrich, J., & Falan, Y. (2021, April). *Strengthening the global semiconductor supply chain in an uncertain era*. Boston Consulting Group (BCG) & Semiconductor Industry Association (SIA). https://www.semiconductors.org/wp-content/uploads/2021/05/BCG-x-SIA-Strengthening-the-Global-Semiconductor-Value-Chain-April-2021_1.pdf

World Semiconductor Trade Statistics. (2016, June 7). *WSTS semiconductor market forecast spring 2016* [Press release]. https://www.wsts.org/esraCMS/extension/media/f/WST/2835/WSTS_nr-2016_05.pdf

World Semiconductor Trade Statistics. (2016, November 29). *WSTS semiconductor market forecast fall 2016* [Press release]. https://www.wsts.org/esraCMS/extension/media/f/WST/2971/WSTS_nr-2016_11.pdf

World Semiconductor Trade Statistics. (2017, June 6). *WSTS semiconductor market forecast spring 2017* [Press release]. https://www.wsts.org/esraCMS/extension/media/f/WST/3132/WSTS_nr-2017_05.pdf

World Semiconductor Trade Statistics. (2017, November 28). *WSTS semiconductor market forecast fall 2017* [Press release]. https://www.wsts.org/esraCMS/extension/media/f/WST/3293/WSTS_nr-2017_11.pdf

World Semiconductor Trade Statistics. (2018, June 5). *WSTS semiconductor market forecast spring 2018* [Press release]. https://www.wsts.org/esraCMS/extension/media/f/WST/3540/WSTS_nr-2018_05.pdf

World Semiconductor Trade Statistics. (2018, November 27). *WSTS semiconductor market forecast fall 2018* [Press release].

https://www.wsts.org/esraCMS/extension/media/f/WST/3730/WSTS_nr-2018_11.pdf

World Semiconductor Trade Statistics. (2019, June 4). *WSTS semiconductor market forecast spring 2019* [Press release]. https://www.wsts.org/esraCMS/extension/media/f/WST/4065/WSTS_nr-2019_05.pdf

World Semiconductor Trade Statistics. (2019, December 3). *WSTS semiconductor market forecast fall 2019* [Press release]. https://www.wsts.org/esraCMS/extension/media/f/WST/4298/WSTS_nr-2019_11.pdf

World Semiconductor Trade Statistics. (2020, June 9). *WSTS semiconductor market forecast spring 2020* [Press release]. https://www.wsts.org/esraCMS/extension/media/f/WST/4622/WSTS_nr-2020_05.pdf

World Semiconductor Trade Statistics. (2020, December 1). *WSTS semiconductor market forecast fall 2020* [Press release]. https://www.wsts.org/esraCMS/extension/media/f/WST/4820/WSTS_nr-2020_11.pdf

World Semiconductor Trade Statistics. (2021, June 8). *WSTS semiconductor market forecast spring 2021* [Press release]. https://www.wsts.org/esraCMS/extension/media/f/WST/5088/WSTS_nr-2021_06.pdf

World Semiconductor Trade Statistics. (2021, November 30). *WSTS semiconductor market forecast fall 2021* [Press release]. https://www.wsts.org/esraCMS/extension/media/f/WST/5263/WSTS_nr-2021_11.pdf

Young, M., Sullivan, P., Nokhasteh, A., & Holt, W. (1999, September 27). All roads lead to Rome: An integrated approach to valuation models. *Goldman Sachs Investment Research*, *27*, 1-32.

Zenner, M., Hill, S., Clark, J., & Mago, N. (2008, May). The most important number in finance: The quest for the market risk premium. *JP Morgan Chase Bank*.