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Forward View of the Semiconductor World: Quantitative Analysis and Financial Valuation

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Abstract:

This research paper analyzes the ever-expanding semiconductor world from a forward-looking point of view. The sector has grown through continuous innovation and improving efficiency, giving rise to a wide variety of specialized subsectors that make every technological development possible. The strong bond between semiconductors and the overall technological sector is tested quantitatively through a regression model over a representative semiconductor traded fund and the technological stock index NASDAQ. The paper then focuses on defining the best-positioned player of the sector through a financial analysis based on ratios and multiples. Ultimately, as COVID-19 has affected every industry in the market, the paper concludes with an overview of the pandemic's impact on the semiconductor landscape.

Keywords: *Semiconductors, quantitative analysis, financial ratios, equity valuation, technology, COVID-19.*

Resumen:

Este trabajo analiza el desarrollo del sector de los semiconductores desde una perspectiva a futuro. El sector ha tenido un gran crecimiento debido a su continua innovación y mejora de eficiencia, creando una gran variedad de subsectores especializados que hacen posible cada avance tecnológico. La gran relación entre los semiconductores y la industria tecnológica se prueba cuantitativamente a través de un modelo de regresión, sobre un fondo representativo de los semiconductores y el índice bursátil tecnológico NASDAQ. El trabajo se centra, más adelante, en seleccionar los mejores competidores del sector a través de un análisis financiero de ratios y múltiplos. Finalmente, como el COVID-19 ha afectado a todas las industrias del mercado, el trabajo concluye con una revisión del impacto de la pandemia sobre el mundo de los semiconductores.

Palabras clave: *Semiconductores, análisis cuantitativo, ratios financieros, valoración empresarial, tecnología, COVID-19.*

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1. Introduction:

This research paper aims to study the semiconductor world since it is recognized to be one of the most attractive sectors of the last decade, exhibiting above-average growth rates and increasing importance over a wide variety of industries. Semiconductors are popularly known as the axis around which technology spins, as chips are the most essential components of any electronic device.

Although some may think of microprocessors or Silicon Valley as recent or modern terms, semiconductors have been present for many decades. Since its inception, chips have been gaining importance in our lives, conquering, and creating new customer segments and practices. As well as being one of the most innovative sectors in the market, following Moore's Law by doubling the number of transistors in a microchip every two years. After decades of progress and expansion, the semiconductor world is now one of the most promising and appealing sectors of the technological industry.

Its resemblance with the overall technology industry is clear and will be proven in this paper by testing its capacity as a leading indicator. This assumption will be tested by comparing the market performance of the semiconductor ETF¹ SOXX, with the NASDAQ² as a representative index of the technological industry in the U.S.A. Both values will be tested through a regression analysis on public market values, which will give statistical support to the matter and clear any biased judgment off the argument. If the assumption ends up being true, the semiconductor industry could have predictable power over the technological industry and could, therefore, serve as a leading indicator.

After determining its relationship with the technological market, this paper will address the competitive landscape of the sector. This analysis will be focused on the best-performing companies of the sector with a particular interest in American players, as it is one of the biggest markets and some international presence from Europe and Southeast Asia. After

¹ The acronym ETF refers to an exchange traded fund further information can be found on the following link <https://www.investopedia.com/terms/e/etf.asp>

² NASDAQ is the National Association of Securities Dealers Automated Quotations exchange, the first electronic exchange that allowed investors to trade stocks on a computerized system. It is mainly formed by technological companies, and therefore it is representative of the overall technological industry.

studying the sample and analyzing the key financial ratios for this sector based on publicly available information presented by the firms, this paper will dispatch which companies seem to be better positioned for the future in terms of financial ratios. The favored firms will be further analyzed and valued via the comparable method, based on market valuation ratios of the sample.

The objective of this thorough analysis is aimed to find investment opportunities based on gaps between the intrinsic valuation of companies and their respective market valuation. The technological industry is one of the hardest to value due to its volatility, profitability structure, and disparity over future expectations and a single valuation approach should not be taken as an investment recommendation.

The previous analysis is forward-looking and based on data up until February. This paper will conclude by delivering an extensive review of the major impacts of the COVID-19³ pandemic on society as a whole and explaining how the unprecedented epidemic will favor the semiconductor sector in particularly over the long run.

³ COVID-19 refers to the coronavirus disease that spread around the world infecting millions of people in 2020. More information about the recent pandemic can be found on the following link.
https://www.who.int/health-topics/coronavirus#tab=tab_1

2. Semiconductors:

I. Overview of the sector:

As defined by the Merriam Webster dictionary, a semiconductor is any class of solid whose electrical conductivity is between that of a conductor and that of an insulator in being nearly as great as that of a metal at high temperatures and roughly absent at low temperatures. As stated in its definition, the most significant attribute about these materials is their ability to conduct electricity at both high and low temperatures.

The first semiconductor was created in 1901 by Jagadis Chandra Bose, who invented a device to detect radio waves and called it "cat whiskers." The appearance of semiconductors enabled John Bardeen, Walter Brattain, and William Shockley to create the first transistor in 1947, allowing computers to perform the same functions using less power and space (Bellis, 2019a). Since then, semiconductors have evolved to be the most necessary component on every technological device, a clear example of this fact is the world-known Silicon Valley, which is named after the most used semiconductor material, silicon.

Along with carbon and germanium, silicon has four electrons on its outer orbital, which create perfect covalent bonds that allow them to form crystals. This silicon crystal is an insulator, but it could turn into a conductor by adding a small amount of another metal. This process is generally known as doping. There are two types of doping; The N-type is negatively charged as it will be combined with phosphorus or arsenic, whereas the P-type is positively charged due to its combination with boron or gallium. By putting these two types together, you create the simplest possible semiconductor, a diode. Finally, adding an additional layer to a diode, you generate a transistor that can act as a switch or an amplifier (Brain, 2019b).

Combining thousands of transistors acting as switches, you can create a microprocessor chip. The first microprocessor chip was the Intel 8080 in 1974, which had the ability to allocate an 8-bit computer on a single chip (Brain, 2019a). Since then, Intel has improved its chips following its co-founder's rule, Moore's Law. This law states that the number of transistors on a microchip doubles every two years while at the same time, the cost of computers halves

almost every two years (Tarda, 2019). Nowadays, this rate has even accelerated to doubling the number of transistors every 18 months.

Moore's law is a clear example of how the semiconductor industry has had an accelerated development since its origin and how it seems to develop even faster. As a result, the semiconductor sector has one of the highest expenditures on research and development of the market because of its highly competitive environment. In 2017, Intel's R&D-to-sales ratio climbed to 21.2%, following its 8% average annual growth rate in R&D⁴ spending since 2001 (Patterson, 2018).

The usage of semiconductors has expanded from the original radio in the 1960s to any thinkable electronic device that has a switch on it, as well as its valuation that has grown from over \$33 billion in 1987 to \$433 billion in 2019 (Alsop, 2020). This enlargement of the sector has given birth to many sub-sectors that can be classified by its functionality or its integrated circuit (Investopedia, 2020).

From the perspective of functionality, the semiconductor industry can be divided into four groups:

- Memory chips are used to store data and programs on computers and data storage devices. There are three main types of memory chips; Random-access memory (RAM) chips provide temporary workspaces, flash memory chips hold information permanently unless erased, and read-only-memory chips can't be modified.
- Microprocessors contain one or more central processing units (CPUs), which are the primary components of computers. Depending on the complexity of the electronic system of the product, the microprocessor would have more or fewer bits on its transistor.
- Standard chips are used for performing repetitive processing routines, typically appearing in single-purpose appliances. These semiconductors are characterized by

⁴ R&D refers to a firm's capital destined to Research & Development activities, which are an indicator of innovation within a company.

their large production volumes and narrow margins due to their simple structure. Asian manufacturers dominate this group.

- Systems-on-a chip (SoC) are the most recently developed semiconductors. They are capable of building all of the electronic components needed for an entire system in a single chip.

On the other hand, semiconductors can also be classified by its type of integrated circuit:

- Analog chips have mostly been replaced by digital chips, although they are still required for wideband signals and used as sensors.
- Mixed circuit semiconductors are digital chips combined with added technology that enables them to work with both analog and digital circuits. This combination allows the microcontroller to connect the abilities of both types of chips for optimal usage, such as receiving data from a temperature sensor or make sounds through analog devices.

All these types of semiconductors are manufactured in a fabrication plant, which are commonly called fabs or foundries. The rapid development and expansion of the industry have allowed the industry to create a differentiation between fab and fabless semiconductor companies.

Companies that have fabrication plants but don't produce their own designs are classified as pure-play semiconductor foundries. These dedicated foundries award customers with a variety of advantages, such as being able to scale production capacity to a customer's needs, offering low-quantity shuttle services along with full-scale production lines. Additionally, they allow the customer to take complete control over the design process while being compliant with the industry-standard E.D.A.⁵ systems.

On the other hand, companies that only design semiconductor chips and outsource their fabrication to a specialized foundry, are called fabless semiconductor companies. This type

⁵ E.D.A acronym refers to Electronic Design Automation, further information on the industry can be found on the following link https://semiengineering.com/knowledge_centers/eda-design/definitions/electronic-design-automation/

of companies focus mainly on research and development resources, as they benefit from having lower capital costs. This business model has become dramatically popular since the 1980s, as it allows smaller companies to compete against established competitors without allocating much capital to investing activities. The leading fabless players are based in the U.S.A. and outsource their production to Asian companies.

The companies that are able to design, manufacture, and sell semiconductor products are classified as integrated device manufacturers (I.D.M.). Originally, every company that sold semiconductor products had to design and manufacture all their devices, which required a vast amount of capital as well as high expenditure in R&D. The biggest I.D.M.s are world-known companies such as Intel, I.B.M., or Texas Instruments.

II. Competitive landscape:

Since its origin in 1901, the semiconductor segment has expanded rapidly into the global markets, making it one of the most concentrated sectors in the electronic industry.

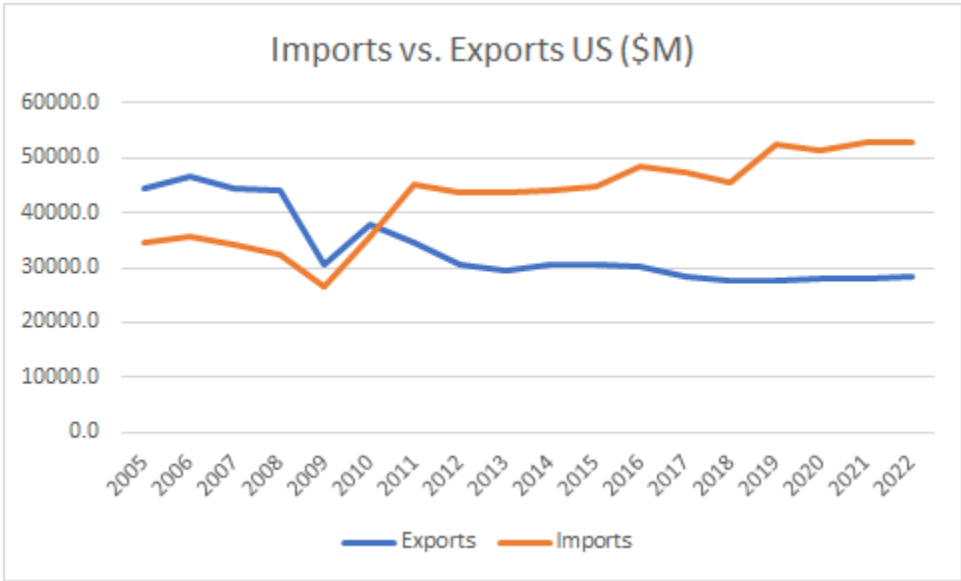
Over the last five years, the sector has become more concentrated as a result of the acquisitions of smaller companies by more significant participants that have access to more resources. Consequently, there has been an increase in the popularity of joint ventures and strategic partnerships to reduce and optimize manufacturing, development, and research costs. Besides, the largest players are also increasing their market share by acquiring smaller companies that improve the efficiency of their downstream structure.

The industry as a whole has become more competitive over time, prices for comparable products have been decreasing, showing that the most significant players will benefit from lower operating costs due to economies of scale. The most significant factor for surviving in the semiconductor sector is through continuous investment in R&D, as mentioned before, the industry follows Moore's law meaning that in order to remain competitive in the market, a company must never stop improving their products.

The main barriers to entry the market include being able to access a significant amount of investment, recruiting and attracting highly skilled employees, and the increasing dominance of already existing players in the market. New entrants must be aware of these barriers and should structure their business models accordingly.

China and the U.S. dominate the global competitive display; China has become the largest output country of semiconductor devices in the world, specialized in manufacturing devices in their foundries. On the other hand, the U.S. has a higher percentage of fabless companies in the market, which outsource their production to Asian companies while focusing on research and development.

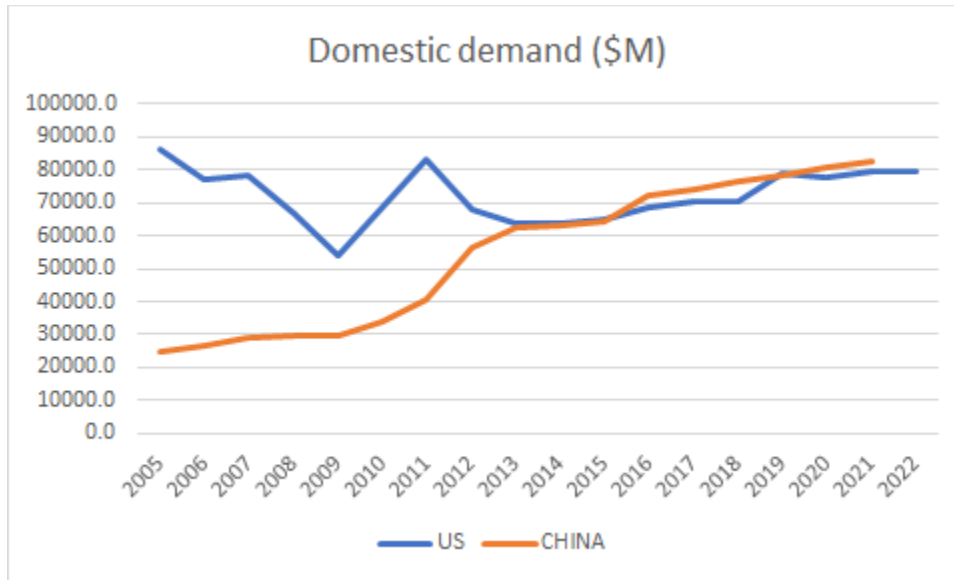
Figure 1: Imports vs. Exports U.S.



Source: Self-elaboration based on data from IBIS World, Semiconductor & Circuit Manufacturing in the U.S.

As shown in Figure 1, the U.S. has had a trade deficit in the semiconductor sector since 2010, matching the accelerated production by Chinese companies in that same time frame. The United States' domestic demand for semiconductor devices has also topped around \$80,000M over the last five years. In contrast, China's domestic demand has almost tripled over the previous ten years, as shown in Figure 2.

Figure 2: Domestic demand comparison U.S.A. vs. China



Source: IBIS World, Global Semiconductor & Electronic Parts Manufacturing

3. Quantitative Analysis of the sector:

I. Previous and current market performance:

The most precise manner to analyze the market performance of the semiconductor industry over the last couple of decades is to compare the most representative exchange-traded funds (ETF) of the sector, accounting for their specific characteristics:

Table 1: Semiconductor ETF comparison

| TICKER | ISSUER | AUM | 5-yr Return (annualized) | SEGMENT |
|---------------|---------------|------------|-------------------------------------|-------------------------------|
| SOXX | Blackrock | \$1.81B | 25.64% | U.S.A. |
| SMH | VanEck | \$1.50B | 25.33% | Global |
| SOXL | Direxion | \$799.49M | 61.19% | Leveraged (Bull 3X) U.S.A. |
| SOXS | Direxion | \$187.24M | -63.90% | Inverse (Bear 3X) U.S. |

Source: ETF.com, semiconductors ETF

The annualized 5-year returns in Table 1 have been calculated on a pre-Coronavirus basis, analyzing historical data for five years up until February 12th, 2020.

- **SOXX:** Issued by Blackrock⁶ in September 2001, provides capped exposure to US-listed companies in the semiconductor industry. Mainly allocated in large U.S. players accounting for 88.82% of the portfolio's weight, but with a narrow exposure to foreign markets by investing 6.74% of its capital in Dutch companies combined

⁶ Blackrock is a global investment institution that provides a wide range of financial solutions such as low-cost diversified ETFs like SOXX. Further information about the company can be found in the following link <https://www.blackrock.com/corporate/about-us>

with less than 5% coverage from Taiwan Semiconductors. Also, this ETF is wholly invested in the Semiconductor industry and has an expense ratio of 0.46%.

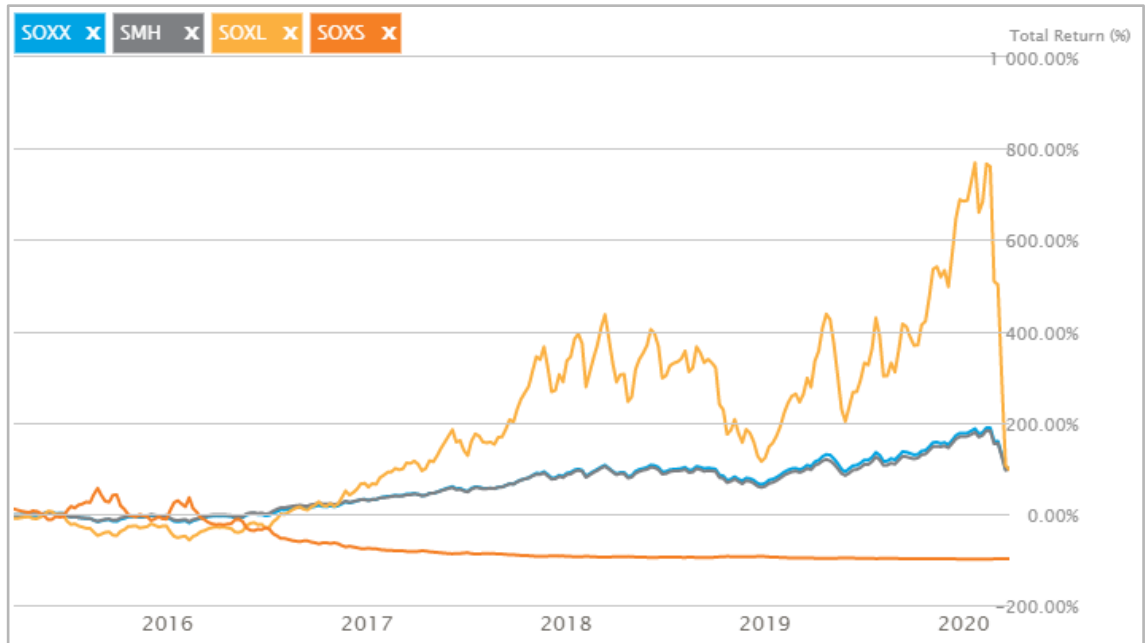
- **S.M.H.**: Issued by VanEck⁷ in May 2010, displays a more geographically diversified exposure than SOXX. U.S. equities still account for the highest weight with 75.65% of the portfolio. Still, it allows more foreign impact with 12.80% invested in Taiwan Semiconductors, 9.15% trusted in Dutch companies, and the resting 2.40% of the portfolio invested in S.T.M. from Switzerland. Besides, this ETF is highly concentrated on the Semiconductor industry, but it is also combined with a 2.62% exposure to the Software sector and has an expense ratio of 0.35%
- **SOXL**: Issued by Direxion⁸ in December 2010 provides an aggressive and bullish 1-day investment in the components of the PHLX, which is an unlevered fund by SOXX. SOXL has an expense ratio of 0.96%, which is around the average for leveraged ETFs. Besides, it has an average 60-day spread of 0.12%, and an adequate trading volume considering its 3x exposure.
- **SOXS**: On the other hand, and also issued by Direxion in December 2010, SOXS focuses on a bearish strategy against the highly concentrated semiconductor sector. Similar to its comparable SOXL, it has a 3x exposure in the opposite direction over PHLX. Although it has a higher expense ratio of 1.08% and a reduced average 60-day spread of 0.06%.

These four semiconductors ETFs address the performance of the industry from different perspectives based on the allocation of their portfolios over the last five years. As shown in Figure 3, the bullish SOXL has significantly been outperforming its peers due to its aggressive strategy. In contrast, the S.M.H. and SOXX have been following a similar route despite their differences, and the bearish SOXS hasn't been able to produce positive returns over the most recent years, showing the success of the semiconductors market performance.

⁷ VanEck is a financial services firm specialized in investment opportunities offering a wide variety of solutions. Further information can be found in the following link <https://www.vaneck.com/row/about-us/>

⁸ Direxion is an investment management firm specialized in index-based products. Further information can be found in the following link <https://www.direxion.com/about>

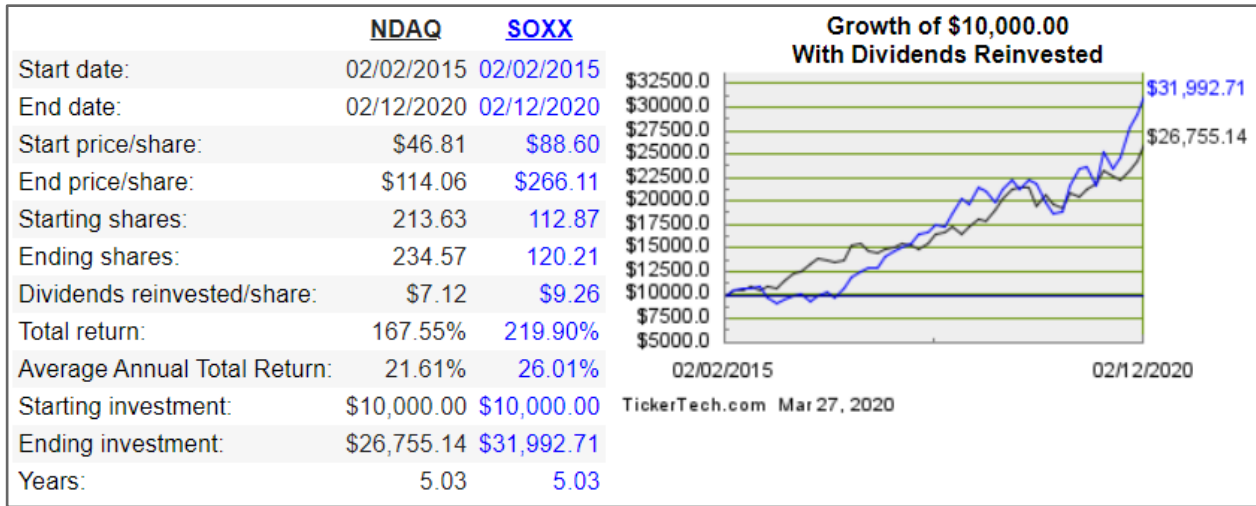
Figure 3: 5-year ETF performance



Source: ETF.com, SOXX overview

As shown by the displayed data, the semiconductor sector has followed a steady uptrend over the last five years. As shown in Figure 4, semis have outperformed comparable indexes such as the NASDAQ, which has a 5-year annualized return of 21.61% compared with the 26.01% return from SOXX, showing the comparison between the semiconductor and tech sectors in the U.S.

Figure 4: NASDAQ vs. SOXX



Source: TickerTech.com, Nasdaq YTD Return

Although the semiconductor industry has outperformed the overall tech industry over the last years, they still seem to follow a similar uptrend and cohesion. As chips now are involved in every technological and electronic device, the performance of the sector should be highly correlated to the development of the overall tech industry and, therefore, the stock market. The correlation between the SOXX and the NASDAQ in the last five years (Pre-COVID19) is 0.9874, showing that their returns follow a similar path. As Andres Cardenal said in one of his articles for Seeking Alpha, "In the same way that the transport sector was considered a key indicator for the economy in the 19th century, semiconductors are now a critical barometer for global economic activity" (Cardenal, 2019). Analyzing and predicting the movements of the semiconductor business cycle could then be of great help for determining the future performance of the stock markets.

II. Statistical analysis:

Economic analysis has been around for centuries, concentrating mainly on determining the length and direction of business cycles, which are the upward or downward movement of economic activity occurring around a growth trend. Many experts have focused their studies in finding a cause for these cycles, such as the British economist William Jevons, who blamed

"sunspots" to be the originators of recessions in the 19th century, supported by the fact that sunspots caused a decline in agricultural production, which ended up affecting the economic environment of societies.

All these studies found common ground in their pursuit of predicting the direction of business cycles before they occurred. Analysts now focus on studying sets of leading indicators that aim to show if a market is overbought or oversold. The market will typically suffer a pull-back or correction if it is overbought and rebound when it is oversold. Leading indicators can then be used to determine entry and exit points based on market prices within a settled trend.

These economic business cycles are similar to industry business cycles, following the four fundamental phases in every cycle: peak, downtrend, trough, and uptrend. Although the indicators may not be the same, as the factors that impact each industry are usually different. In order to find the most suitable indicators for the analysis, it is recommended to follow the tests that define the classical criteria for selecting leading indicators. Based on the Business Cycle Indicators Handbook written by the The Conference Board in 2001, leading indicators must follow:

- Conformity—the series must conform well to the business cycle
- Consistent Timing—the series must exhibit a consistent timing pattern over time
- Economic Significance—cyclical timing must be economically logical
- Statistical Adequacy—data must be collected and processed in a statistically reliable way
- Smoothness—month-to-month movements must not be too erratic
- Currency—the series must be published on a reasonably prompt schedule.

Two of the most representative leading indicators for the semiconductor industry are new orders of semiconductors, which shows an indication of the demand in the industry, and the producer price index (PPI) for the sector, which represents the balance between supply and demand in the market.

As shown in Figure 5, there is a high positive correlation between the SOXX and the new orders of semiconductors, as the market price of the industry reflects the variation in market

demand for these products. Additionally, the producer price index indicates a high negative correlation with the other variables. Not only is it an indicator of the balance between supply and demand in the market, but it also demonstrates the effect of improving technologies and economies of scale, which end up decreasing prices over time. The steady rise of NASDAQ over the last five years has been matched by an almost equal increase in new orders and, ultimately, a decline in semiconductor prices.

Figure 5: Correlation Table SOXX-NO-PPI

| | <i>SOXX</i> | <i>New Orders</i> | <i>PPI</i> |
|-------------------|-------------|-------------------|------------|
| <i>SOXX</i> | 1 | | |
| <i>New Orders</i> | 0.875377 | 1 | |
| <i>PPI</i> | -0.90832 | -0.912258063 | 1 |

Source: Self-elaboration based on U.S. Bureau of Labor Statistics data⁹

Since the early 19th century, analysts and mathematicians have been performing regression analysis to estimate the relationship between a dependent variable and one or more independent variables. The analysis will only be meaningful if it relies on the established assumptions; The sample must be representative of the population, the independent variables must be measured with no error, deviations from the model have an expected value of zero, the variance of the residuals is constant across observations, and the residuals are uncorrelated with one another.

Regression modeling is highly popular for evaluating relationships between variables, and therefore much useful for analyzing leading indicators. The dependent variable that the model explains is the SOXX returns, while the new orders and PPI are taken as independent variables. The highest frequency obtained is monthly, constrained by both the new orders and PPI figures. The analyzed period is still five years, as compared previously; therefore, the model will have 60 monthly statistics of all the variables.

⁹ This figure is a section of the Appendix 1, which covers a regression model of the SOXX, New Orders of Semiconductors and the Producer Price Index.

One of the most representative figures of a regression model is R Square, as it shows the proportion of the variance in the dependent variable that is predictable from the independent variable. Its value ranges from 0 to 1, although it is mostly used as a percentage. As this model has more than one independent variable, the coefficient of determination must be adjusted as it is no longer a linear regression. As shown in figure 6, the regression model has an adjusted R Square of 0.8323, meaning that 83.23% of the variance in SOXX returns is predictable from the independent variables.

Figure 6: Regression Summary

| <i>Regression Statistics</i> | |
|------------------------------|----------|
| Multiple R | 0.915465 |
| R Square | 0.838076 |
| Adjusted R Square | 0.832395 |
| Standard Error | 20.18398 |
| Observations | 60 |

Source: Self-elaboration based on Yahoo Finance data¹⁰

Although other professionals prefer to evaluate a regression model based on its Standard Error, as it is an indicator of the average distance that the data points fall from the regression line. The objective of a significant model is to have a high R Square and a low Standard Error. As shown in the previous figure, the model matches a high enough adjusted R Square, as well as a sufficiently low standard error. According to the mathematical theory, 95% of the results must be within a range of +/- two times the standard error from the regression line; in this case, the figure is low enough when compared with the values of SOXX. Overall, this regression model has high predictive power and sufficient precision to forecast future returns of the semiconductor industry.

After analyzing the main components underlying the semiconductor industry, and understanding their predictive power, the regression analysis can be used to prove the

¹⁰ This figure is a section of the Appendix 1, which covers a regression model of the SOXX, New Orders of Semiconductors and the Producer Price Index.

relationship between the returns of both NASDAQ and SOXX over the last five years. As the purpose of this paper is to establish the predictive power of the semiconductor industry over the electronics market, now the dependent variable used is the NASDAQ returns, and the SOXX returns will be the independent variable. To introduce the previous independent variables would now be redundant as their effect will already be entailed on the SOXX figures. Although the analyzed period is still the same, now the model will be based on daily returns of both indexes, ending up with 1257 observations.

The new model is more accurate due to the increase in analyzed observations, although it is offset by a decrease in its predictability reflected on an R Square of 0.6931. The technological industry has changed over time, and particularly the semiconductor sector has gained momentum over the last five years. To better analyze the relationship between these two indexes, it is optimal to run a regression analysis over each year throughout the entire period. Figure 7 shows the variation in the regression parameters over each of the five analyzed periods.

Figure 7: Regression analysis over time

| Daily returns | BETA | CORRELATION | R SQUARE | St. Error |
|----------------------|-------------|--------------------|-----------------|------------------|
| 2015-16 | 1.077 | 0.818 | 0.670 | 0.007 |
| 2016-17 | 1.211 | 0.809 | 0.655 | 0.005 |
| 2017-18 | 1.463 | 0.866 | 0.751 | 0.004 |
| 2018-19 | 1.159 | 0.856 | 0.733 | 0.007 |
| 2019-20 | 1.394 | 0.826 | 0.683 | 0.005 |

Source: Self-elaboration based on Yahoo Finance data¹¹

As shown in the previous figure, the beta calculated on the different analyzed periods has been increasing over time, indicating that the semiconductor sector has increased its volatility in reference to the overall technological industry. A beta over one means that the variations of the SOXX will be more extensive than the ones of NASDAQ, showing a higher increase

¹¹ This figure summarized the findings from the annual regression models done over the 5-year analyzed period, the entire excel file can be found on Appendix 2.

in expanding periods and a harder decline in contraction periods. The beta of SOXX with respect to NASDAQ shows that the semiconductor sector has experienced higher returns than the overall technological industry, especially over the 2017-18 expansion and last year. It is indicating the superior growth of the semiconductor sector compared to the global technology landscape. Additionally, the correlation has remained strong over the analyzed time frame, supported by resilient R Square and St. Error figures on its model.

The idea behind leading indicators relies on the fact that a variable could be studied to anticipate future movements of another variable. The time gap between the similar changes in the variables represents an opportunity as it allows investors to predict the performance of the independent variable.

Even though the technology industry is highly dependent on semiconductors, the market returns of SOXX do not seem to anticipate the market performance of the technology industry, as represented by the NASDAQ returns. After a thorough study of different regression analyses comparing the returns of NASDAQ with previous returns of SOXX with a time gap variation of days, weeks, and months, the model did not show any improvement. If the SOXX could impact the forward performance of the NASDAQ, the model would have shown a higher R Squared coefficient when the time gap was applied. However as shown in Figure 8, the model not only did not improve but worsened its predictability after applying the time gap, lowering its R Square to less than 0.10 and its correlation to less than 20%. This worsening was general across different time periods and different time gaps applied to the model.

Figure 8: Regression summary 2015-16 one week gap

| One week leading gap 2015-2016 | |
|-----------------------------------|----------|
| <i>Regression Statistics</i> | |
| Multiple R | 0.207946 |
| R Square | 0.043241 |
| Adjusted R Square | 0.023309 |
| Standard Error | 0.025384 |
| Observations | 50 |

Source: Self-elaboration based on Yahoo Finance data¹²

These results support that the semiconductor industry does not display a leading ability over the technology industry overall, but that it shares a highly similar market movement when analyzed simultaneously. This is a characteristic of coincident indicators, which are useful for showing the current state of the underlying economic activity within a particular area, in this case, the technological industry. Although these indicators may not be useful for predicting future performance of independent variables, they are used as a primary source of information to document "official" business-cycle turning points. The steady growth that the semiconductor sector has shown over the last five years supports the undeniable expansion of the technological industry.

¹² This figure shows the findings from the regression model over the 2015-2016 period with a one week leading period for SOXX, supporting how the model became less predictable when anticipated by any time gap. The entire excel file with more leading trials can be found on Appendix 3.

4. Key players:

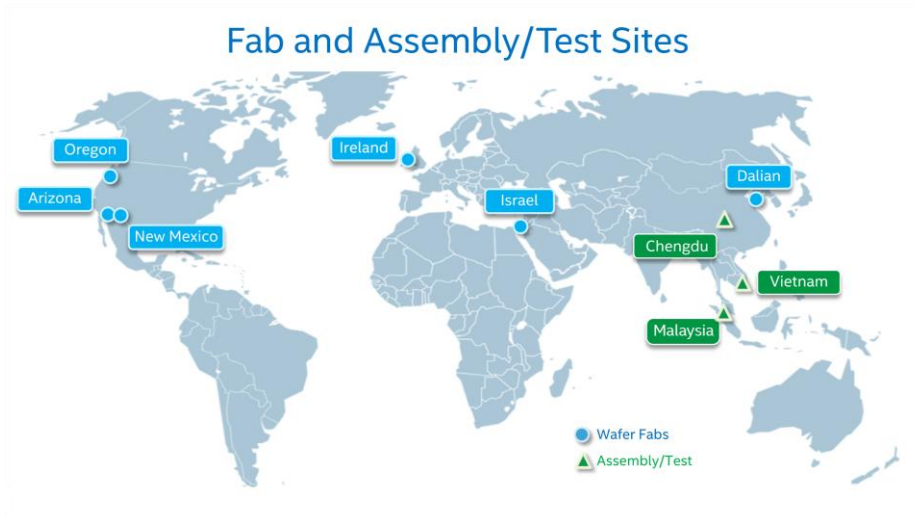
The semiconductor sector has been growing since its inception, reaching international markets and expanding into new specialized sub-sectors. Companies around the world arise with new technologies and expertise, conquering market share in one of the most competitive and innovative business landscapes of the market. As stated previously, the sector is dominated mainly by American companies. This paper will analyze Intel, NVIDIA, Texas Instruments, and Broadcom as representatives of the Yankee nation, as well as international players like ASML (Netherlands) and Taiwan Semiconductors. This study aims to find the best positioned firms in the sector by analyzing its fundamentals and qualitative characteristics.

I. Overview of the sample:

- **INTEL CORPORATION (NASDAQ: INTC):**

Intel was founded in 1968 in Santa Clara, California, and provides computing, networking, data storage, and communication solutions worldwide. It is a respectable player in the sector, as it was the first company to develop a microprocessor chip since then, they have specialized and maintained their leading position in data storage. As shown in Figure 9, the Company counts with six wafer fabs, and three assembly sites located efficiently to deliver their products to their customers around the globe.

Figure 9: Geographical presence of Intel's facilities



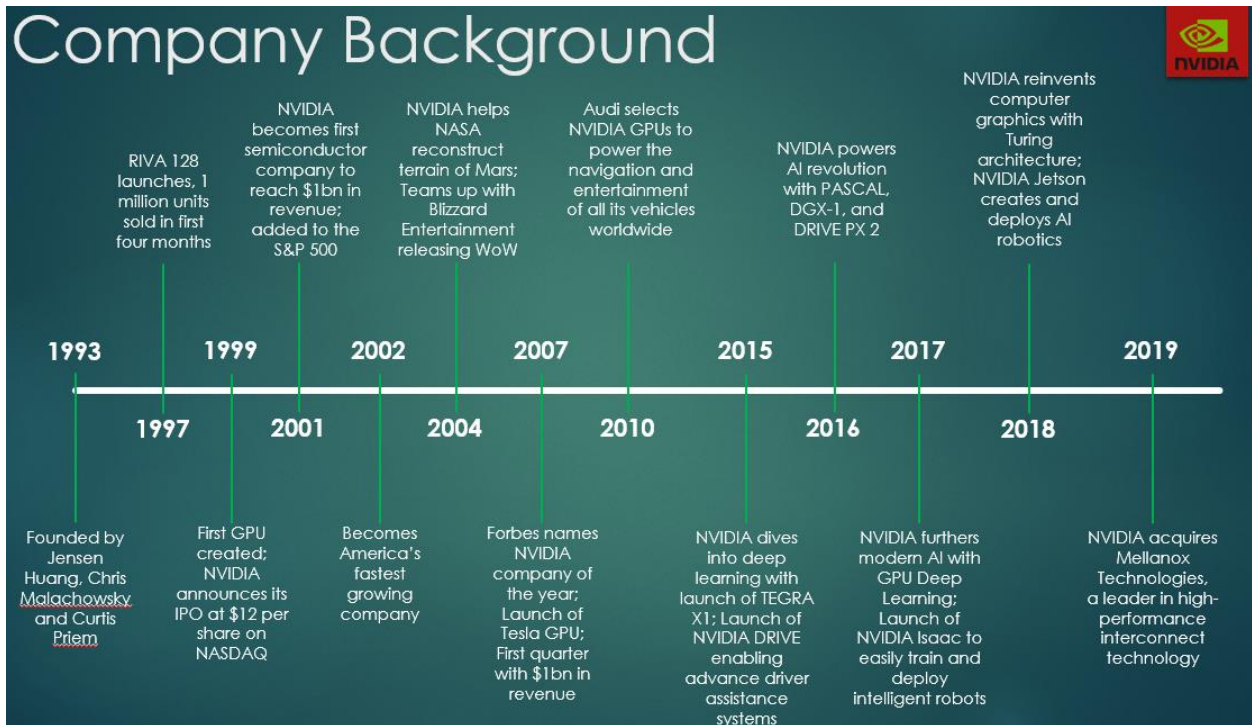
Source: Intel.com¹³

- NVIDIA CORPORATION (NASDAQ: NVDA):

Nvidia was founded in 1993 in Santa Clara, California, and it's specialized in two broad segments: GPU and Tegra processor. They were the creators of the first Graphics Processing Unit (GPU), which creates interactive graphics for laptops, P.C., and notebook. They revolutionized the gaming world and have been continuously improving their products to remain as undeniable leaders of this fast-growing market. The Tegra Processor segment provides devices and services designed to harness the power of mobile-cloud to revolutionize home entertainment, A.I., and robotics. As shown in Figure 10, they have long-lasting partnerships with world-known players like Audi, Tesla, or NASA to develop the visual graphics of their navigation and entertainment systems. Over the last few years, they have been expanding into robotics, deep-learning, and high-performance interconnect technology with the recent acquisition of Mellanox Technologies.

¹³ This figure can be found on the Company's website <https://www.intel.com/content/www/us/en/company-overview/company-overview.html>

Figure 10: Timeline NVIDIA Corporation



Source: Self-elaboration based on NVIDIA website; History¹⁴

- BROADCOM Inc. (NASDAQ; AVGO):

Broadcom was founded in 1961 in San Jose, California, and it is a designer, developer, manufacturer, and global supplier of a wide range of semiconductors and infrastructure software products. Their products focus on technologies that connect our world, being a leader and innovator in a variety of divisions like data center, networking, software, broadband, wireless, and storage and industrial markets. Their continuous innovation has enabled them to produce the first fiber optic transmitters and receivers for data communications, as well as the first single-chip DOCSIS cable modem to allow cable T.V. operators to provide Internet access. Additionally, they have completed Industry's First End-to-End 5G Mobile Networking Switch Portfolio and many other pioneering advances in the sector. They have a long and successful growth history through acquisitions, combining

¹⁴ This figure is self-elaborated and based on the firm's information provided on their website <https://www.nvidia.com/en-us/about-nvidia/corporate-timeline/>

leading firms like LSI, Broadcom Corporation, Brocade, CA Technologies, and Symantec under the same corporation to drive the industry into the future.

- TEXAS INSTRUMENTS Inc. (NASDAQ; T.X.N.):

Texas Instruments was founded in 1951 in Dallas, Texas, and it is a designer and manufacturer of semiconductors and various integrated circuits operating in two primary segments: Analog and embedded processing. The analog segment offers products to manage power requirements in various levels using battery management solutions, portable components, power supply controls, switches and interfaces, integrated protection devices, high-voltage products, and mobile lighting and display products. Moreover, they manufacture signal chain products that sense, condition, and measure signals to allow information to be transferred or converted for further processing and control for use in end markets. The Embedded Processing segment offers connected microcontrollers with integrated wireless capabilities and stand-alone wireless connectivity solutions that are used in electronic equipment. T.X.N. has lead essential innovations for the world, such as inventing the silicon transistor in 1954, the first integrated circuit in 1958, or developing the first hand-held calculator. The Texan manufacturer succeeded at launching the first family of single-chip digital cellphone solutions in 2007, making cellphone technology more affordable and adding features to make phones smarter.

- TAIWAN SEMICONDUCTOR MANUFACTURING COMPANY Ltd. (NYSE; T.S.M.):

Taiwan Semiconductor Manufacturing was established in 1987 in Taiwan, after many years of development they have become the number one pure-play semiconductor foundry in the world and focuses solely on manufacturing their customers' products. They have accomplished partnerships with leading players on a variety of divisions around the globe, by maintaining a competitive and respectable approach throughout its history as well as taking advantage of its expertise in the specialized manufacturing stage.

- ASML Holding (NASDAQ: ASML):

ASML was founded in 1984 in the Netherlands, it designs, manufactures, and sells advanced semiconductor equipment systems consisting of lithography related systems for memory and logic chipmakers. Over the last 20 years, the humble Dutch company has enabled the industry to design and produce smaller and faster chips by projecting light through a layer of water between the lens and the wafer. The firm believes in growth through continued innovation and collaboration with its loyal customers.

II. Financial Analysis:

This paper aims to analyze the fundamental financial components of the leading players in the sector, seeking to find the best-performing company for the current and upcoming business landscape. This analysis considers the most influential ratios and indicators of the semiconductor sector over the last five years, considering the six analyzed companies as a representative sample. Aiming to deliver the most consistent and objective analysis possible, this study has calculated the compounded annual growth rate (CAGR) of each ratio from the median of the results instead of from the latest released data.

This analysis is mostly based on publicly available information delivered by the companies on their earnings reports. It is, therefore, objective and not influenced by any personal judgment.

- Net profit margin:

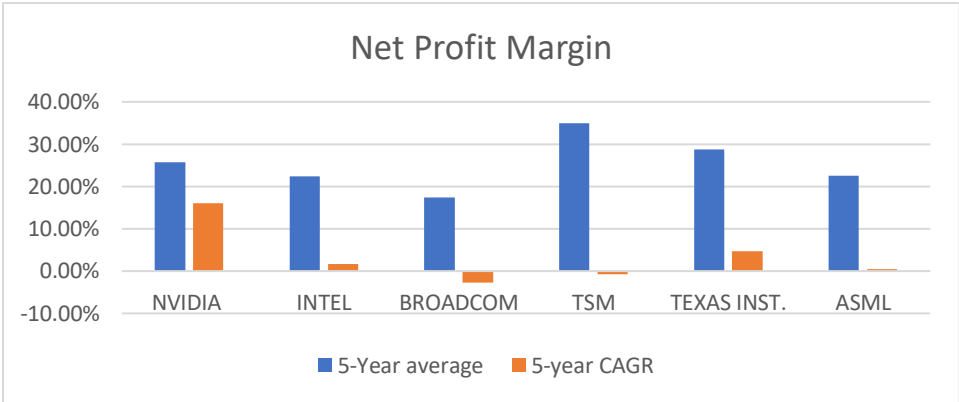
The net profit margin is one of the most crucial indicators for assessing a company's financial health, as it shows the percentage of revenues that remain after paying operating expenses, interests, taxes, and preferred stock. Investors pay close attention to the net profit margin performance of a company as it indicates how well the management team is converting revenues into profit for shareholders.

The average 5-year net profit margin median of the sample is 24.14%, which is higher than the average figure for the overall semiconductor industry of 19.42%, and more than twice as high as the global market's average of 7.71%, as stated by an N.Y.U. Stern industry research

(N.Y.U. Stern, margins). As shown in figure 10, Taiwan Semiconductor leads the sample with an average net margin of 34.98%, followed by T.X.N. with 28.79% and NVIDIA with 25.73%. Although T.S.M. stands out as a leader, it is also essential to consider the recent growth in margins.

The 5-year net margin CAGR¹⁵, shows which company has experienced the highest improvement of its operating efficiency. As shown in the figure below, NVIDIA clearly shows the greatest improvement over the last five years, with a 16% compounded annual growth rate in net margins, followed by T.S.M. with growth below 5%. On the other hand, the worst figures come from Broadcom, with a net margin of 17.43%, below the industry average, and negative growth of 2.69%, the lowest of the sample.

Figure 11: Net Profit Margin



Source: Self-elaboration based on Company's data¹⁶

These results conclude that NVIDIA seems to be the best positioned when considering operating efficiency compared to its peers, as it has the highest recent growth in margins and a higher than average current net margin. Additionally, its Texan peer follows closely with a higher net profit figure but less than a third of its growth.

¹⁵ The term CAGR refers to Compounded Annual Growth Rate, and shows the performance of the ratio over the analyzed period. Further information can be found on the following link <https://www.investopedia.com/terms/c/cagr.asp>

¹⁶ This chart is part of the Overall Analysis tab on the Player Analysis excel file attached on Appendix 4.

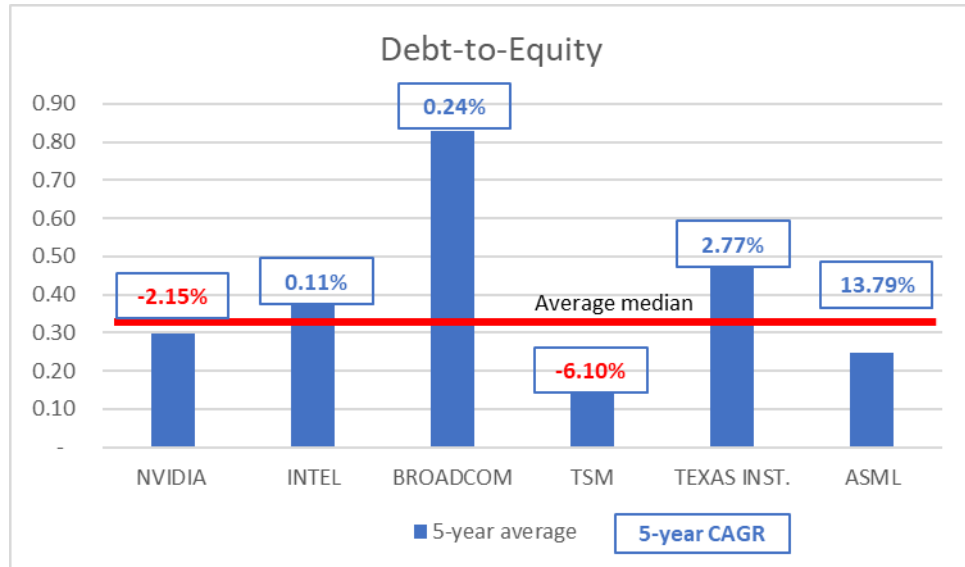
- Debt/Equity:

The debt-to-equity ratio is one of the fundamental core ratios as it is used to evaluate a company's financial leverage. It is calculated as total debt over shareholders' equity and measures the degree to which a company is financing its operations through debt versus external equity. A company's financing combination directly affects its cost of capital. Historically the cost of debt has been cheaper than the cost of equity, which will allow companies with a higher leverage to access a lower cost of capital. At the same time, an inconceivable high leverage will end up increasing the firm's credit risk and, therefore, increase its overall cost of borrowing. This fundamental ratio must be analyzed considering the firm's contemporary situation, as a high debt-to-equity (D/E) ratio will be dangerous for a company facing difficulties as it may not be able to deal with its liquidity obligations. In contrast, a low debt-to-equity ratio could mean that a company is over-relying on equity to finance its business, which can be costly and inefficient.

As represented in figure 12, the average median D/E ratio of the sample is 0.33, which is below the 0.6 average of the overall technology sector. Broadcom clearly leads the sample with the highest rate above 0.8, followed by Texas Instruments below 0.5 and Intel below 0.4. Debt is not as popular out of the U.S.A., with the Taiwanese foundry having the lowest debt-to-equity ratio followed by ASML with less than 0.15 and 0.25, respectively.

It is also essential to analyze the tendency of these firms over time. The Asian foundry has been decreasing its ratio by 6.10% over the last five years, followed by NVIDIA with a negative D/E CAGR of 2.15%. On the other hand, ASML has been the only firm growing at a double-digit rate as an effort to reduce its overall cost of capital.

Figure 12: Debt/Equity



Source: Self-elaboration based on Company's data¹⁷

- Return on Equity (RoE):

Return on equity is measured as net income over shareholders' equity, showing how much profit a company is generating from its shareholder's investment. RoE is a profitability ratio from the investor's point of view, as it measures how efficient a company is at using equity financing to grow its operations. It is always interesting to have a high RoE figure but must pay close attention to its performance over time as it will determine its consistency.

The average 5-year return on equity median of the sample is 21.98%, which is higher than the average figure for the overall semiconductor industry of 20.29%, and more than twice as high as the global market's average of 13.63%, as stated by an N.Y.U. Stern industry research (N.Y.U. Stern, RoE). As presented in Figure 13, Texas Instruments leads the sample with an average RoE of 43.66%, followed by NVIDIA with 30.13% and Taiwan Semiconductors with 23.24%. Although T.X.N. stands out as a leader with an RoE of more than twice the

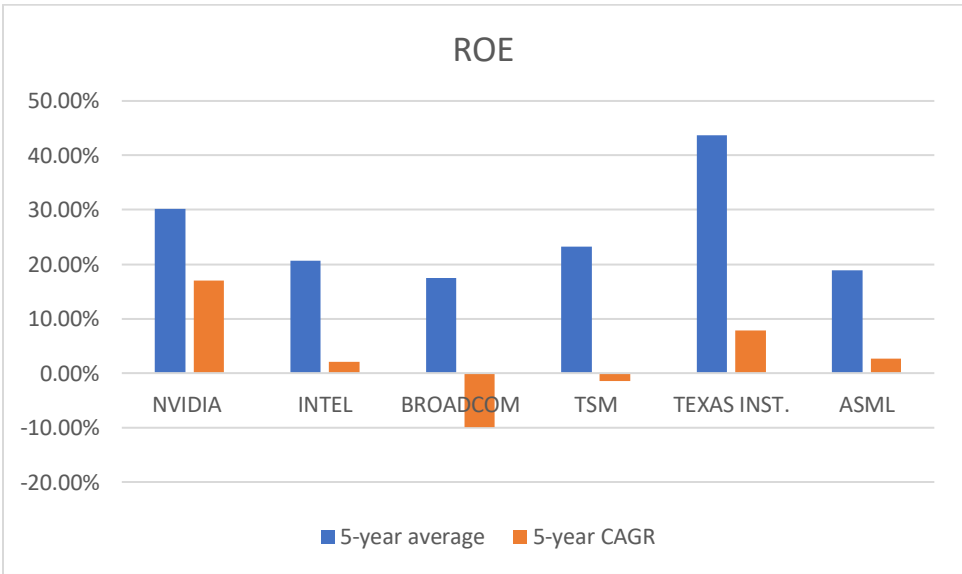
¹⁷ This chart is part of the Overall Analysis tab on the Player Analysis excel file attached on Appendix 4.

industry's average, it is also essential to consider the evolution over time to ensure its uniformity.

The 5-year RoE CAGR median of the sample is 2.36%, there is a high contrast on this analysis as Broadcom and T.S.M. have had negative growth on RoE of 9.90% and -1.50% over the last five years, and on the other hand, NVIDIA and Texas Instruments have shown high growth of 17.02% and 7.78% respectively. Overall, Broadcom shows the worst performance, with the lowest return for investors and a menacing negative growth.

These figures point out Texas Instruments to be more attractive from an investor's point of view as it exhibits a return on equity investment of more than twice the average and a high growth compared with its peers. NVIDIA follows closely with high double-digit growth and a rate higher than the industry.

Figure 13: Return on Equity



Source: Self-elaboration based on Company's data¹⁸

¹⁸ This chart is part of the Overall Analysis tab on the Player Analysis excel file attached on Appendix 4.

- Return on Investment (RoI):

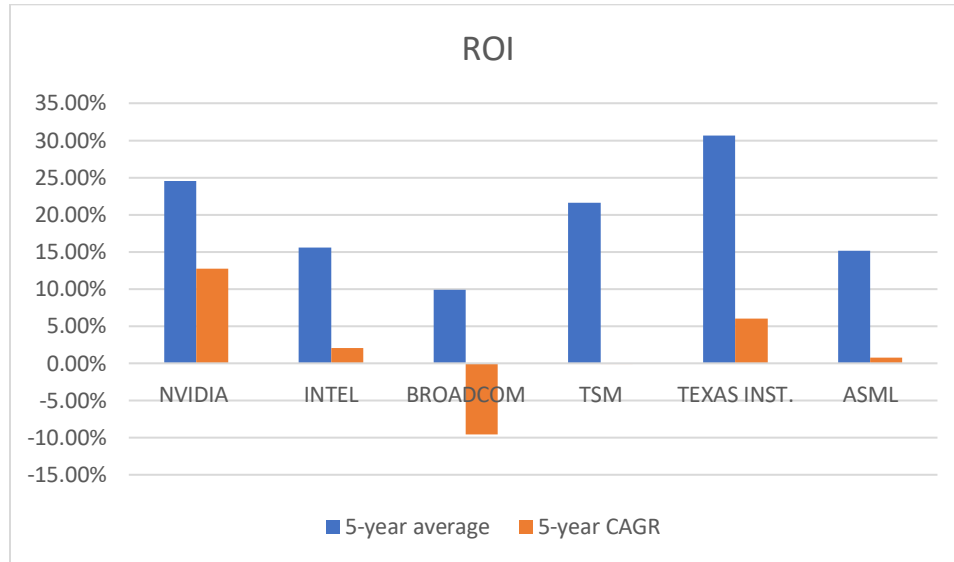
The return on investment is a profitability ratio that measures the profits of an investment as a percentage of its cost. It is calculated as the investment revenue minus the investment cost over the investment cost, it is a flexible formula, as each industry or specific firm can determine the investment revenue and cost as they consider. The most common way of calculating the RoI for shareholders is by dividing net profit over the cost of the investment, as it already takes into account the interests and taxes on the return and considers the amount of profit available for its investors.

The average 5-year return on investment median of the sample is 18.56%, which is similar to the 2019 average figure for the overall semiconductor industry of 18.64%, as calculated by C.S.I. Market. Although the sample median for 2019 is 19.71%, higher than its related industry in the same year. Figure 14 shows how Texas Instruments leads the sample with an average RoI of 30.65%, followed by NVIDIA with 24.51% and Taiwan Semiconductors with 21.57%. Although T.X.N. stands out as a leader with an RoE 50% higher than the industry's average, it is also essential to consider the improvement overtime to ensure its future performance.

The 5-year RoI CAGR median of the sample is 1.38%, there is a high contrast on this analysis as Broadcom and T.S.M. have had negative growth on RoE of 9.55% and 0.09% over the last five years, and on the other hand, NVIDIA and Texas Instruments have shown strong growth of 12.77% and 6.05% respectively. The Asian foundry holds the third-highest 5-year average RoI and has maintained its return stable over time with a slight decrease over the last three years. On the other hand, Broadcom shows the worst performance, with the lowest return as a percentage of cost and threatening negative growth.

Texas Instruments seems to be the best positioned when considering RoI, as it exhibits a high return on investment and has been growing at a higher rate than its peers. Additionally, NVIDIA has grown at the most robust rate and has the second-highest return on investment, which could help it ensure its leadership in the upcoming future.

Figure 14: Return on Investment



Source: Self-elaboration based on Company's data¹⁹

- Return on capital employed (ROCE):

The return on capital employed (ROCE) is an additional profitability ratio that is useful for comparing the profitability based on the amount of capital applied. It is calculated as EBIT²⁰ over capital employed, taking total assets minus current liabilities as the divisor. This ratio considers how efficient a company is at generating operating income from its shareholders' equity and debt liabilities. It is complementary to RoE, but it also considers the amount of debt that a firm relies on for its operations.

The average 5-year ROCE median of the sample is 20.30%; this figure is similar to the previous analyzed RoE as the sample average is not highly leveraged. As exposed in Figure 15, T.X.N. dominates the sample as it has the lowest debt/equity ratio of the peers with an average ROCE of 37.44%, almost twice as high as the median, followed by NVIDIA with

¹⁹ This chart is part of the Overall Analysis tab on the Player Analysis excel file attached on Appendix 4.

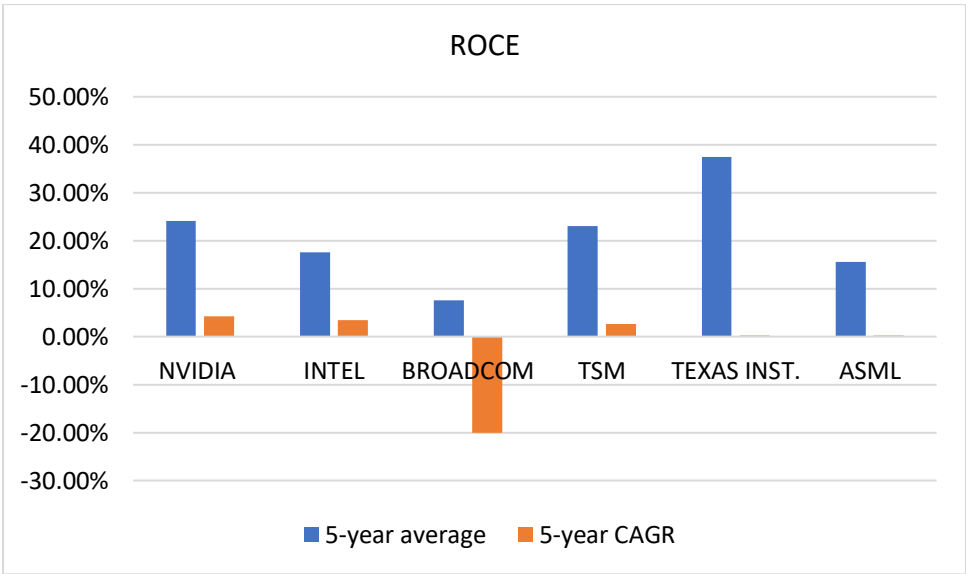
²⁰ The acronym EBIT refers to Earnings Before Interests and Taxes, which is one of the main components of an income statement.

24.17% and T.S.M. with 23.05%. Although Texas Instruments leads the sample, it is also important to consider consistency and growth in the analysis.

The 5-year ROCE CAGR shows that Broadcom is in a dangerous situation as it has the lowest average ROCE of the sample and has had negative growth of 20% over the last five years. Moreover, T.S.M. will likely lose its podium position as it has not been able to improve its ROCE at the same rate as its American competitor Intel, which has had the second strongest growth behind NVIDIA.

T.X.N. will likely maintain its leadership as it has proved to grow its already strong ROCE at a 2.64% 5-year CAGR, as long as it holds its low debt-to-equity ratio.

Figure 15: Return on Capital Employed



Source: Self-elaboration based on Company's data²¹

- FCF/Share:

Free cash flow (FCF) per share is a highly useful and comprehensive financial ratio that demonstrates the amount of cash flow available to be distributed to both debt and equity shareholders. This ratio shows a company's ability to pay debt, dividends, buy back stock,

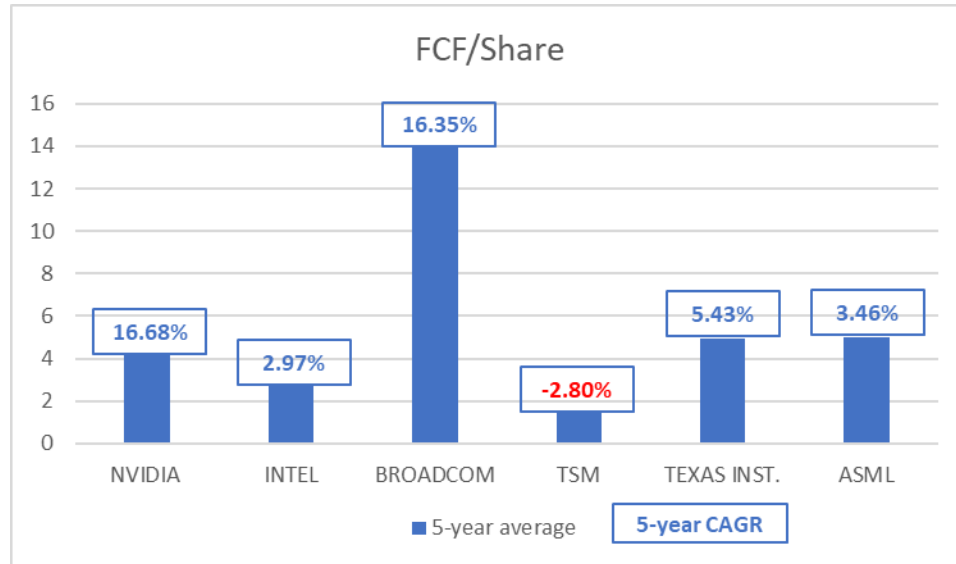
²¹ This chart is part of the Overall Analysis tab on the Player Analysis excel file attached on Appendix 4.

and ensure the growth of the firm. It is calculated as free cash flow over the number of outstanding shares of a company. Therefore it could be used as an indicator for changes in earnings per share. Positive growth in FCF/Share is always a sign of financial health, as a firm will aim to grow its cash flow from operations and to invest while maintaining a stable number of shares.

Due to the variation in the number of shares outstanding that each company has, the absolute value of FCF/Share is not as representative as its growth over an analyzed period. The median 5-year FCF/Share CAGR of the sample is 4.44%, which implies that these companies have been able to generate more cash from its operations over time, supporting the strength of the sector. The well-defined leaders, as shown in Figure 16, are NVIDIA and Broadcom with a growth of more than four times the sample median, whereas, on the other hand, the Asian foundry has been decreasing its FCF over the analyzed period while maintaining its shares outstanding at a stable amount.

Overall, NVIDIA and Broadcom are the best-positioned companies with growth rates considerably above the sample median and following a steady upward slope over the last five years. Taiwan Semiconductors, on the other hand, seems to be struggling with its cash flow generation.

Figure 16: FCF/Share



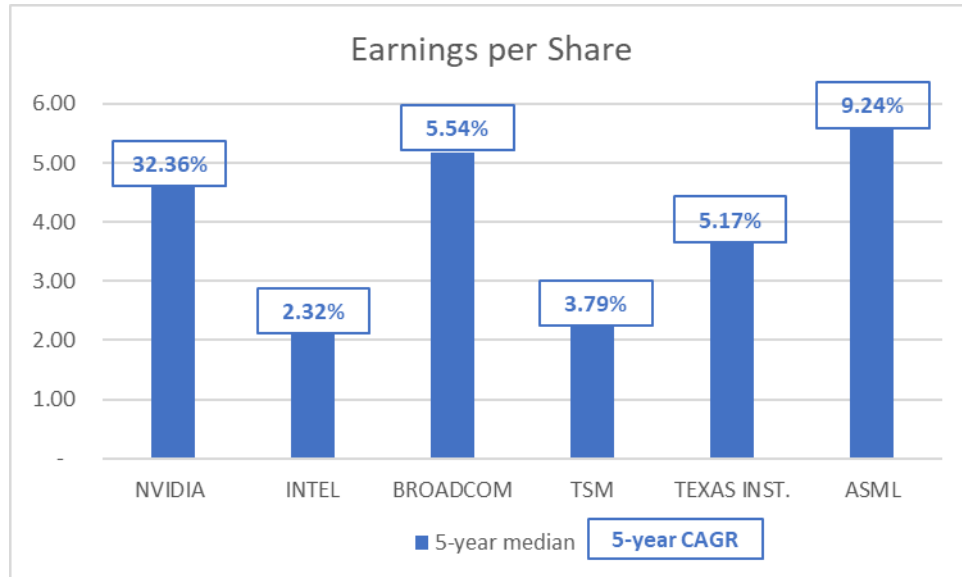
Source: Self-elaboration based on Company's data²²

- Earnings per Share:

As stated above, FCF/Share is an indicator of earnings per share (EPS), which is one of the most anticipated figures of every quarterly report. EPS is a profitability ratio that represents the portion of a company's earnings, excluding preferred stock dividends, that is allocated to each share of common stock. Following the same rationale as with FCF/Share, the absolute value of EPS should not be compared across companies, while growth is now more representative than ever. Additionally, as analysts tend to forecast the quarterly EPS figure of companies, it is also significant to consider if a company has been able to beat its estimates over the most recent periods.

²² This chart is part of the Overall Analysis tab on the Player Analysis excel file attached on Appendix 4.

Figure 17: Earnings per Share

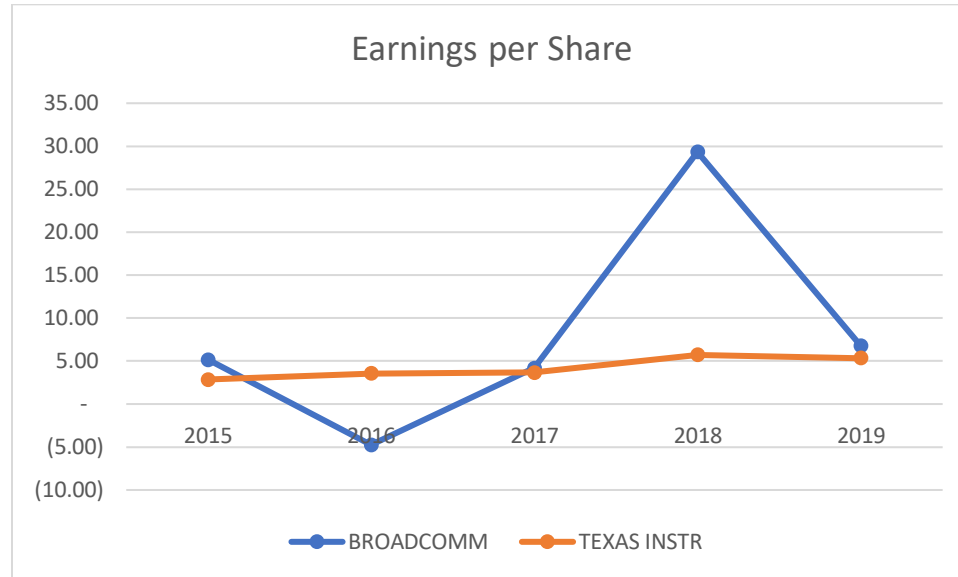


Source: Self-elaboration based on Company's data²³

As shown in Figure 17, NVIDIA exceeds the median CAGR of the sample with a 5-year growth in EPS of 32.36%, followed by the Dutch designer with 9.24%. Although Broadcom and Texas Instruments have been growing at similar CAGR, it is essential to point out that Broadcom has had much more variance than its Texan peer, as shown in Figure 18. Consistency is vital for companies, as these variances in its results increase their share price volatility and deteriorate their overall corporate profile.

²³ This chart is part of the Overall Analysis tab on the Player Analysis excel file attached on Appendix 4.

Figure 18: EPS Broadcom vs. Texas Instruments



Source: Self-elaboration based on Company's data²⁴

- Sustainable Growth Rate (SGR):

The sustainable growth rate is an additional measure of financial development, as it is a representation of the maximum growth a firm can achieve, excluding external financing from equity or debt. It is important to consider the SGR of a company to avoid over-leveraging and financial distress. The SGR is calculated as RoE multiplied by the retention ratio (1 – dividend payout ratio). Following the DuPont method of calculating RoE, an analyst can determine the most influential components of growth of a company and the effects of its changes, as it is derived from the multiplication of asset turnover²⁵, financial leverage, and net profit margin. Additionally, it is crucial to consider the progress of SGR over time, as a firm must always aim to increase its maximum organic growth.

The 5-year average S.G.R. median of the sample is 13.22%, led by NVIDIA with an SGR of 25.93% as shown in Figure 19, almost twice as high as the median due to both its high RoE

²⁴ This chart is part of the Overall Analysis tab on the Player Analysis excel file attached on Appendix 4.

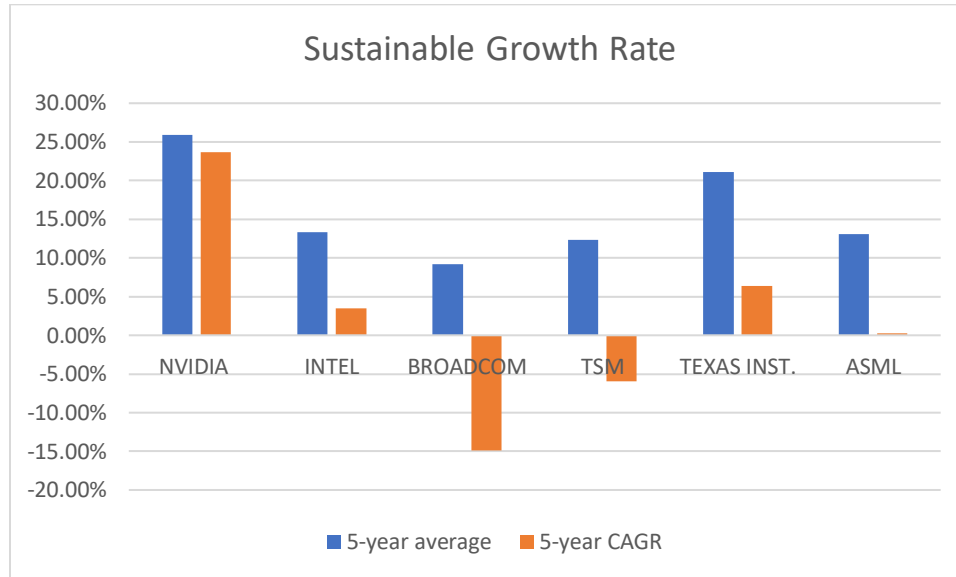
²⁵ Asset turnover is calculated as sales over total assets.

and its high retention ratio, followed by T.S.M. which as discussed previously showed the highest RoE of the sample but with an average 5-year retention ratio of 0.52 compared to NVIDIA's 0.83. Intel and ASML follow closely with an S.G.R. around the sample median due to their similar RoE and dividend payout ratios. On the other hand, Broadcom leads the low level of the sample as it had the lowest return on equity and a retention ratio below the average.

Considering the 5-year SGR CAGR, Figure 19 shows that NVIDIA will most likely remain the leader of this category as it has grown at a robust 23.66% while the rest of its peers have not been able to reach double-digit growth figures. T.S.M. follows with the second strongest growth, although their retention ratio has been decreasing over the analyzed period and will most likely reduce its maximum internal growth. A similar reduction in retention rates due to an increase in paid dividends by T.X.N. has led them to reduce its S.G.R. over the last five years, even more, extreme is the case of Broadcom, which has had a CAGR of -14.91% on the same period.

As stated previously, NVIDIA seems to be highly favored to dominate this ratio in the upcoming future as long as it manages to maintain its RoE growth and retention ratio as high as before.

Figure 19: Sustainable Growth Rate



Source: Self-elaboration based on Company's data²⁶

After careful consideration and analysis of the nine indicators discussed above, Figure 20 shows which companies seem to be better positioned from a fundamental point of view by determining the best and second-best performing firms:

- NVIDIA Corporation exhibits the best results overall compared with its sampled peers. The Company has been able to grow its Net Profit margin at the highest rate, with a 16% 5-year CAGR, reaching the third-highest margin of the sample after T.S.M. and T.X.N. It shows the highest RoE. and RoI CAGR, being the only firm to grow at a double-digit rate over the last five years. Its decreasing and below-average debt-to-equity rate has enabled them to achieve the highest sustainable growth rate of the sample, as well as being the only company to reach a CAGR higher than 20% on the same indicator. Its earnings per share have shown a 32% compounded growth over the last five years, more than three times higher than the sample average and only followed by ASML with growth below 10%. Overall, NVIDIA has proven its

²⁶ This chart is part of the Overall Analysis tab on the Player Analysis excel file attached on Appendix 4.

high strength as a growth firm and seems to be able to hold the leading position of the sector for the upcoming periods.

Figure 20: Financial Ratios Comparison

| Company | NVIDIA | INTEL | BROADCOM | TSM | TEXAS INST. | ASML | MEDIAN |
|-------------------------------|--------|--------|----------|--------|-------------|--------|--------|
| Net Profit Margin | 25.73% | 22.45% | 17.43% | 34.98% | 28.79% | 22.55% | 24.14% |
| Net Profit Margin CAGR 5-year | 16.00% | 1.70% | -2.69% | -0.76% | 4.62% | 0.44% | 1.07% |
| ROI | 24.51% | 15.55% | 9.86% | 21.57% | 30.65% | 15.13% | 18.56% |
| ROI CAGR | 12.77% | 2.02% | -9.55% | -0.09% | 6.05% | 0.74% | 1.38% |
| ROE | 30.13% | 20.71% | 17.51% | 23.24% | 43.66% | 18.84% | 21.98% |
| ROE CAGR | 17.02% | 2.07% | -9.90% | -1.50% | 7.78% | 2.65% | 2.36% |
| FCF/SHARE | 4.152 | 2.766 | 13.926 | 1.44 | 4.9368 | 5.026 | 4.54 |
| FCF/Share CAGR 5-year | 16.68% | 2.97% | 16.35% | -2.80% | 5.43% | 3.46% | 4.44% |
| DEBT/EQUITY | 0.30 | 0.37 | 0.83 | 0.15 | 0.47 | 0.25 | 0.33 |
| D/E CAGR | -2.15% | 0.11% | 0.24% | -6.10% | 2.77% | 13.79% | 0.18% |
| Sustainable Growth Rate | 25.93% | 13.34% | 9.22% | 12.30% | 21.11% | 13.11% | 13.22% |
| SGR CAGR | 23.66% | 3.49% | -14.91% | -5.95% | 6.37% | 0.28% | 1.89% |
| AVERAGE ROCE | 24.17% | 17.55% | 7.50% | 23.05% | 37.44% | 15.55% | 20.30% |
| ROCE CAGR | 4.25% | 3.41% | -20.02% | 2.64% | 0.20% | 0.26% | 1.45% |
| EPS CAGR | 32.36% | 2.32% | 5.54% | 3.79% | 5.17% | 9.24% | 5.36% |
| EPS MEDIAN | 4.59 | 2.12 | 5.17 | 2.24 | 3.68 | 5.57 | 4.14 |

Best 2nd best

Source: Self-elaboration based on Company's data²⁷

- Texas Instruments follows with a better than average performance over the last five years. The Texan manufacturer holds the second-highest net profit margin 5-year CAGR, achieving a 28.8% net margin average. The Company seems highly attractive for investors, as it has been able to operate with the highest RoE and RoI of the sample with returns of 43.66% and 30.65%, respectively, supported by the highest growth rates after NVIDIA. Additionally, T.X.N. has the highest ROCE of the sample, with an average return on capital employed of 37.44%, almost twice as high as the sample average. Moreover, the firm has been able to grow its earnings per share at nearly 10% over the last five years of operations. Texas Instruments shows growth potential accompanied by stable historical performance and a 50% retention ratio, making it highly attractive for investors willing to enter the semiconductor sector.

²⁷ This chart is part of the Overall Analysis tab on the Player Analysis excel file attached on Appendix 4.

III. Market valuation analysis:

After studying and analyzing the fundamental factors of each one of the selected players, two companies seem to be better positioned to outperform their peers in the future. This section examines these favored companies from a market valuation perspective, with the objective of understanding the investor sentiment behind their performance.

As defined by the Corporate Finance Institute, the stock price is a reflection of the company's value, which is based on the idea of how much the public is willing to pay for a piece of the company. However, it is not always representative of its intrinsic value, as it is affected by external factors such as supply and demand or market sentiment. It is, therefore, crucial to analyze the market value of a company along with its operating performance.

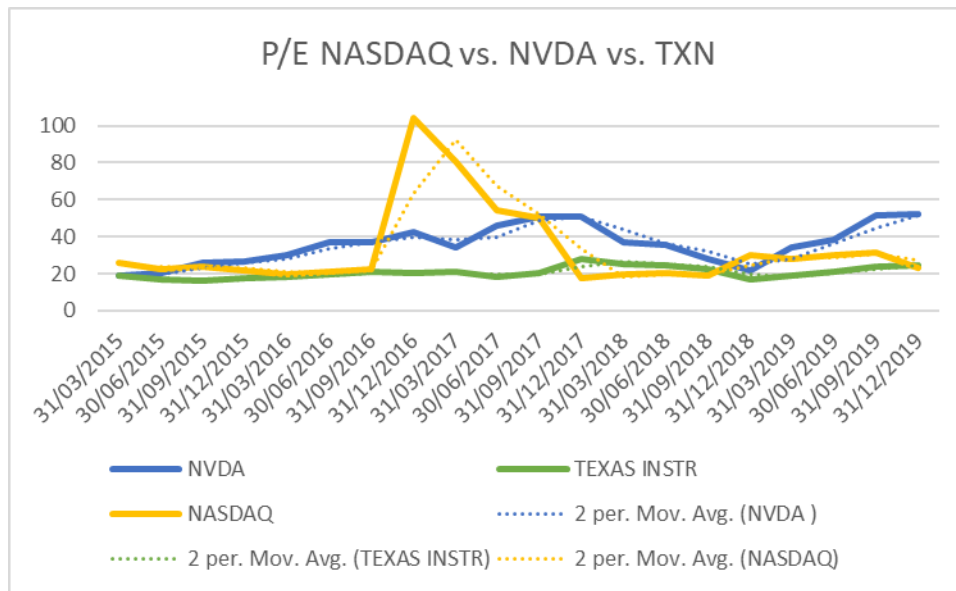
The price-to-earnings ratio (P/E ratio) is one of the most popular stock analysis tools, as it is used to determine whether a company's share price is overvalued or undervalued relative to its operating performance. It is calculated as the current share price of a company divided by its earnings-per-share (EPS). Companies usually measure this ratio based on the latest released earnings or forecasted future earnings when calculating the forward P/E ratio. There is no such thing as a high or low ratio, as it must be compared relative to its sector or peers over a long period of time. Companies with a high P/E ratio will be expected to deliver high growth in earnings compared to peers with a lower rate, or simply show that the firm is overvalued in the market. On the other hand, a low P/E ratio could mean that the stock is currently undervalued or that the firm is performing better than in the past.

Focusing on NVIDIA and Texas Instruments as the best-performing companies among the sample, the paper now analyzes their market performance over the same time period. Studying the data of these companies and comparing it with the NASDAQ as their representative benchmark will help to determine if their market price is undervalued or overvalued. Additionally, it is important to consider the two-period moving average as an indicator of their expected price-to-earnings rate.

- NVIDIA has been increasing its P/E ratio over the last five years because of both an increase in its earnings and an even higher increase in its share price. This trend is

supported by their outstanding operating performance, which has improved its investors' expectations. As shown in Figure 21, the Company had a decreasing ratio from late 2017 to the end of 2018, as it went from holding a P/E ratio twice as high as the NASDAQ at the end of 2017 to halving the same ratio and reaching levels below its index in only 12 months, showing how the market noticed its overvaluation and regulated accordingly. This behavior seems to be repeated over the last year, when NVIDIA has been increasing its P/E ratio over its two-period moving average and has again reached levels of over two times the NASDAQ which could be a sign of overvaluation, and therefore an expected price correction in the upcoming future.

Figure 21: P/E NASDAQ vs. NVIDIA vs. Texas Instruments



Source: Self-elaboration based on Company's data and Yahoo Finance²⁸

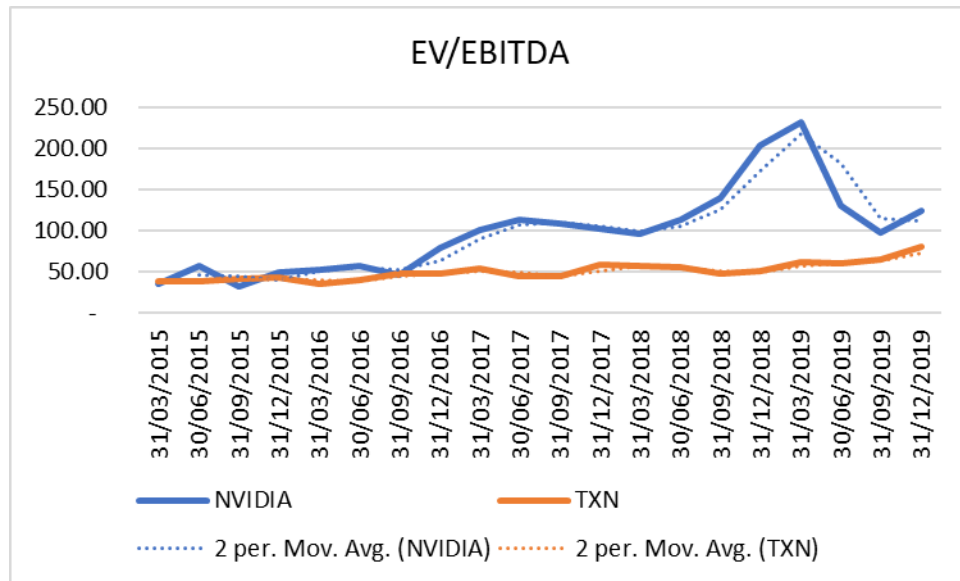
- Texas Instruments managed to grow its earnings at the same rate as its share price throughout the past five years, maintaining a stable price-to-earnings ratio around 20. As shown in figure 21, the Company has reached the same ratio as its index at the end of 2019, after a steady increase over the previous 12 months. Based on its P/E

²⁸ This chart is based on stock prices found in Yahoo Finance and earnings figures presented by the companies, and it is part of the Valuation Ratios tab on the Player Analysis excel file attached on Appendix 6.

performance, it seems correctly valued as it has been able to move along its two-period moving average and keeping its historically firm ratio. These findings favor the Texan manufacturer as its outstanding fundamental performance is supported by a realistic market representation, which improves its attractiveness for investors even more.

An additional measure to determine whether a firm is undervalued or overvalued in the market is the enterprise multiple. The enterprise multiple is derived after dividing the enterprise value (E.V.) of a company by its EBITDA²⁹. The E.V. realistically measures the value of a firm, as it is calculated by adding its market capitalization, value of debt, minority interests, and preferred shares and subtracting the firm's cash and cash equivalents.

Figure 22: EV/EBITDA NVIDIA vs. T.X.N.



Source: Self-elaboration based on Company's data and Bloomberg³⁰

Figure 22 shows the enterprise multiple performances of both NVIDIA and Texas Instruments over the last five years. This graph supports the fact that the Texan manufacturer

²⁹The acronym EBITDA refers to Earnings Before Interests Taxes Depreciation and Amortization and it is one of the main components of the income statement.

³⁰ This chart is part of the Valuation Ratios tab on the Player Analysis excel file attached on Appendix 6.

has a less volatile market valuation when compared with its operating performance, as explained in the P/E ratio analysis. Additionally, NVIDIA suffered a correction at the beginning of 2019 after increasing its enterprise multiple over its 2-period moving average and almost reaching values close to 250. Although both companies have been able to increase its EBITDA, T.X.N. seems to have a higher resemblance to its market capitalization over time, making it a more cautious investment.

IV. Valuation via comparable method:

After analyzing and studying the development of these companies through a variety of multiples, this paper now focuses on equity valuation through the comparable method.

Gathering the entire sample again as a representation of the semiconductor sector and using the median of the results as the benchmark, the comparable method offers a valuation range for NVIDIA and Texas Instruments. The share price is determined as the median P/E ratio of the sample multiplied by the EPS of the company at the end of 2019, and as the median P/FCF ratio of the sample multiplied by the FCF/Share of the firm at the end of 2019. This data was extracted from Yahoo Finance (Share price) and Bloomberg (EPS, EV, and EBITDA)

As shown in Figure 23, NVIDIA has the highest P/E ratio of the sample and a higher than average P/FCF. This valuation approach settles the firm as overvalued when compared with its peers. The ratios offer a share price range between \$153.22 and \$190, both below the price settled at the end of 2019. On the other hand, T.X.N. exhibits an upward potential of more than 20% when compared with the sample. Its surprisingly low P/E ratio and below-average P/FCF offer a valuation range between \$168.45 and \$175.25 dollars per share at the end of 2019.

Figure 23: Comparable method analysis

| Company | Date | Price | EPS | EV | EBITDA | FCF/Share | P/E | P/FCF | EV/EBITDA |
|---------------|------------|--------|-------|---------|---------|-----------|---------------------|------------------|-----------|
| NVIDIA | 31/12/2019 | 235.3 | 4.59 | 145.039 | 3.386 | 6.91 | 51.26 | 34.05 | 42.83 |
| INTEL | 31/12/2019 | 59.85 | 4.33 | 270.2 | 42.14 | 3.78 | 29.63 | 15.83 | 6.41 |
| BROADCOMM | 31/12/2019 | 316.02 | 8.51 | 149.52 | 10.42 | 22.32 | 37.14 | 14.16 | 14.35 |
| TAIWAN SEMI | 31/12/2019 | 58.1 | 13.39 | 8193.15 | 660.209 | 0.99 | 4.34 | 58.69 | 12.41 |
| TEXAS INSTR | 31/12/2019 | 128.29 | 5.25 | 120.32 | 6.88 | 6.126 | 11.40 | 20.94 | 17.49 |
| ASML | 31/12/2019 | 295.94 | 6.16 | 109.3 | 3.32 | 6.66 | 48.04 | 44.44 | 32.92 |
| Median | | | | | | | 33.38 | 27.50 | 15.92 |
| | | | | | | | Target Price | Target EV | |
| NVIDIA | | | | | | | 153.22 | 190.00 | 53.90 |
| TXN | | | | | | | 175.25 | 168.45 | 109.52 |

Source: Self-elaboration based on Yahoo Finance and Bloomberg³¹

Additionally, figure 22 also analyses the enterprise multiple of the sample, showing how both NVIDIA and T.X.N. are above the median of the sector. NVIDIA has the highest enterprise multiple, almost doubling the average, and is therefore determined as significantly overvalued under this ratio. Texas Instruments has a slightly higher than average multiple and could be identified as vaguely overvalued in terms of enterprise value.

³¹ This chart is part of the Valuation Ratios tab on the Player Analysis excel file attached on Appendix 6.

5. Impact of COVID-19 on the Semiconductor Industry:

Although this paper has focused on analyzing the performance of the semiconductor industry over the last five years up until the end of 2019, the world has now been impacted by an unexpected pandemic that has strongly affected the overall economy, and therefore modified the expected performance of many companies. This section will aim to study these changes and their influence over the analyzed sector.

While the pandemic outbreak was originated in a seafood market in the city of Wuhan in China, it quickly spread around the world, reaching more than 200 countries in every continent in less than three months. This rapid expansion was possible due to a combination of both the extremely high infection rate of the virus and the deep international connections resulting from globalization. As stated in the paper of Chakraboity and Maity, "the World Trade Organization (W.T.O.) and the Organization for Economic Cooperation and Development (OECD) have indicated COVID-19 pandemic as the largest threat to the global economy since the financial emergency of 2008-2009."

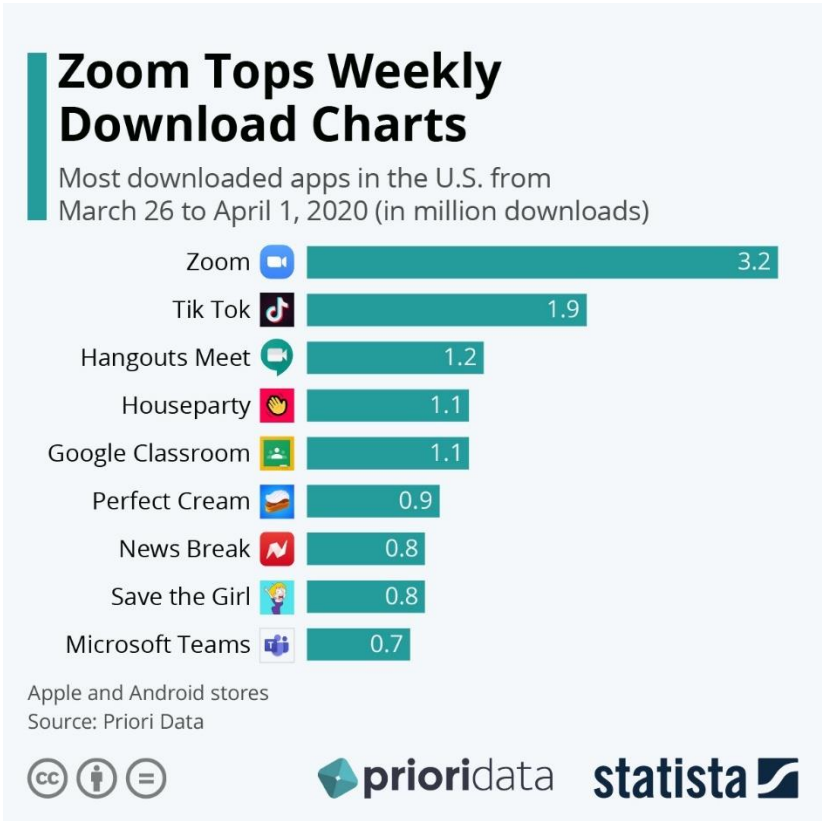
Societies have been affected on a wholesale level. The fear of being infected by this unknown disease has stopped the world in many ways. International travel has been reduced to levels below the aftermath of 9-11³², the majority of the world population has faced daily life restrictions such as lockdowns and scheduled curfews, unemployment has reached crisis rates, and those that remain employed now are challenged to work from home. Industries such as tourism face an output decrease of 50-70%, destroying small businesses and heading large and leading corporations such as Hertz to bankruptcy³³. The retail sector has encountered their essential dependency on on-line sales, as their only source of revenue due to the closure of stores, forcing top companies such as J.C. Penney or Primark to dangerous financial situations. Society as a whole has turned back to basics, leaving many industries behind, while on the other hand, others have now gained more importance than ever before.

³² The 9-11 term refers to the terrorist attack of the World Trade Center on the 11th of September, 2001.

³³ Further information about Hertz bankruptcy can be found on the following link
<https://edition.cnn.com/2020/05/22/business/hertz-bankruptcy/index.html>

As stated above, social distancing and widespread lockdowns have boosted the importance of digitalization in every industry. Society is now challenged to maintain the previously settled lifestyle and outputs through digital tools that make the stay-at-home standard possible. As shown in Figure 24, on-line communication apps such as Zoom, Houseparty, or Microsoft Teams have seen a significant increase in volume due to this situation, as not only workers need to manage their job duties remotely but also social relationships have to remain active by any means. These new forms of work, education, and social communication have become essential in these unprecedented times but have also shown that society can manage to deliver similar or even better outputs through alternative procedures.

Figure 24: Most downloaded apps in the U.S. from 26/03 to 01/04 2020



Source: Buchholz Katharina from Statista based on Prioridata figures

The novel standard has forced us to adapt to new environments that could be settled for the rest of our life. Many companies like Twitter or Square now know that their workers are

happier and more comfortable working from home, and have offered the choice of working remotely forever³⁴. Educational systems have modified their methodology rapidly, and although it may be challenging for some students and professors, others have discovered their fit in on-line learning. Undoubtedly, humanity's development will always depend on some face-to-face contact as it has great benefits; nevertheless, society has now noticed its ability to function correctly in times of social emergency through technology.

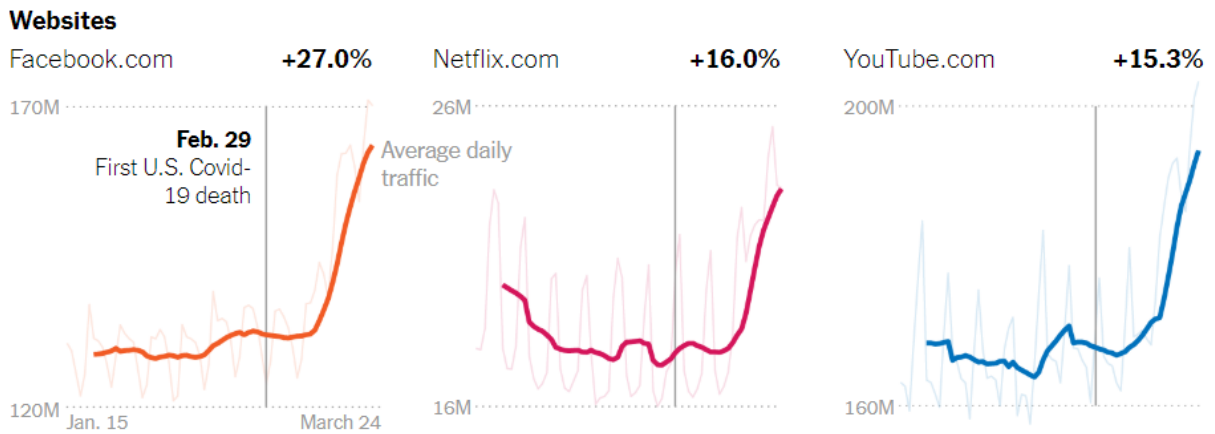
As stated in the first section of this paper, semiconductors are essentially the axis around which technology spins, and therefore follow similar growth patterns. This recent pandemic has changed the lifestyle of millions of people around the world, with the shared characteristic of an increase in the use of technological equipment.

Social distancing policies have affected the way of working in the majority of companies in the world, employees have been obliged to set up an office at their home, causing them or their company to purchase the necessary equipment and tools to function properly through telecommuting. Not only offices have been affected by this new norm, but also factories will modify their structure by further implementing robotic automation and artificial intelligence (A.I.), as these technologies cut down manual intervention, lowering transmission risks, and reducing the dependence on employees to work face-to-face.

As shown in Figure 25, internet usage has risen considerably after the first cases of the pandemic on the U.S. appeared, as users relied mainly on on-line services for entertainment. On-line shopping has saved many retail companies from bankruptcy, and as stated on the Internet Retailing article, "six out of ten consumers say that they will continue to buy as much on-line as they do today after the pandemic has passed." The new norm has modified consumer behavior, what experts expected to happen in three or four years has now been done in just a few months due to the sudden appearance of this life-changing event.

³⁴ Further details about this can be found on the following link <https://www.cnn.com/2020/05/18/square-lets-employees-work-from-home-permanently.html#:~:text=Square%20to%20allow%20employees%20to%20work%20from%20home%20permanently%2C%20following%20Twitter's%20lead&text=The%20news%20comes%20a%20week,%2C%22%20a%20Square%20spokesperson%20said.>

Figure 25: Website daily traffic after first US COVID-death



Source: Koeze E. and Poppe N. from The New York Times

These new safety measures have influenced the entire consumer journey, not only on-line sales have increased drastically, but the essential physical sales have also been modified. ATM cash volumes have dropped across the world, reaching surprising rates of as much as 90% decline YoY in Spain, or 62% drop in the United Kingdom. As both consumers and employees aim to reduce physical contact to minimum, cash is starting to disappear from many businesses. This does not necessarily mean that cash will be extinct as a result of the pandemic, but it has certainly “fuelled trends that already had momentum” (Thomas, D. and Megaw, N 2020).

The drastic increase in daily on-line traffic has involuntarily matched perfectly with the development of 5G technologies around the world. These wireless communications developments are expected to improve even more in the coming decade, as digital users will keep demanding faster and more convenient connections to perform their daily activities as comfortable as possible.

Consumers have now reached record volumes of data storage used over the pandemic lockdown, as there is a high correlation between internet usage and consumption of data cloud services. As supported by Tom Coughlin on a Forbes article, "OpenVault projects that consumption for March will reach nearly 400 GB per subscriber, an increase of almost 11% over the previous monthly record of 361 GB, established in January of this year." At the same

time, memory chips used in mobiles and P.C.s are expected to decline due to their dependence on labor intensive factories, which are mainly located in China. However, these negative figures will be balanced by strong demand from server manufacturers driven by "increasing over-the-top services, games and on-line activities," as stated by Fitch Ratings. The agency also reports that DRAMeXchange "forecasts server DRAM prices to increase by double-digit percentages throughout the year, supporting the industry's overall revenue growth."

As stated by the Fitch Ratings article, the electronic gaming industry has been one of the most advantaged sectors from the pandemic, as millions of users have boosted their playtime as a result of the lockdown. As shown in Figure 26, this industry has experienced one of the strongest growth rates of the market over the last decade, reaching an 11% CAGR from 2012-2021 based on 2018 expectations. Additionally, according to Liz Lanier's article on Variety, the gaming industry could reach \$300bn in revenues in 2025. Semiconductor companies like NVIDIA have benefitted from this trend, as graphic processing units are and will continue to be essential for the improvement of the gaming experience.

Figure 26: 2012-2021 Global games revenue growth



Source: Tom Wijman from NewZoo³⁵

³⁵ This chart is based on 2018 figures and estimates from industry's specialists.

Despite the drop in overall automobile sales during the first quarter of 2020, the electric vehicle segment has remained present and is already showing signs of high expectations. According to the article by Veronika Henze on BNEF, E.V. sales are forecast to fall only by 18% in 2020 compared to a 23% drop on combustion engine cars. Electric vehicle sales have been increasing YoY over the last decade, reaching 3% of total car sales and are forecast to achieve 7% by 2023. This drastic expansion will change the industry for the better, supported by environmental regulations, an increase in the amount of publicly accessible charging points for E.V., and an expected decrease in prices of lithium-ion batteries. Electric vehicles are supported by the development of semiconductors, as they "power electric vehicle (E.V.) batteries and components in the power train," as stated by William Crockett Jr. in an article of Manufacturing Business Technology.

Additionally, William also recalls that the amount of semiconductor components on the average automobile has expanded over the last ten years, as chips support touch screen connectivity and are "responsible for powering systems that store and apply updates to firmware." The digitalization of cars will only increase over time, as drivers have now become accustomed to visual sensors and driving assistance systems for ensuring their safety. This movement will be boosted by the much anticipated development of self-driving and autonomous cars, which depend solely on chips.

Overall, the catastrophic pandemic that will set 2020 as a memorable year has affected the entire world population in many ways that most benefit the performance of the semiconductor sector. Although annual sales may end up being lower compared to 2019, the decrease will not be comparable to the drastic impact suffered by the whole market. The most significant value will come over time, as this unprecedented situation has accelerated the digital revolution that was supposed to happen in five years, and has settled the grounds on which semiconductors will be the cornerstone of not only technology but evolution as a whole.

6. Conclusion:

The semiconductor sector has been expanding since its inception, supporting human progress through the development of technology, and conquering every border of the world via continuous innovation. This expansion has been accelerated by the surge of digitalization on societies, as the dependence of technology on the daily routine of millions has enabled the conception of a variety of subsectors inside the semis world which keep on growing and improving.

This growth has been matched by the sector's market performance, as shown on Figure 4, the semiconductor focused ETF SOXX, has outperformed the NASDAQ over the last five years showing its strength over the broad technology industry in the U.S. The high correlation between the index and the ETF supports the fact that semis are the cornerstone around which technology spins. However, this strong correlation does not necessarily imply causation.

The regression analysis over the NASDAQ and SOXX daily returns failed to support the thesis on semiconductors being leading indicators of the technology industry. Statistical results showed that the predictability of the model did not improve by anticipating the SOXX returns, indicating that the index didn't follow the leading performance of the sector. Instead, the regression model supported the fact that the semiconductor sector can be categorized as a coincident rather than a leading indicator. This finding is still highly useful, although it can not predict future performance, it constantly shows the health of the technology industry, as well as its shifts on supply and demand. Therefore, the outstanding market performance of the SOXX over the last few years supports the strength of the surge in technological equities.

Gathering a sample of the most representative players of the sector is helpful for understanding the growth of semis as well as the popularity of the different subsectors in which each company is specialized. The analysis is based on the most fundamental financial ratios of the sector, comparing each company across the sample helps determine which player is better positioned currently, and in the upcoming future. NVIDIA and Texas Instruments were selected as clear favorites after leading the majority of the analyzed ratios over the last five years. When analyzing their market performance, the study showed that NVIDIA

seemed currently overvalued while the Texan manufacturer looked more attractive. The analysis concluded with a valuation of the two favored companies via the comparable method. Based on both the P/E and P/FCF ratios, NVIDIA still looked overvalued, and TXN undervalued in terms of the share price. This simple valuation is based on a small size sample and only on financial ratios; therefore, it shouldn't be taken as an investment recommendation.

After careful research over the leading players of the sector, the paper concluded with the implication of the recent COVID-19 pandemic over the sector. The severe epidemic has altered human behavior on a global scale, hardly impacting many industries in the market, while some others have been able to benefit from this new norm. The digitalization of daily routines has benefitted the semiconductor sector, as technology is now even more present than ever before. Some of these changes have come to stay, new challenges that were expected to happen in the future have been reached due to this extreme situation.

Semiconductors have been the engine behind every technological innovation and will continue to be in the future. As experienced over the last two decades, humanity is heading towards an ever more digitalized world where semis will be present in almost every aspect of life.

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8. Appendix:

Appendix 1: Leading Indicators Model, SOXX-NO-PPI tab

All these figures are public and taken from the Labour of Bureau Statistics of the USA.

| Date | SOXX | New Orders | PPI |
|------------|-----------|------------|------|
| 01/03/2015 | 88.011368 | 21718 | 38.0 |
| 01/04/2015 | 87.110497 | 20960 | 37.9 |
| 01/05/2015 | 94.863228 | 20885 | 38.0 |
| 01/06/2015 | 86.434685 | 21195 | 37.6 |
| 01/07/2015 | 82.37809 | 21265 | 37.7 |
| 01/08/2015 | 78.124588 | 21176 | 37.4 |
| 01/09/2015 | 76.656578 | 20794 | 37.3 |
| 01/10/2015 | 84.733879 | 20759 | 37.3 |
| 01/11/2015 | 86.692772 | 20398 | 37.3 |
| 01/12/2015 | 85.017784 | 20572 | 37.2 |
| 01/01/2016 | 78.740234 | 20603 | 36.7 |
| 01/02/2016 | 80.105835 | 20409 | 36.5 |
| 01/03/2016 | 86.886421 | 20413 | 36.4 |
| 01/04/2016 | 83.11573 | 21032 | 36.4 |
| 01/05/2016 | 90.335342 | 21031 | 36.4 |
| 01/06/2016 | 89.070251 | 20620 | 36.3 |
| 01/07/2016 | 99.238144 | 20983 | 36.3 |
| 01/08/2016 | 103.9138 | 20703 | 36.2 |
| 01/09/2016 | 107.81652 | 20574 | 36.2 |
| 01/10/2016 | 106.70721 | 20225 | 36.0 |
| 01/11/2016 | 114.39209 | 20343 | 35.9 |
| 01/12/2016 | 117.59257 | 20982 | 35.9 |
| 01/01/2017 | 122.80366 | 21177 | 36.4 |
| 01/02/2017 | 126.26131 | 21473 | 36.4 |
| 01/03/2017 | 131.47656 | 20885 | 36.3 |
| 01/04/2017 | 131.0695 | 21122 | 36.7 |
| 01/05/2017 | 142.50955 | 21106 | 36.6 |
| 01/06/2017 | 135.00803 | 21061 | 36.6 |
| 01/07/2017 | 141.88591 | 21612 | 35.5 |
| 01/08/2017 | 146.00792 | 21843 | 35.4 |
| 01/09/2017 | 153.07423 | 22172 | 34.8 |
| 01/10/2017 | 167.27901 | 22499 | 34.8 |
| 01/11/2017 | 167.12402 | 22667 | 34.7 |
| 01/12/2017 | 164.46068 | 22277 | 34.7 |
| 01/01/2018 | 178.98598 | 22560 | 34.8 |
| 01/02/2018 | 179.38379 | 22470 | 35.0 |
| 01/03/2018 | 174.69739 | 22596 | 34.9 |
| 01/04/2018 | 164.02609 | 22841 | 34.9 |
| 01/05/2018 | 182.21556 | 23034 | 34.7 |
| 01/06/2018 | 173.28125 | 23339 | 34.7 |
| 01/07/2018 | 180.95972 | 23474 | 34.1 |
| 01/08/2018 | 185.66173 | 23352 | 33.6 |
| 01/09/2018 | 180.52071 | 23410 | 33.5 |
| 01/10/2018 | 159.67299 | 23987 | 33.3 |
| 01/11/2018 | 164.85631 | 24232 | 33.3 |
| 01/12/2018 | 153.74503 | 23990 | 33.2 |
| 01/01/2019 | 169.56567 | 23672 | 32.6 |
| 01/02/2019 | 180.41576 | 23555 | 32.5 |
| 01/03/2019 | 186.11081 | 24056 | 32.5 |
| 01/04/2019 | 208.29771 | 23936 | 32.6 |
| 01/05/2019 | 173.79807 | 24053 | 32.4 |
| 01/06/2019 | 195.35049 | 23691 | 32.5 |
| 01/07/2019 | 207.19617 | 23640 | 32.5 |
| 01/08/2019 | 202.40134 | 23618 | 32.6 |
| 01/09/2019 | 209.00536 | 23510 | 32.7 |
| 01/10/2019 | 222.79167 | 23595 | 32.5 |
| 01/11/2019 | 231.84833 | 23577 | 32.5 |
| 01/12/2019 | 249.35587 | 23844 | 32.6 |
| 01/01/2020 | 242.22566 | 23670 | 32.3 |
| 01/02/2020 | 230.99434 | 23513 | 32.4 |

SUMMARY OUTPUT

| Regression Statistics | | SOXX | New Orders | PPI |
|-----------------------|-------------|-----------|--------------|--------------|
| Multiple R | 0.915465062 | SOXX | 1 | |
| R Square | 0.838076279 | New Order | 0.875377134 | 1 |
| Adjusted R | 0.832394745 | PPI | -0.908321818 | -0.912258063 |
| Standard E | 20.18398299 | | | |
| Observatic | 60 | | | |

ANOVA

| | df | SS | MS | F | Significance F |
|------------|----|-------------|----------|-------------|----------------|
| Regression | 2 | 120188.1562 | 60094.08 | 147.5088014 | 2.91977E-23 |
| Residual | 57 | 23221.41066 | 407.3932 | | |
| Total | 59 | 143409.5669 | | | |

| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | Upper 95.0% |
|-----------|--------------|----------------|----------|-------------|-------------|-----------|-------------|-------------|
| Intercept | 527.6089997 | 224.0256466 | 2.355128 | 0.021981953 | 79.00538044 | 976.2126 | 79.00538 | 976.2126 |
| New Order | 0.010378167 | 0.004846227 | 2.141494 | 0.036521741 | 0.000673766 | 0.020083 | 0.000673 | 0.020083 |
| PPI | -17.44525306 | 3.470240852 | -5.0271 | 5.25894E-06 | -24.3942905 | -10.4962 | -24.39429 | -10.4962 |

Appendix 2: Leading Indicators model, Returns regression daily NASDAQ-SOXX tab

These regression models are done over daily stock returns from Yahoo Finance.

SUMMARY OUTPUT 15-16

| Regression Statistics | |
|-----------------------|----------|
| Multiple R | 0.818454 |
| R Square | 0.669867 |
| Adjusted R Square | 0.668546 |
| Standard Error | 0.006657 |
| Observations | 252 |

ANOVA

| | df | SS | MS | F | Significance F |
|------------|-----|----------|----------|----------|----------------|
| Regression | 1 | 0.022483 | 0.022483 | 507.2703 | 4.22E-62 |
| Residual | 250 | 0.01108 | 4.43E-05 | | |
| Total | 251 | 0.033563 | | | |

| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | Upper 95.0% |
|--------------|--------------|----------------|----------|----------|-----------|-----------|-------------|-------------|
| Intercept | 9.21E-06 | 0.00042 | 0.021931 | 0.98252 | -0.00082 | 0.000836 | -0.00082 | 0.000836 |
| X Variable 1 | 0.61939 | 0.027501 | 22.52266 | 4.22E-62 | 0.565227 | 0.673553 | 0.565227 | 0.673553 |

SUMMARY OUTPUT 17-18

| Regression Statistics | |
|-----------------------|----------|
| Multiple R | 0.866448 |
| R Square | 0.750732 |
| Adjusted R Square | 0.749731 |
| Standard Error | 0.00374 |
| Observations | 251 |

ANOVA

| | df | SS | MS | F | Significance F |
|------------|-----|----------|----------|----------|----------------|
| Regression | 1 | 0.010489 | 0.010489 | 749.9266 | 4.47E-77 |
| Residual | 249 | 0.003483 | 1.4E-05 | | |
| Total | 250 | 0.013972 | | | |

| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | Upper 95.0% |
|--------------|--------------|----------------|----------|----------|-----------|-----------|-------------|-------------|
| Intercept | 0.000155 | 0.000237 | 0.653391 | 0.514107 | -0.00031 | 0.000622 | -0.00031 | 0.000622 |
| X Variable 1 | 0.51116 | 0.018666 | 27.38479 | 4.47E-77 | 0.474397 | 0.547923 | 0.474397 | 0.547923 |

SUMMARY OUTPUT 19-20

| Regression Statistics | |
|-----------------------|----------|
| Multiple R | 0.82641 |
| R Square | 0.682953 |
| Adjusted R Square | 0.68168 |
| Standard Error | 0.0052 |
| Observations | 251 |

ANOVA

| | df | SS | MS | F | Significance F |
|------------|-----|----------|----------|----------|----------------|
| Regression | 1 | 0.014502 | 0.014502 | 536.3734 | 4.73E-64 |
| Residual | 249 | 0.006732 | 2.7E-05 | | |
| Total | 250 | 0.021234 | | | |

| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | Upper 95.0% |
|--------------|--------------|----------------|----------|----------|-----------|-----------|-------------|-------------|
| Intercept | 0.000286 | 0.00033 | 0.868045 | 0.386205 | -0.00036 | 0.000936 | -0.00036 | 0.000936 |
| X Variable 1 | 0.487838 | 0.021064 | 23.15974 | 4.73E-64 | 0.446352 | 0.529325 | 0.446352 | 0.529325 |

SUMMARY OUTPUT 16-17

| Regression Statistics | |
|-----------------------|-------------|
| Multiple R | 0.809480932 |
| R Square | 0.65259379 |
| Adjusted R Square | 0.653880416 |
| Standard Error | 0.004865739 |
| Observations | 252 |

ANOVA

| | df | SS | MS | F | Significance F |
|------------|-----|----------|----------|-------------|----------------|
| Regression | 1 | 0.01125 | 0.01125 | 475.1828899 | 9.54959E-60 |
| Residual | 250 | 0.005919 | 2.37E-05 | | |
| Total | 251 | 0.017169 | | | |

| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | Upper 95.0% |
|--------------|--------------|----------------|----------|-------------|--------------|-------------|--------------|-------------|
| Intercept | -2.67893E-05 | 0.000311 | -0.08605 | 0.931498113 | -0.000639962 | 0.000586383 | -0.000639962 | 0.000586 |
| X Variable 1 | 0.539076607 | 0.02473 | 21.79869 | 9.54959E-60 | 0.490371364 | 0.587781851 | 0.490371364 | 0.587782 |

SUMMARY OUTPUT 18-19

| Regression Statistics | |
|-----------------------|-------------|
| Multiple R | 0.856263776 |
| R Square | 0.733187654 |
| Adjusted R Square | 0.732116118 |
| Standard Error | 0.006834998 |
| Observations | 251 |

ANOVA

| | df | SS | MS | F | Significance F |
|------------|-----|----------|----------|-------------|----------------|
| Regression | 1 | 0.031966 | 0.031966 | 684.2401721 | 2.15182E-73 |
| Residual | 249 | 0.011633 | 4.67E-05 | | |
| Total | 250 | 0.043598 | | | |

| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | Upper 95.0% |
|--------------|--------------|----------------|----------|-------------|--------------|-------------|--------------|-------------|
| Intercept | 7.89868E-05 | 0.000432 | 0.183041 | 0.854914708 | -0.000770918 | 0.000928891 | -0.000770918 | 0.000929 |
| X Variable 1 | 0.630275135 | 0.024095 | 26.15798 | 2.15182E-73 | 0.582819258 | 0.677731012 | 0.582819258 | 0.677731 |

SUMMARY OUTPUT 5 years

| Regression Statistics | |
|-----------------------|-------------|
| Multiple R | 0.832544298 |
| R Square | 0.693130009 |
| Adjusted R Square | 0.692885491 |
| Standard Error | 0.005636876 |
| Observations | 1257 |

ANOVA

| | df | SS | MS | F | Significance F |
|------------|------|----------|----------|-------------|----------------|
| Regression | 1 | 0.09007 | 0.09007 | 2834.679784 | 0 |
| Residual | 1255 | 0.039877 | 3.18E-05 | | |
| Total | 1256 | 0.129947 | | | |

| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | Upper 95.0% |
|--------------|--------------|----------------|----------|-------------|-------------|-------------|-------------|-------------|
| Intercept | 4.64359E-05 | 0.000159 | 0.291452 | 0.770754179 | -0.00026614 | 0.000359012 | -0.00026614 | 0.000359 |
| X Variable 1 | 0.56705255 | 0.010651 | 53.24171 | 0 | 0.54615774 | 0.587947361 | 0.54615774 | 0.587947 |

| Date | SOXX returns | NASDAQ returns | Date | SOXX returns | NASDAQ returns | Date | SOXX returns | NASDAQ returns | Date | SOXX returns | NASDAQ returns | Date | SOXX returns | NASDAQ returns |
|------------|--------------|----------------|------------|--------------|----------------|------------|--------------|----------------|------------|--------------|----------------|------------|--------------|----------------|
| 13/02/2015 | 0.0071 | 0.0075 | 29/05/2015 | 0.0038 | -0.0055 | 10/09/2015 | 0.0044 | 0.0084 | 22/12/2015 | 0.0016 | 0.0065 | 07/04/2016 | -0.0153 | -0.0147 |
| 17/02/2015 | 0.0031 | 0.0011 | 01/06/2015 | 0.0006 | 0.0025 | 11/09/2015 | 0.0006 | 0.0054 | 23/12/2015 | 0.0070 | 0.0090 | 08/04/2016 | 0.0046 | 0.0005 |
| 18/02/2015 | -0.0026 | 0.0014 | 02/06/2015 | -0.0112 | -0.0013 | 14/09/2015 | 0.0023 | -0.0034 | 24/12/2015 | 0.0040 | 0.0005 | 11/04/2016 | -0.0002 | -0.0036 |
| 19/02/2015 | 0.0027 | 0.0037 | 03/06/2015 | -0.0068 | 0.0045 | 15/09/2015 | 0.0128 | 0.0114 | 28/12/2015 | -0.0039 | -0.0015 | 12/04/2016 | -0.0014 | 0.0080 |
| 20/02/2015 | 0.0060 | 0.0063 | 04/06/2015 | -0.0091 | -0.0079 | 16/09/2015 | 0.0021 | 0.0059 | 29/12/2015 | 0.0117 | 0.0133 | 13/04/2016 | 0.0224 | 0.0155 |
| 23/02/2015 | -0.0062 | 0.0010 | 05/06/2015 | 0.0001 | 0.0018 | 17/09/2015 | -0.0080 | 0.0010 | 30/12/2015 | -0.0090 | -0.0082 | 14/04/2016 | -0.0077 | -0.0003 |
| 24/02/2015 | 0.0134 | 0.0014 | 08/06/2015 | -0.0188 | -0.0092 | 18/09/2015 | -0.0174 | -0.0136 | 31/12/2015 | -0.0136 | -0.0115 | 15/04/2016 | -0.0086 | -0.0016 |
| 25/02/2015 | -0.0052 | -0.0002 | 09/06/2015 | -0.0006 | -0.0015 | 21/09/2015 | -0.0030 | 0.0004 | 04/01/2016 | -0.0116 | -0.0208 | 18/04/2016 | 0.0001 | 0.0044 |
| 26/02/2015 | 0.0068 | 0.0042 | 10/06/2015 | 0.0124 | 0.0125 | 22/09/2015 | -0.0220 | -0.0150 | 05/01/2016 | -0.0095 | -0.0024 | 19/04/2016 | -0.0122 | -0.0040 |
| 27/02/2015 | -0.0030 | -0.0049 | 11/06/2015 | -0.0003 | 0.0011 | 23/09/2015 | -0.0074 | -0.0008 | 06/01/2016 | -0.0346 | -0.0134 | 20/04/2016 | 0.0095 | 0.0016 |
| 02/03/2015 | 0.0275 | 0.0090 | 12/06/2015 | -0.0090 | -0.0062 | 24/09/2015 | -0.0020 | -0.0038 | 07/01/2016 | -0.0280 | -0.0303 | 21/04/2016 | -0.0059 | -0.0005 |
| 03/03/2015 | -0.0185 | -0.0056 | 15/06/2015 | -0.0021 | -0.0042 | 25/09/2015 | 0.0055 | -0.0101 | 08/01/2016 | -0.0144 | -0.0098 | 22/04/2016 | 0.0018 | -0.0080 |
| 04/03/2015 | -0.0013 | -0.0026 | 16/06/2015 | 0.0028 | 0.0051 | 28/09/2015 | -0.0277 | -0.0304 | 11/01/2016 | 0.0034 | -0.0012 | 25/04/2016 | -0.0060 | -0.0021 |
| 05/03/2015 | 0.0006 | 0.0032 | 17/06/2015 | 0.0008 | 0.0018 | 29/09/2015 | 0.0067 | -0.0059 | 12/01/2016 | 0.0083 | 0.0103 | 26/04/2016 | 0.0133 | -0.0015 |
| 06/03/2015 | -0.0103 | -0.0111 | 18/06/2015 | 0.0141 | 0.0134 | 30/09/2015 | 0.0388 | 0.0228 | 13/01/2016 | -0.0318 | -0.0341 | 27/04/2016 | 0.0102 | -0.0051 |
| 09/03/2015 | 0.0031 | 0.0031 | 19/06/2015 | -0.0050 | -0.0031 | 01/10/2015 | -0.0119 | 0.0015 | 14/01/2016 | 0.0206 | 0.0197 | 28/04/2016 | -0.0262 | -0.0119 |
| 10/03/2015 | -0.0185 | -0.0167 | 22/06/2015 | 0.0085 | 0.0072 | 02/10/2015 | 0.0209 | 0.0174 | 15/01/2016 | -0.0451 | -0.0274 | 29/04/2016 | -0.0264 | -0.0062 |
| 11/03/2015 | 0.0022 | -0.0020 | 23/06/2015 | -0.0050 | 0.0012 | 05/10/2015 | 0.0195 | 0.0156 | 19/01/2016 | 0.0017 | -0.0026 | 02/05/2016 | 0.0076 | 0.0088 |
| 12/03/2015 | -0.0003 | 0.0089 | 24/06/2015 | -0.0106 | -0.0073 | 06/10/2015 | 0.0032 | -0.0069 | 20/01/2016 | 0.0066 | -0.0012 | 03/05/2016 | -0.0114 | -0.0113 |
| 13/03/2015 | 0.0067 | -0.0044 | 25/06/2015 | -0.0007 | -0.0020 | 07/10/2015 | 0.0132 | 0.0090 | 21/01/2016 | 0.0148 | 0.0001 | 04/05/2016 | -0.0114 | -0.0079 |
| 16/03/2015 | 0.0152 | 0.0119 | 26/06/2015 | -0.0249 | -0.0062 | 08/10/2015 | 0.0066 | 0.0041 | 22/01/2016 | 0.0182 | 0.0266 | 05/05/2016 | 0.0024 | -0.0018 |
| 17/03/2015 | -0.0073 | 0.0016 | 29/06/2015 | -0.0281 | -0.0240 | 09/10/2015 | -0.0062 | 0.0041 | 25/01/2016 | -0.0138 | -0.0158 | 06/05/2016 | 0.0014 | 0.0040 |
| 18/03/2015 | 0.0074 | 0.0092 | 30/06/2015 | 0.0036 | 0.0057 | 12/10/2015 | 0.0000 | 0.0017 | 26/01/2016 | 0.0093 | 0.0109 | 09/05/2016 | -0.0013 | 0.0030 |
| 19/03/2015 | 0.0023 | 0.0019 | 01/07/2015 | 0.0024 | 0.0053 | 13/10/2015 | -0.0123 | -0.0087 | 27/01/2016 | -0.0114 | -0.0218 | 10/05/2016 | 0.0118 | 0.0126 |
| 20/03/2015 | 0.0141 | 0.0068 | 02/07/2015 | 0.0047 | -0.0008 | 14/10/2015 | 0.0364 | -0.0029 | 28/01/2016 | -0.0023 | 0.0086 | 11/05/2016 | -0.0024 | -0.0102 |
| 23/03/2015 | -0.0083 | -0.0031 | 06/07/2015 | -0.0146 | -0.0034 | 15/10/2015 | 0.0094 | 0.0182 | 29/01/2016 | 0.0453 | 0.0238 | 12/05/2016 | -0.0179 | -0.0049 |
| 24/03/2015 | -0.0086 | -0.0032 | 07/07/2015 | -0.0032 | 0.0011 | 16/10/2015 | 0.0023 | 0.0034 | 01/02/2016 | 0.0045 | 0.0014 | 13/05/2016 | 0.0036 | -0.0041 |
| 25/03/2015 | -0.0465 | -0.0237 | 08/07/2015 | -0.0270 | -0.0175 | 19/10/2015 | -0.0003 | 0.0038 | 02/02/2016 | -0.0330 | -0.0224 | 16/05/2016 | 0.0161 | 0.0122 |
| 26/03/2015 | -0.0137 | -0.0027 | 09/07/2015 | -0.0127 | 0.0026 | 20/10/2015 | -0.0009 | -0.0050 | 03/02/2016 | 0.0024 | -0.0028 | 17/05/2016 | -0.0065 | -0.0125 |
| 27/03/2015 | 0.0284 | 0.0057 | 10/07/2015 | 0.0185 | 0.0153 | 21/10/2015 | 0.0015 | -0.0084 | 04/02/2016 | 0.0173 | 0.0012 | 18/05/2016 | 0.0156 | 0.0050 |
| 30/03/2015 | 0.0128 | -0.0015 | 13/07/2015 | 0.0084 | 0.0148 | 22/10/2015 | 0.0347 | 0.0165 | 05/02/2016 | -0.0343 | -0.0325 | 19/05/2016 | -0.0056 | -0.0056 |
| 31/03/2015 | -0.0113 | -0.0094 | 14/07/2015 | 0.0105 | 0.0066 | 23/10/2015 | 0.0122 | 0.0227 | 08/02/2016 | -0.0252 | -0.0182 | 20/05/2016 | 0.0303 | 0.0121 |
| 01/04/2015 | -0.0065 | -0.0042 | 15/07/2015 | -0.0059 | -0.0012 | 26/10/2015 | -0.0180 | 0.0006 | 09/02/2016 | -0.0057 | -0.0035 | 23/05/2016 | 0.0070 | -0.0008 |
| 02/04/2015 | -0.0022 | 0.0014 | 16/07/2015 | 0.0019 | 0.0126 | 27/10/2015 | -0.0087 | -0.0009 | 10/02/2016 | -0.0078 | 0.0035 | 24/05/2016 | 0.0241 | 0.0200 |
| 06/04/2015 | 0.0044 | 0.0062 | 17/07/2015 | -0.0021 | 0.0091 | 28/10/2015 | 0.0148 | 0.0130 | 11/02/2016 | -0.0077 | -0.0039 | 25/05/2016 | 0.0059 | 0.0070 |
| 07/04/2015 | 0.0004 | -0.0014 | 20/07/2015 | -0.0069 | 0.0017 | 29/10/2015 | -0.0268 | -0.0042 | 12/02/2016 | 0.0219 | 0.0166 | 26/05/2016 | 0.0033 | 0.0014 |
| 08/04/2015 | 0.0059 | 0.0083 | 21/07/2015 | 0.0002 | -0.0021 | 30/10/2015 | 0.0080 | -0.0040 | 16/02/2016 | 0.0351 | 0.0227 | 27/05/2016 | 0.0063 | 0.0065 |
| 09/04/2015 | 0.0131 | 0.0048 | 22/07/2015 | -0.0249 | -0.0070 | 02/11/2015 | 0.0088 | 0.0145 | 17/02/2016 | 0.0238 | 0.0221 | 31/05/2016 | 0.0058 | 0.0029 |
| 10/04/2015 | 0.0041 | 0.0042 | 23/07/2015 | 0.0149 | -0.0049 | 03/11/2015 | 0.0052 | 0.0035 | 18/02/2016 | -0.0048 | -0.0103 | 01/06/2016 | 0.0053 | 0.0008 |
| 13/04/2015 | -0.0059 | -0.0015 | 24/07/2015 | -0.0201 | -0.0112 | 04/11/2015 | 0.0029 | -0.0005 | 19/02/2016 | 0.0044 | 0.0038 | 02/06/2016 | 0.0002 | 0.0039 |
| 14/04/2015 | -0.0102 | -0.0022 | 27/07/2015 | -0.0074 | -0.0096 | 05/11/2015 | 0.0210 | -0.0029 | 22/02/2016 | 0.0157 | 0.0147 | 03/06/2016 | 0.0029 | -0.0058 |
| 15/04/2015 | 0.0167 | 0.0068 | 28/07/2015 | 0.0209 | 0.0098 | 06/11/2015 | 0.0265 | 0.0038 | 23/02/2016 | -0.0157 | -0.0147 | 06/06/2016 | -0.0023 | 0.0053 |
| 16/04/2015 | -0.0043 | -0.0006 | 29/07/2015 | 0.0012 | 0.0044 | 09/11/2015 | -0.0097 | -0.0101 | 24/02/2016 | 0.0133 | 0.0087 | 07/06/2016 | 0.0095 | -0.0014 |
| 17/04/2015 | -0.0142 | -0.0152 | 30/07/2015 | 0.0040 | 0.0033 | 10/11/2015 | -0.0182 | -0.0024 | 25/02/2016 | 0.0122 | 0.0087 | 08/06/2016 | -0.0004 | 0.0026 |
| 20/04/2015 | 0.0085 | 0.0127 | 31/07/2015 | -0.0116 | -0.0001 | 11/11/2015 | 0.0008 | -0.0032 | 26/02/2016 | 0.0064 | 0.0018 | 09/06/2016 | 0.0011 | -0.0032 |
| 21/04/2015 | 0.0069 | 0.0039 | 03/08/2015 | -0.0032 | -0.0025 | 12/11/2015 | -0.0129 | -0.0122 | 29/02/2016 | -0.0024 | -0.0071 | 10/06/2016 | -0.0164 | -0.0129 |
| 22/04/2015 | 0.0141 | 0.0042 | 04/08/2015 | -0.0111 | -0.0019 | 13/11/2015 | -0.0090 | -0.0154 | 01/03/2016 | 0.0270 | 0.0289 | 13/06/2016 | -0.0052 | -0.0094 |
| 23/04/2015 | -0.0155 | 0.0041 | 05/08/2015 | 0.0126 | 0.0067 | 16/11/2015 | 0.0123 | 0.0115 | 02/03/2016 | 0.0062 | 0.0029 | 14/06/2016 | -0.0003 | -0.0010 |
| 24/04/2015 | -0.0165 | 0.0071 | 06/08/2015 | -0.0179 | -0.0162 | 17/11/2015 | 0.0067 | 0.0003 | 03/03/2016 | 0.0011 | 0.0009 | 15/06/2016 | -0.0001 | -0.0018 |
| 27/04/2015 | 0.0026 | -0.0063 | 07/08/2015 | 0.0057 | -0.0026 | 18/11/2015 | 0.0099 | 0.0179 | 04/03/2016 | 0.0103 | 0.0020 | 16/06/2016 | -0.0001 | 0.0021 |
| 28/04/2015 | 0.0010 | -0.0010 | 10/08/2015 | 0.0248 | 0.0116 | 19/11/2015 | 0.0023 | -0.0003 | 07/03/2016 | 0.0045 | -0.0019 | 17/06/2016 | -0.0085 | -0.0092 |
| 29/04/2015 | -0.0055 | -0.0063 | 11/08/2015 | -0.0225 | -0.0127 | 20/11/2015 | 0.0032 | 0.0062 | 08/03/2016 | -0.0227 | -0.0126 | 20/06/2016 | 0.0111 | 0.0077 |
| 30/04/2015 | -0.0087 | -0.0164 | 12/08/2015 | 0.0058 | 0.0015 | 23/11/2015 | -0.0120 | -0.0005 | 09/03/2016 | 0.0070 | 0.0055 | 21/06/2016 | 0.0032 | 0.0014 |
| 01/05/2015 | 0.0278 | 0.0129 | 13/08/2015 | -0.0080 | -0.0021 | 24/11/2015 | 0.0118 | 0.0001 | 10/03/2016 | 0.0050 | -0.0026 | 22/06/2016 | -0.0010 | -0.0022 |
| 04/05/2015 | -0.0020 | 0.0023 | 14/08/2015 | -0.0082 | 0.0029 | 25/11/2015 | 0.0014 | 0.0026 | 11/03/2016 | 0.0190 | 0.0185 | 23/06/2016 | 0.0250 | 0.0159 |
| 05/05/2015 | -0.0217 | -0.0155 | 17/08/2015 | 0.0085 | 0.0086 | 27/11/2015 | 0.0043 | 0.0022 | 14/03/2016 | -0.0023 | 0.0004 | 24/06/2016 | -0.0543 | -0.0412 |
| 06/05/2015 | -0.0012 | -0.0040 | 18/08/2015 | -0.0189 | -0.0064 | 30/11/2015 | 0.0108 | -0.0037 | 15/03/2016 | -0.0026 | -0.0045 | 27/06/2016 | -0.0406 | -0.0241 |
| 07/05/2015 | 0.0110 | 0.0053 | 19/08/2015 | -0.0090 | -0.0080 | 01/12/2015 | 0.0155 | 0.0093 | 16/03/2016 | 0.0090 | 0.0075 | 28/06/2016 | 0.0262 | 0.0212 |
| 08/05/2015 | 0.0100 | 0.0117 | 20/08/2015 | -0.0375 | -0.0282 | 02/12/2015 | -0.0047 | -0.0064 | 17/03/2016 | 0.0069 | 0.0023 | 29/06/2016 | 0.0202 | 0.0186 |
| 11/05/2015 | 0.0006 | -0.0020 | 21/08/2015 | -0.0274 | -0.0352 | 03/12/2015 | -0.0060 | -0.0167 | 18/03/2016 | 0.0132 | 0.0043 | 30/06/2016 | 0.0172 | 0.0133 |
| 12/05/2015 | -0.0090 | -0.0035 | 24/08/2015 | -0.0224 | -0.0382 | 04/12/2015 | 0.0173 | 0.0208 | 21/03/2016 | 0.0013 | 0.0028 | 01/07/2016 | -0.0082 | 0.0041 |
| 13/05/2015 | 0.0062 | 0.0011 | 25/08/2015 | -0.0099 | -0.0044 | 07/12/2015 | -0.0081 | -0.0079 | 22/03/2016 | -0.0002 | 0.0027 | 05/07/2016 | -0.0183 | -0.0082 |
| 14/05/2015 | 0.0119 | 0.0139 | 26/08/2015 | 0.0499 | 0.0424 | 08/12/2015 | -0.0085 | -0.0007 | 23/03/2016 | -0.0131 | -0.0110 | 06/07/2016 | 0.0013 | 0.0075 |
| 15/05/2015 | 0.0017 | -0.0005 | 27/08/2015 | 0.0372 | 0.0245 | 09/12/2015 | -0.0130 | -0.0148 | 24/03/2016 | -0.0007 | 0.0010 | 07/07/2016 | 0.0122 | 0.0036 |
| 18/05/2015 | 0.0098 | 0.0060 | 28/08/2015 | 0.0058 | | | | | | | | | | |

| Date | SOXX retur | NASDAQ returns | Date | SOXX returns | NASDAQ return | Date | SOXX retur | NASDAQ r | Date | SOXX retur | NASDAQ r | Date | SOXX retur | NASDAQ r |
|------------|------------|----------------|------------|--------------|---------------|------------|------------|----------|------------|------------|----------|------------|------------|----------|
| 20/07/2016 | 0.0158 | 0.0106 | 31/10/2016 | 0.0054 | -0.0002 | 14/02/2017 | -0.0028 | 0.0032 | 30/05/2017 | 0.0067 | -0.0011 | 11/09/2017 | 0.0190 | 0.0113 |
| 21/07/2016 | -0.0070 | -0.0031 | 01/11/2016 | -0.0089 | -0.0069 | 15/02/2017 | 0.0077 | 0.0064 | 31/05/2017 | -0.0001 | -0.0008 | 12/09/2017 | 0.0045 | 0.0034 |
| 22/07/2016 | 0.0050 | 0.0052 | 02/11/2016 | -0.0066 | -0.0093 | 16/02/2017 | 0.0016 | -0.0008 | 01/06/2017 | 0.0010 | 0.0078 | 13/09/2017 | 0.0020 | 0.0009 |
| 25/07/2016 | -0.0058 | -0.0005 | 03/11/2016 | -0.0017 | -0.0092 | 17/02/2017 | 0.0052 | 0.0041 | 02/06/2017 | 0.0102 | -0.0094 | 14/09/2017 | 0.0039 | -0.0048 |
| 26/07/2016 | 0.0388 | 0.0024 | 04/11/2016 | -0.0063 | -0.0024 | 21/02/2017 | 0.0141 | 0.0047 | 05/06/2017 | 0.0024 | -0.0016 | 15/09/2017 | 0.0175 | 0.0030 |
| 27/07/2016 | -0.0001 | 0.0058 | 07/11/2016 | 0.0281 | 0.0237 | 22/02/2017 | 0.0002 | -0.0009 | 06/06/2017 | 0.0033 | -0.0033 | 18/09/2017 | 0.0131 | 0.0010 |
| 28/07/2016 | -0.0055 | 0.0030 | 08/11/2016 | 0.0021 | 0.0053 | 23/02/2017 | -0.0162 | -0.0043 | 07/06/2017 | 0.0074 | 0.0036 | 19/09/2017 | 0.0032 | 0.0010 |
| 29/07/2016 | -0.0044 | 0.0014 | 09/11/2016 | -0.0047 | 0.0111 | 24/02/2017 | -0.0007 | 0.0017 | 08/06/2017 | 0.0183 | 0.0039 | 20/09/2017 | -0.0138 | -0.0008 |
| 01/08/2016 | 0.0008 | 0.0043 | 10/11/2016 | -0.0216 | -0.0080 | 27/02/2017 | 0.0096 | 0.0028 | 09/06/2017 | -0.0420 | -0.0180 | 21/09/2017 | -0.0043 | -0.0052 |
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| 03/08/2016 | 0.0013 | 0.0043 | 14/11/2016 | -0.0052 | -0.0036 | 01/03/2017 | 0.0156 | 0.0135 | 13/06/2017 | 0.0068 | 0.0073 | 25/09/2017 | -0.0193 | -0.0088 |
| 04/08/2016 | 0.0094 | 0.0013 | 15/11/2016 | 0.0187 | 0.0110 | 02/03/2017 | -0.0103 | -0.0073 | 14/06/2017 | -0.0105 | -0.0041 | 26/09/2017 | -0.0016 | 0.0015 |
| 05/08/2016 | 0.0127 | 0.0106 | 16/11/2016 | 0.0115 | 0.0036 | 03/03/2017 | -0.0005 | 0.0016 | 15/06/2017 | -0.0079 | -0.0047 | 27/09/2017 | 0.0242 | 0.0115 |
| 08/08/2016 | -0.0011 | -0.0015 | 17/11/2016 | 0.0108 | 0.0074 | 06/03/2017 | 0.0005 | -0.0037 | 16/06/2017 | -0.0040 | -0.0022 | 28/09/2017 | 0.0074 | 0.0000 |
| 09/08/2016 | 0.0081 | 0.0024 | 18/11/2016 | 0.0072 | -0.0023 | 07/03/2017 | 0.0022 | -0.0026 | 19/06/2017 | 0.0190 | 0.0142 | 29/09/2017 | 0.0087 | 0.0066 |
| 10/08/2016 | -0.0068 | -0.0040 | 21/11/2016 | 0.0067 | 0.0089 | 08/03/2017 | 0.0023 | 0.0006 | 20/06/2017 | -0.0113 | -0.0082 | 02/10/2017 | 0.0067 | 0.0032 |
| 11/08/2016 | 0.0038 | 0.0046 | 22/11/2016 | 0.0107 | 0.0033 | 09/03/2017 | 0.0020 | 0.0002 | 21/06/2017 | 0.0116 | 0.0074 | 03/10/2017 | 0.0028 | 0.0023 |
| 12/08/2016 | 0.0047 | 0.0009 | 23/11/2016 | 0.0012 | -0.0011 | 10/03/2017 | 0.0114 | 0.0039 | 22/06/2017 | -0.0023 | 0.0004 | 04/10/2017 | 0.0023 | 0.0004 |
| 15/08/2016 | 0.0136 | 0.0056 | 25/11/2016 | 0.0017 | 0.0034 | 13/03/2017 | 0.0075 | 0.0024 | 23/06/2017 | 0.0030 | 0.0046 | 05/10/2017 | 0.0009 | 0.0078 |
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| 17/08/2016 | -0.0002 | 0.0003 | 29/11/2016 | -0.0018 | 0.0021 | 15/03/2017 | 0.0079 | 0.0074 | 27/06/2017 | -0.0267 | -0.0161 | 09/10/2017 | 0.0076 | -0.0016 |
| 18/08/2016 | 0.0072 | 0.0022 | 30/11/2016 | -0.0057 | -0.0105 | 16/03/2017 | -0.0010 | 0.0001 | 28/06/2017 | 0.0173 | 0.0143 | 10/10/2017 | 0.0056 | 0.0011 |
| 19/08/2016 | 0.0086 | -0.0003 | 01/12/2016 | -0.0488 | -0.0136 | 17/03/2017 | 0.0021 | 0.0000 | 29/06/2017 | -0.0249 | -0.0144 | 11/10/2017 | 0.0069 | 0.0025 |
| 22/08/2016 | 0.0005 | 0.0012 | 02/12/2016 | 0.0123 | 0.0009 | 20/03/2017 | 0.0074 | 0.0001 | 30/06/2017 | -0.0055 | -0.0006 | 12/10/2017 | -0.0032 | -0.0018 |
| 23/08/2016 | 0.0049 | 0.0030 | 05/12/2016 | 0.0122 | 0.0101 | 21/03/2017 | -0.0234 | -0.0182 | 03/07/2017 | -0.0137 | -0.0049 | 13/10/2017 | 0.0064 | 0.0022 |
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| 26/08/2016 | 0.0044 | 0.0013 | 08/12/2016 | 0.0087 | 0.0044 | 24/03/2017 | 0.0073 | 0.0019 | 07/07/2017 | 0.0169 | 0.0104 | 18/10/2017 | 0.0034 | 0.0001 |
| 29/08/2016 | 0.0040 | 0.0026 | 09/12/2016 | -0.0034 | 0.0050 | 27/03/2017 | 0.0015 | 0.0020 | 10/07/2017 | 0.0115 | 0.0038 | 19/10/2017 | -0.0025 | -0.0029 |
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| 07/09/2016 | -0.0076 | 0.0015 | 19/12/2016 | 0.0099 | 0.0037 | 04/04/2017 | -0.0050 | 0.0007 | 18/07/2017 | 0.0031 | 0.0047 | 27/10/2017 | 0.0209 | 0.0220 |
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| 14/09/2016 | 0.0088 | 0.0036 | 27/12/2016 | 0.0123 | 0.0045 | 11/04/2017 | -0.0081 | -0.0024 | 25/07/2017 | -0.0009 | 0.0002 | 03/11/2017 | 0.0177 | 0.0074 |
| 15/09/2016 | 0.0231 | 0.0147 | 28/12/2016 | -0.0190 | -0.0089 | 12/04/2017 | -0.0172 | -0.0052 | 26/07/2017 | 0.0110 | 0.0017 | 06/11/2017 | 0.0141 | 0.0033 |
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| 19/09/2016 | 0.0012 | -0.0018 | 30/12/2016 | -0.0155 | -0.0090 | 17/04/2017 | 0.0125 | 0.0089 | 28/07/2017 | -0.0038 | -0.0012 | 08/11/2017 | 0.0032 | 0.0032 |
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| 27/09/2016 | 0.0173 | 0.0092 | 10/01/2017 | 0.0048 | 0.0036 | 25/04/2017 | 0.0102 | 0.0070 | 07/08/2017 | 0.0172 | 0.0051 | 16/11/2017 | 0.0149 | 0.0130 |
| 28/09/2016 | 0.0020 | 0.0024 | 11/01/2017 | 0.0034 | 0.0021 | 26/04/2017 | -0.0082 | 0.0000 | 08/08/2017 | -0.0029 | -0.0021 | 17/11/2017 | -0.0044 | -0.0015 |
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| 30/09/2016 | 0.0158 | 0.0081 | 13/01/2017 | 0.0065 | 0.0048 | 28/04/2017 | -0.0170 | -0.0002 | 10/08/2017 | -0.0279 | -0.0213 | 21/11/2017 | 0.0114 | 0.0106 |
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| 04/10/2016 | -0.0026 | -0.0021 | 18/01/2017 | 0.0137 | 0.0031 | 02/05/2017 | -0.0105 | 0.0006 | 14/08/2017 | 0.0254 | 0.0134 | 24/11/2017 | 0.0090 | 0.0032 |
| 05/10/2016 | 0.0073 | 0.0050 | 19/01/2017 | -0.0045 | -0.0028 | 03/05/2017 | 0.0035 | -0.0037 | 15/08/2017 | 0.0025 | -0.0011 | 27/11/2017 | -0.0125 | -0.0015 |
| 06/10/2016 | 0.0059 | -0.0017 | 20/01/2017 | 0.0129 | 0.0028 | 04/05/2017 | -0.0007 | 0.0005 | 16/08/2017 | 0.0016 | -0.0019 | 28/11/2017 | 0.0004 | 0.0049 |
| 07/10/2016 | -0.0015 | -0.0027 | 23/01/2017 | -0.0061 | -0.0004 | 05/05/2017 | 0.0040 | 0.0042 | 17/08/2017 | -0.0253 | -0.0194 | 29/11/2017 | -0.0441 | -0.0127 |
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| 18/10/2016 | 0.0116 | 0.0085 | 01/02/2017 | 0.0159 | 0.0050 | 16/05/2017 | 0.0143 | 0.0033 | 28/08/2017 | 0.0030 | 0.0028 | 08/12/2017 | -0.0052 | 0.0040 |
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| Date | SOXX return | NASDAQ r | Date | SOXX return | NASDAQ r | Date | SOXX return | NASDAQ r | Date | SOXX return | NASDAQ r | Date | SOXX return | NASDAQ r |
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| 18/01/2018 | 0.0045 | -0.0003 | 02/05/2018 | -0.0044 | -0.0042 | 14/08/2018 | -0.0020 | 0.0065 | 26/11/2018 | 0.0181 | 0.0206 | 13/03/2019 | 0.0040 | 0.0069 |
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| 13/02/2018 | -0.0012 | -0.0045 | 29/05/2018 | -0.0060 | -0.0050 | 10/09/2018 | 0.0106 | 0.0027 | 21/12/2018 | -0.0170 | -0.0299 | 08/04/2019 | 0.0023 | 0.0019 |
| 14/02/2018 | 0.0234 | 0.0186 | 30/05/2018 | 0.0065 | 0.0089 | 11/09/2018 | -0.0097 | 0.0061 | 24/12/2018 | -0.0293 | -0.0221 | 09/04/2019 | -0.0104 | -0.0056 |
| 15/02/2018 | 0.0119 | 0.0158 | 31/05/2018 | -0.0073 | -0.0027 | 12/09/2018 | -0.0116 | -0.0023 | 26/12/2018 | 0.0600 | 0.0584 | 10/04/2019 | 0.0077 | 0.0069 |
| 16/02/2018 | -0.0036 | -0.0023 | 01/06/2018 | 0.0228 | 0.0151 | 13/09/2018 | 0.0114 | 0.0075 | 27/12/2018 | 0.0066 | 0.0038 | 11/04/2019 | -0.0008 | -0.0021 |
| 20/02/2018 | 0.0177 | -0.0007 | 04/06/2018 | 0.0079 | 0.0069 | 14/09/2018 | 0.0112 | -0.0005 | 28/12/2018 | 0.0072 | 0.0008 | 12/04/2019 | 0.0139 | 0.0046 |
| 21/02/2018 | -0.0115 | -0.0022 | 05/06/2018 | 0.0048 | 0.0041 | 17/09/2018 | -0.0139 | -0.0143 | 31/12/2018 | 0.0070 | 0.0077 | 15/04/2019 | -0.0074 | -0.0010 |
| 22/02/2018 | -0.0022 | -0.0011 | 06/06/2018 | 0.0063 | 0.0067 | 18/09/2018 | 0.0086 | 0.0076 | 02/01/2019 | 0.0064 | 0.0046 | 16/04/2019 | 0.0320 | 0.0030 |
| 23/02/2018 | 0.0214 | 0.0177 | 07/06/2018 | -0.0089 | -0.0070 | 19/09/2018 | 0.0016 | -0.0008 | 03/01/2019 | -0.0583 | -0.0304 | 17/04/2019 | 0.0166 | -0.0005 |
| 26/02/2018 | 0.0216 | 0.0115 | 08/06/2018 | -0.0089 | 0.0014 | 20/09/2018 | 0.0121 | 0.0098 | 04/01/2019 | 0.0451 | 0.0426 | 18/04/2019 | 0.0001 | 0.0002 |
| 27/02/2018 | -0.0033 | -0.0123 | 11/06/2018 | -0.0019 | 0.0019 | 21/09/2018 | -0.0027 | -0.0051 | 07/01/2019 | 0.0185 | 0.0126 | 22/04/2019 | -0.0008 | 0.0022 |
| 28/02/2018 | -0.0089 | -0.0078 | 12/06/2018 | 0.0052 | 0.0057 | 24/09/2018 | 0.0035 | 0.0008 | 08/01/2019 | -0.0044 | 0.0108 | 23/04/2019 | 0.0103 | 0.0132 |
| 01/03/2018 | -0.0158 | -0.0127 | 13/06/2018 | -0.0015 | -0.0011 | 25/09/2018 | -0.0159 | 0.0018 | 09/01/2019 | 0.0257 | 0.0087 | 24/04/2019 | 0.0093 | -0.0023 |
| 02/03/2018 | 0.0170 | 0.0108 | 14/06/2018 | 0.0060 | 0.0085 | 26/09/2018 | -0.0103 | -0.0021 | 10/01/2019 | 0.0088 | 0.0042 | 25/04/2019 | -0.0176 | 0.0021 |
| 05/03/2018 | 0.0090 | 0.0100 | 15/06/2018 | -0.0009 | -0.0019 | 27/09/2018 | 0.0038 | 0.0065 | 11/01/2019 | 0.0107 | -0.0021 | 26/04/2019 | -0.0083 | 0.0034 |
| 06/03/2018 | 0.0150 | 0.0056 | 18/06/2018 | -0.0096 | 0.0001 | 28/09/2018 | 0.0063 | 0.0005 | 14/01/2019 | -0.0163 | -0.0094 | 29/04/2019 | -0.0012 | 0.0019 |
| 07/03/2018 | 0.0032 | 0.0033 | 19/06/2018 | -0.0110 | -0.0028 | 01/10/2018 | 0.0035 | -0.0011 | 15/01/2019 | 0.0029 | 0.0171 | 30/04/2019 | 0.0079 | -0.0081 |
| 08/03/2018 | 0.0009 | 0.0042 | 20/06/2018 | 0.0048 | 0.0072 | 02/10/2018 | 0.0000 | -0.0047 | 16/01/2019 | -0.0092 | 0.0015 | 01/05/2019 | -0.0080 | -0.0057 |
| 09/03/2018 | 0.0208 | 0.0179 | 21/06/2018 | -0.0124 | -0.0088 | 03/10/2018 | 0.0009 | 0.0032 | 17/01/2019 | 0.0092 | 0.0011 | 02/05/2019 | 0.0096 | -0.0016 |
| 12/03/2018 | 0.0106 | 0.0036 | 22/06/2018 | -0.0079 | -0.0026 | 04/10/2018 | -0.0177 | -0.0181 | 18/01/2019 | 0.0260 | 0.0103 | 03/05/2019 | 0.0078 | 0.0158 |
| 13/03/2018 | -0.0154 | -0.0102 | 25/06/2018 | -0.0294 | -0.0209 | 05/10/2018 | -0.0237 | -0.0116 | 22/01/2019 | -0.0288 | -0.0191 | 06/05/2019 | -0.0163 | -0.0050 |
| 14/03/2018 | -0.0001 | -0.0019 | 26/06/2018 | 0.0036 | 0.0039 | 08/10/2018 | -0.0112 | -0.0067 | 23/01/2019 | -0.0070 | 0.0008 | 07/05/2019 | -0.0246 | -0.0196 |
| 15/03/2018 | -0.0008 | -0.0020 | 27/06/2018 | -0.0239 | -0.0154 | 09/10/2018 | -0.0011 | 0.0003 | 24/01/2019 | 0.0581 | 0.0068 | 08/05/2019 | -0.0085 | -0.0026 |
| 16/03/2018 | -0.0004 | 0.0000 | 28/06/2018 | 0.0076 | 0.0079 | 10/10/2018 | -0.0441 | -0.0408 | 25/01/2019 | 0.0207 | 0.0129 | 09/05/2019 | -0.0110 | -0.0041 |
| 19/03/2018 | -0.0191 | -0.0184 | 29/06/2018 | 0.0021 | 0.0009 | 11/10/2018 | -0.0100 | -0.0125 | 28/01/2019 | -0.0197 | -0.0111 | 10/05/2019 | 0.0014 | 0.0008 |
| 20/03/2018 | 0.0073 | 0.0027 | 02/07/2018 | 0.0063 | 0.0076 | 12/10/2018 | 0.0182 | 0.0229 | 29/01/2019 | -0.0144 | -0.0081 | 13/05/2019 | -0.0468 | -0.0341 |
| 21/03/2018 | 0.0019 | -0.0026 | 03/07/2018 | -0.0182 | -0.0086 | 15/10/2018 | -0.0082 | -0.0088 | 30/01/2019 | 0.0290 | 0.0220 | 14/05/2019 | 0.0230 | 0.0114 |
| 22/03/2018 | -0.0263 | -0.0243 | 05/07/2018 | 0.0267 | 0.0112 | 16/10/2018 | 0.0326 | 0.0289 | 31/01/2019 | -0.0005 | 0.0137 | 15/05/2019 | 0.0077 | 0.0113 |
| 23/03/2018 | -0.0333 | -0.0243 | 06/07/2018 | 0.0123 | 0.0134 | 17/10/2018 | -0.0040 | -0.0004 | 01/02/2019 | 0.0120 | -0.0025 | 16/05/2019 | -0.0158 | 0.0097 |
| 26/03/2018 | 0.0417 | 0.0326 | 09/07/2018 | 0.0064 | 0.0088 | 18/10/2018 | -0.0250 | -0.0206 | 04/02/2019 | 0.0050 | 0.0115 | 17/05/2019 | -0.0195 | -0.0104 |
| 27/03/2018 | -0.0368 | -0.0293 | 10/07/2018 | 0.0106 | | | | | | | | | | |

| Date | SOXX retur | NASDAQ r | Date | SOXX retur | NASDAQ r | Date | SOXX retur | NASDAQ r |
|------------|------------|----------|------------|------------|----------|------------|------------|----------|
| 31/05/2019 | -0.0149 | -0.0151 | 12/09/2019 | 0.0022 | 0.0030 | 24/12/2019 | 0.0016 | 0.0008 |
| 03/06/2019 | 0.0024 | -0.0161 | 13/09/2019 | -0.0020 | -0.0022 | 26/12/2019 | 0.0011 | 0.0078 |
| 04/06/2019 | 0.0437 | 0.0265 | 16/09/2019 | -0.0064 | -0.0028 | 27/12/2019 | -0.0020 | -0.0017 |
| 05/06/2019 | -0.0072 | 0.0064 | 17/09/2019 | 0.0022 | 0.0040 | 30/12/2019 | -0.0075 | -0.0067 |
| 06/06/2019 | 0.0139 | 0.0053 | 18/09/2019 | 0.0018 | -0.0011 | 31/12/2019 | 0.0027 | 0.0030 |
| 07/06/2019 | 0.0113 | 0.0166 | 19/09/2019 | -0.0066 | 0.0007 | 02/01/2020 | 0.0207 | 0.0133 |
| 10/06/2019 | 0.0244 | 0.0105 | 20/09/2019 | -0.0184 | -0.0080 | 03/01/2020 | -0.0187 | -0.0079 |
| 11/06/2019 | 0.0040 | -0.0001 | 23/09/2019 | 0.0118 | -0.0006 | 06/01/2020 | -0.0104 | 0.0056 |
| 12/06/2019 | -0.0232 | -0.0038 | 24/09/2019 | -0.0165 | -0.0146 | 07/01/2020 | 0.0184 | -0.0003 |
| 13/06/2019 | 0.0048 | 0.0057 | 25/09/2019 | 0.0167 | 0.0105 | 08/01/2020 | -0.0009 | 0.0067 |
| 14/06/2019 | -0.0252 | -0.0052 | 26/09/2019 | 0.0013 | -0.0058 | 09/01/2020 | 0.0063 | 0.0081 |
| 17/06/2019 | -0.0074 | 0.0062 | 27/09/2019 | -0.0234 | -0.0113 | 10/01/2020 | -0.0058 | -0.0027 |
| 18/06/2019 | 0.0433 | 0.0139 | 30/09/2019 | 0.0088 | 0.0075 | 13/01/2020 | 0.0117 | 0.0104 |
| 19/06/2019 | 0.0020 | 0.0042 | 01/10/2019 | -0.0094 | -0.0113 | 14/01/2020 | 0.0022 | -0.0024 |
| 20/06/2019 | 0.0084 | 0.0080 | 02/10/2019 | -0.0146 | -0.0156 | 15/01/2020 | -0.0106 | 0.0008 |
| 21/06/2019 | -0.0057 | -0.0024 | 03/10/2019 | 0.0176 | 0.0112 | 16/01/2020 | 0.0158 | 0.0106 |
| 24/06/2019 | 0.0010 | -0.0032 | 04/10/2019 | 0.0166 | 0.0140 | 17/01/2020 | 0.0075 | 0.0034 |
| 25/06/2019 | -0.0138 | -0.0151 | 07/10/2019 | -0.0059 | -0.0033 | 21/01/2020 | -0.0006 | -0.0019 |
| 26/06/2019 | 0.0323 | 0.0032 | 08/10/2019 | -0.0310 | -0.0167 | 22/01/2020 | 0.0067 | 0.0014 |
| 27/06/2019 | 0.0145 | 0.0073 | 09/10/2019 | 0.0163 | 0.0102 | 23/01/2020 | 0.0076 | 0.0020 |
| 28/06/2019 | 0.0013 | 0.0048 | 10/10/2019 | 0.0098 | 0.0060 | 24/01/2020 | -0.0106 | -0.0093 |
| 01/07/2019 | 0.0252 | 0.0106 | 11/10/2019 | 0.0236 | 0.0134 | 27/01/2020 | -0.0382 | -0.0189 |
| 02/07/2019 | -0.0125 | 0.0022 | 14/10/2019 | -0.0001 | -0.0010 | 28/01/2020 | 0.0232 | 0.0143 |
| 03/07/2019 | -0.0046 | 0.0075 | 15/10/2019 | 0.0220 | 0.0124 | 29/01/2020 | -0.0184 | 0.0006 |
| 05/07/2019 | -0.0057 | -0.0010 | 16/10/2019 | -0.0142 | -0.0030 | 30/01/2020 | 0.0000 | 0.0026 |
| 08/07/2019 | -0.0077 | -0.0078 | 17/10/2019 | 0.0017 | 0.0040 | 31/01/2020 | -0.0357 | -0.0159 |
| 09/07/2019 | 0.0062 | 0.0054 | 18/10/2019 | -0.0106 | -0.0083 | 03/02/2020 | 0.0112 | 0.0134 |
| 10/07/2019 | 0.0081 | 0.0075 | 21/10/2019 | 0.0197 | 0.0091 | 04/02/2020 | 0.0312 | 0.0210 |
| 11/07/2019 | 0.0028 | -0.0008 | 22/10/2019 | -0.0087 | -0.0072 | 05/02/2020 | 0.0230 | 0.0043 |
| 12/07/2019 | 0.0182 | 0.0059 | 23/10/2019 | -0.0193 | 0.0019 | 06/02/2020 | 0.0006 | 0.0067 |
| 15/07/2019 | 0.0088 | 0.0017 | 24/10/2019 | 0.0247 | 0.0081 | 07/02/2020 | -0.0236 | -0.0054 |
| 16/07/2019 | -0.0106 | -0.0043 | 25/10/2019 | 0.0209 | 0.0070 | 10/02/2020 | 0.0140 | 0.0113 |
| 17/07/2019 | 0.0030 | -0.0046 | 28/10/2019 | 0.0182 | 0.0101 | 11/02/2020 | 0.0202 | 0.0011 |
| 18/07/2019 | 0.0145 | 0.0027 | 29/10/2019 | -0.0104 | -0.0059 | | | |
| 19/07/2019 | -0.0012 | -0.0074 | 30/10/2019 | 0.0004 | 0.0033 | | | |
| 22/07/2019 | 0.0191 | 0.0071 | 31/10/2019 | -0.0051 | -0.0014 | | | |
| 23/07/2019 | 0.0128 | 0.0058 | 01/11/2019 | 0.0230 | 0.0113 | | | |
| 24/07/2019 | 0.0305 | 0.0085 | 04/11/2019 | 0.0223 | 0.0056 | | | |
| 25/07/2019 | -0.0168 | -0.0100 | 05/11/2019 | 0.0006 | 0.0002 | | | |
| 26/07/2019 | -0.0003 | 0.0111 | 06/11/2019 | -0.0067 | -0.0029 | | | |
| 29/07/2019 | 0.0027 | -0.0044 | 07/11/2019 | 0.0060 | 0.0028 | | | |
| 30/07/2019 | -0.0023 | -0.0024 | 08/11/2019 | 0.0050 | 0.0048 | | | |
| 31/07/2019 | -0.0332 | -0.0119 | 11/11/2019 | -0.0041 | -0.0013 | | | |
| 01/08/2019 | -0.0198 | -0.0079 | 12/11/2019 | 0.0020 | 0.0026 | | | |
| 02/08/2019 | -0.0147 | -0.0132 | 13/11/2019 | 0.0011 | -0.0005 | | | |
| 05/08/2019 | -0.0432 | -0.0347 | 14/11/2019 | -0.0033 | -0.0004 | | | |
| 06/08/2019 | 0.0128 | 0.0139 | 15/11/2019 | 0.0092 | 0.0073 | | | |
| 07/08/2019 | 0.0063 | 0.0038 | 18/11/2019 | -0.0023 | 0.0011 | | | |
| 08/08/2019 | 0.0277 | 0.0224 | 19/11/2019 | -0.0050 | 0.0024 | | | |
| 09/08/2019 | -0.0175 | -0.0100 | 20/11/2019 | -0.0118 | -0.0051 | | | |
| 12/08/2019 | -0.0131 | -0.0120 | 21/11/2019 | -0.0107 | -0.0024 | | | |
| 13/08/2019 | 0.0295 | 0.0195 | 22/11/2019 | -0.0010 | 0.0016 | | | |
| 14/08/2019 | -0.0308 | -0.0302 | 25/11/2019 | 0.0240 | 0.0132 | | | |
| 15/08/2019 | -0.0018 | -0.0009 | 26/11/2019 | -0.0037 | 0.0018 | | | |
| 16/08/2019 | 0.0266 | 0.0167 | 27/11/2019 | 0.0072 | 0.0066 | | | |
| 19/08/2019 | 0.0184 | 0.0135 | 29/11/2019 | -0.0107 | -0.0046 | | | |
| 20/08/2019 | -0.0037 | -0.0068 | 02/12/2019 | -0.0154 | -0.0112 | | | |
| 21/08/2019 | 0.0082 | 0.0090 | 03/12/2019 | -0.0155 | -0.0055 | | | |
| 22/08/2019 | 0.0000 | -0.0036 | 04/12/2019 | 0.0158 | 0.0054 | | | |
| 23/08/2019 | -0.0435 | -0.0300 | 05/12/2019 | 0.0050 | 0.0005 | | | |
| 26/08/2019 | 0.0085 | 0.0132 | 06/12/2019 | 0.0145 | 0.0100 | | | |
| 27/08/2019 | -0.0037 | -0.0034 | 09/12/2019 | -0.0046 | -0.0040 | | | |
| 28/08/2019 | 0.0063 | 0.0038 | 10/12/2019 | 0.0042 | -0.0007 | | | |
| 29/08/2019 | 0.0240 | 0.0148 | 11/12/2019 | 0.0205 | 0.0044 | | | |
| 30/08/2019 | 0.0047 | -0.0013 | 12/12/2019 | 0.0271 | 0.0073 | | | |
| 03/09/2019 | -0.0165 | -0.0111 | 13/12/2019 | -0.0044 | 0.0020 | | | |
| 04/09/2019 | 0.0269 | 0.0130 | 16/12/2019 | 0.0096 | 0.0091 | | | |
| 05/09/2019 | 0.0308 | 0.0175 | 17/12/2019 | 0.0045 | 0.0010 | | | |
| 06/09/2019 | 0.0027 | -0.0017 | 18/12/2019 | -0.0005 | 0.0005 | | | |
| 09/09/2019 | 0.0036 | -0.0019 | 19/12/2019 | 0.0081 | 0.0067 | | | |
| 10/09/2019 | 0.0045 | -0.0004 | 20/12/2019 | 0.0095 | 0.0042 | | | |
| 11/09/2019 | 0.0150 | 0.0106 | 23/12/2019 | 0.0032 | 0.0023 | | | |

Appendix 3: Leading trials tab, Player Analysis excel file

These regression models tried different time gaps to find an improvement on R Square, while the results only worsened. The SOXX and NASDAQ returns are the same as in Appendix 2, but with different leading gaps.

SUMMARY OUTPUT 15-16 (+1)

| Regression Statistics | |
|-----------------------|-------------|
| Multiple R | 0.10291216 |
| R Square | 0.010590913 |
| Adjusted R Square | 0.006568925 |
| Standard Error | 0.011555064 |
| Observations | 248 |

ANOVA

| | df | SS | MS | F | Significance F |
|------------|-----|----------|----------|----------|----------------|
| Regression | 1 | 0.000352 | 0.000352 | 2.633253 | 0.105928 |
| Residual | 246 | 0.032846 | 0.000134 | | |
| Total | 247 | 0.033197 | | | |

| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | Upper 95.0% |
|--------------|--------------|----------------|-----------|----------|-----------|-----------|-------------|-------------|
| Intercept | -0.000419936 | 0.000735 | -0.571724 | 0.568031 | -0.00187 | 0.001027 | -0.00187 | 0.001027 |
| X Variable 1 | 0.077903283 | 0.048008 | 1.62273 | 0.105928 | -0.01665 | 0.172462 | -0.01665 | 0.172462 |

SUMMARY OUTPUT 15-16 (+3)

| Regression Statistics | |
|-----------------------|--------------|
| Multiple R | 0.038674667 |
| R Square | 0.00149573 |
| Adjusted R Square | -0.002596501 |
| Standard Error | 0.011651739 |
| Observations | 246 |

ANOVA

| | df | SS | MS | F | Significance F |
|------------|-----|----------|----------|----------|----------------|
| Regression | 1 | 4.96E-05 | 4.96E-05 | 0.365505 | 0.546027 |
| Residual | 244 | 0.033126 | 0.000136 | | |
| Total | 245 | 0.033176 | | | |

| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | Upper 95.0% |
|--------------|--------------|----------------|-----------|----------|-----------|-----------|-------------|-------------|
| Intercept | -0.000482176 | 0.000743 | -0.648593 | 0.517212 | -0.00195 | 0.000982 | -0.00195 | 0.000982 |
| X Variable 1 | 0.029426659 | 0.048674 | 0.60457 | 0.546027 | -0.06645 | 0.125301 | -0.06645 | 0.125301 |

SUMMARY OUTPUT 16-17 (+1)

| Regression Statistics | |
|-----------------------|----------|
| Multiple R | 0.016556 |
| R Square | 0.000274 |
| Adjusted R Square | -0.00374 |
| Standard Error | 0.008355 |
| Observations | 251 |

ANOVA

| | df | SS | MS | F | Significance F |
|------------|-----|----------|----------|----------|----------------|
| Regression | 1 | 4.77E-06 | 4.77E-06 | 0.068273 | 0.794084 |
| Residual | 249 | 0.01738 | 6.98E-05 | | |
| Total | 250 | 0.017385 | | | |

| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | Upper 95.0% |
|--------------|--------------|----------------|----------|----------|-----------|-----------|-------------|-------------|
| Intercept | 0.001225 | 0.000536 | 2.284635 | 0.023176 | 0.000169 | 0.002281 | 0.000169 | 0.002281 |
| X Variable 1 | -0.01104 | 0.042267 | -0.26129 | 0.794084 | -0.09429 | 0.072203 | -0.09429 | 0.072203 |

One week leading gap

2015-2016

| Regression Statistics | |
|-----------------------|----------|
| Multiple R | 0.207946 |
| R Square | 0.043241 |
| Adjusted R Square | 0.023309 |
| Standard Error | 0.025384 |
| Observations | 50 |

ANOVA

| | df | SS | MS | F | Significance F |
|------------|----|----------|----------|--------|----------------|
| Regression | 1 | 0.001398 | 0.001398 | 2.1694 | 0.147309 |
| Residual | 48 | 0.030928 | 0.000644 | | |
| Total | 49 | 0.032326 | | | |

| | Coefficients | Standard Error | t Stat | P-value | Lower 95% | Upper 95% | Lower 95.0% | Upper 95.0% |
|--------------|--------------|----------------|----------|----------|-----------|-----------|-------------|-------------|
| Intercept | -0.00253 | 0.003596 | -0.70456 | 0.48449 | -0.00976 | 0.004697 | -0.00976 | 0.004697 |
| X Variable 1 | -0.16087 | 0.109221 | -1.47289 | 0.147309 | -0.38047 | 0.058733 | -0.38047 | 0.058733 |

Appendix 4: Overall analysis tab, Player Analysis excel file

Figures 11-19 are based on this table that summarized the findings of the financial ratios tab displayed on Appendix 5.

| Company | NVIDIA | INTEL | BROADCOM | TSM | TEXAS INST. | ASML | MEDIAN |
|-------------------------------|--------|--------|----------|--------|-------------|--------|--------|
| Net Profit Margin | 25.73% | 22.45% | 17.43% | 34.98% | 28.79% | 22.55% | 24.14% |
| Net Profit Margin CAGR 5-year | 16.00% | 1.70% | -2.69% | -0.76% | 4.62% | 0.44% | 1.07% |
| ROI | 24.51% | 15.55% | 9.86% | 21.57% | 30.65% | 15.13% | 18.56% |
| ROI CAGR | 12.77% | 2.02% | -9.55% | -0.09% | 6.05% | 0.74% | 1.38% |
| ROE | 30.13% | 20.71% | 17.51% | 23.24% | 43.66% | 18.84% | 21.98% |
| ROE CAGR | 17.02% | 2.07% | -9.90% | -1.50% | 7.78% | 2.65% | 2.36% |
| FCF/SHARE | 4.152 | 2.766 | 13.926 | 1.44 | 4.9368 | 5.026 | 4.54 |
| FCF/Share CAGR 5-year | 16.68% | 2.97% | 16.35% | -2.80% | 5.43% | 3.46% | 4.44% |
| DEBT/EQUITY | 0.30 | 0.37 | 0.83 | 0.15 | 0.47 | 0.25 | 0.33 |
| D/E CAGR | -2.15% | 0.11% | 0.24% | -6.10% | 2.77% | 13.79% | 0.18% |
| Sustainable Growth Rate | 25.93% | 13.34% | 9.22% | 12.30% | 21.11% | 13.11% | 13.22% |
| SGR CAGR | 23.66% | 3.49% | -14.91% | -5.95% | 6.37% | 0.28% | 1.89% |
| AVERAGE ROCE | 24.17% | 17.55% | 7.50% | 23.05% | 37.44% | 15.55% | 20.30% |
| ROCE CAGR | 4.25% | 3.41% | -20.02% | 2.64% | 0.20% | 0.26% | 1.45% |
| EPS CAGR | 32.36% | 2.32% | 5.54% | 3.79% | 5.17% | 9.24% | 5.36% |
| EPS MEDIAN | 4.59 | 2.12 | 5.17 | 2.24 | 3.68 | 5.57 | 4.14 |

Best 2nd best

Appendix 5: Player Analysis, Financial Ratios

These financial ratios are derived from public information presented by the firms on their earnings releases. The CAGR is calculated from the median of the results.

| | 2015 | 2016 | 2017 | 2018 | 2019 | AVERAGE | CAGR |
|-----------------------------|-----------|-----------|-----------|--------|-----------|---------|--------|
| Net Profit Margin | 22.37% | 18.65% | 23.22% | 36.30% | 26.07% | 25.32% | |
| NVIDIA | 12.25% | 24.11% | 31.36% | 35.34% | 25.60% | 25.73% | 16.00% |
| INTEL | 20.63% | 17.37% | 15.29% | 29.71% | 29.24% | 22.45% | 1.70% |
| BROADCOMM | 19.98% | -13.13% | 9.59% | 58.80% | 11.92% | 17.43% | -2.69% |
| TAIWAN SEMI | 36.34% | 34.99% | 35.29% | 35.20% | 33.07% | 34.98% | -0.76% |
| TEXAS INSTR | 22.97% | 26.88% | 24.38% | 35.07% | 34.65% | 28.79% | 4.62% |
| ASML | 22.06% | 21.66% | 23.40% | 23.68% | 21.93% | 22.55% | 0.44% |
| Return on Investment | 17.15% | 14.73% | 18.42% | 27.83% | 19.60% | 19.54% | |
| NVIDIA | 13.44% | 21.42% | 32.22% | 36.55% | 18.94% | 24.51% | 12.77% |
| INTEL | 14.07% | 11.87% | 10.20% | 21.12% | 20.47% | 15.55% | 2.02% |
| BROADCOMM | 16.28% | -4.98% | 4.40% | 28.60% | 4.98% | 9.86% | -9.55% |
| TAIWAN SEMI | 21.67% | 21.93% | 21.75% | 21.13% | 21.39% | 21.57% | -0.09% |
| TEXAS INSTR | 22.85% | 26.72% | 26.46% | 41.91% | 35.30% | 30.65% | 6.05% |
| ASML | 14.58% | 11.41% | 15.49% | 17.66% | 16.51% | 15.13% | 0.74% |
| FCF per share | 3.4216667 | 3.4283333 | 5.1566667 | 7.068 | 7.7976667 | 5.37 | |
| NVIDIA | 1.92 | 2.31 | 4.6 | 5.02 | 6.91 | 4.15 | 16.68% |
| INTEL | 2.39 | 2.49 | 2.14 | 3.03 | 3.78 | 2.77 | 2.97% |
| BROADCOMM | 6.53 | 7.03 | 14.07 | 19.68 | 22.32 | 13.93 | 16.35% |
| TAIWAN SEMI | 1.66 | 1.26 | 1.66 | 1.63 | 0.99 | 1.44 | -2.80% |
| TEXAS INSTR | 3.79 | 3.99 | 4.65 | 6.128 | 6.126 | 4.94 | 5.43% |
| ASML | 4.24 | 3.49 | 3.82 | 6.92 | 6.66 | 5.03 | 3.46% |
| Debt/Equity Ratio | 37.67% | 38.83% | 36.83% | 35.50% | 48.00% | 39.37% | |
| NVIDIA | 33.00% | 48.00% | 26.00% | 21.00% | 20.00% | 29.60% | -2.15% |
| INTEL | 37.00% | 38.00% | 39.00% | 35.00% | 37.00% | 37.20% | 0.11% |
| BROADCOMM | 82.00% | 62.00% | 75.00% | 65.00% | 131.00% | 83.00% | 0.24% |
| TAIWAN SEMI | 20.00% | 18.00% | 14.00% | 10.00% | 11.00% | 14.60% | -6.10% |
| TEXAS INSTR | 41.00% | 34.00% | 39.00% | 56.00% | 65.00% | 47.00% | 2.77% |
| ASML | 13.00% | 33.00% | 28.00% | 26.00% | 24.00% | 24.80% | 13.79% |
| Return on Equity | 22.26% | 18.35% | 23.49% | 37.68% | 26.64% | 25.68% | |
| NVIDIA | 13.73% | 28.91% | 40.78% | 44.32% | 22.91% | 30.13% | 17.02% |
| INTEL | 18.69% | 15.57% | 13.91% | 28.23% | 27.15% | 20.71% | 2.07% |
| BROADCOMM | 29.50% | -7.99% | 7.72% | 47.37% | 10.96% | 17.51% | -9.90% |
| TAIWAN SEMI | 25.07% | 24.29% | 23.08% | 21.85% | 21.92% | 23.24% | -1.50% |
| TEXAS INSTR | 30.02% | 34.32% | 35.61% | 62.04% | 56.32% | 43.66% | 7.78% |
| ASML | 16.53% | 14.98% | 19.84% | 22.26% | 20.58% | 18.84% | 2.65% |

| | 2015 | 2016 | 2017 | 2018 | 2019 | AVERAGE | CAGR |
|--------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|---------|
| Earnings per share | 2.75 | 1.63 | 3.79 | 9.30 | 5.10 | 3.79 | |
| NVIDIA | 1.13 | 3.08 | 5.09 | 6.81 | 4.59 | 4.59 | 32.36% |
| INTEL | 1.89 | 2.12 | 1.99 | 4.48 | 4.71 | 2.12 | 2.32% |
| BROADCOMM | 5.17 | 4.75 | 4.18 | 29.33 | 6.77 | 6.77 | 5.54% |
| TAIWAN SEMI | 1.86 | 1.97 | 2.24 | 2.29 | 2.28 | 2.24 | 3.79% |
| TEXAS INSTR | 2.86 | 3.54 | 3.68 | 5.71 | 5.33 | 3.68 | 5.17% |
| ASML | 3.58 | 3.83 | 5.57 | 7.20 | 6.90 | 5.57 | 9.24% |
| EPS growth TTM | | 5% | -11% | 141% | -19% | -3% | |
| NVIDIA | | 173% | 65% | 34% | -33% | 50% | |
| INTEL | | 12% | -6% | 125% | 5% | 9% | |
| BROADCOMM | | -192% | -188% | 602% | -77% | -77% | |
| TAIWAN SEMI | | 6% | 14% | 2% | 0% | 4% | |
| TEXAS INSTR | | 24% | 4% | 55% | -7% | 14% | |
| ASML | | 7% | 45% | 29% | -4% | 18% | |
| Dividends paid | 1,772.04 | 2,146.22 | 2,661.65 | 3,157.86 | 3,893.88 | 2,726.33 | |
| NVIDIA | 213.00 | 261.00 | 341.00 | 371.00 | 390.00 | 315.20 | 8.2% |
| INTEL | 4,556.00 | 4,925.00 | 5,072.00 | 5,541.00 | 5,576.00 | 5,134.00 | 2.4% |
| BROADCOMM | 408.00 | 750.00 | 1,745.00 | 2,998.00 | 4,235.00 | 2,027.20 | 37.8% |
| TAIWAN SEMI | 3,675.53 | 4,801.90 | 6,123.90 | 6,777.00 | 8,669.50 | 6,009.57 | 10.3% |
| TEXAS INSTR | 1,444.00 | 1,646.00 | 2,104.00 | 2,555.00 | 3,008.00 | 2,151.40 | 8.3% |
| ASML | 335.69 | 493.39 | 584.03 | 705.18 | 1,484.78 | 720.61 | 16.5% |
| Net Income | 4,827.14 | 5,163.00 | 5,645.72 | 9,905.35 | 7,920.48 | 6,692.34 | |
| NVIDIA | 614.00 | 1,666.00 | 3,047.00 | 4,141.00 | 2,796.00 | 2,452.80 | 31.9% |
| INTEL | 11,420.00 | 10,316.00 | 9,601.00 | 21,053.00 | 21,048.00 | 14,687.60 | 5.2% |
| BROADCOMM | 1,364.00 | 1,861.00 | 1,784.00 | 12,610.00 | 2,724.00 | 4,068.60 | 24.4% |
| TAIWAN SEMI | 11,038.51 | 11,911.20 | 13,365.80 | 12,987.40 | 13,034.50 | 12,467.48 | 2.5% |
| TEXAS INSTR | 2,986.00 | 3,595.00 | 3,682.00 | 5,580.00 | 5,017.00 | 4,172.00 | 6.9% |
| ASML | 1,540.32 | 1,628.80 | 2,394.54 | 3,060.68 | 2,903.38 | 2,305.54 | 8.4% |
| Retention ratio | 0.65 | 0.63 | 0.52 | 0.70 | 0.38 | 0.58 | |
| NVIDIA | 0.65 | 0.84 | 0.89 | 0.91 | 0.86 | 0.83 | 4.94% |
| INTEL | 0.60 | 0.52 | 0.47 | 0.74 | 0.74 | 0.61 | 0.41% |
| BROADCOMM | 0.70 | 0.60 | 0.02 | 0.76 | 0.55 | 0.31 | -15.30% |
| TAIWAN SEMI | 0.67 | 0.60 | 0.54 | 0.48 | 0.33 | 0.52 | -4.72% |
| TEXAS INSTR | 0.52 | 0.54 | 0.43 | 0.54 | 0.40 | 0.49 | -1.21% |
| ASML | 0.78 | 0.70 | 0.76 | 0.77 | 0.49 | 0.70 | -2.23% |
| Sustainable growth rate | 14.34% | 11.88% | 14.29% | 26.41% | 12.26% | 15.83% | |
| NVIDIA | 8.97% | 24.38% | 36.22% | 40.35% | 19.71% | 25.93% | 23.66% |
| INTEL | 11.23% | 8.14% | 6.56% | 20.80% | 19.96% | 13.34% | 3.49% |
| BROADCOMM | 20.68% | -4.77% | 0.17% | 36.11% | -6.08% | 9.22% | -14.91% |
| TAIWAN SEMI | 16.72% | 14.50% | 12.51% | 10.45% | 7.34% | 12.30% | -5.95% |
| TEXAS INSTR | 15.50% | 18.61% | 15.26% | 33.63% | 22.55% | 21.11% | 6.37% |
| ASML | 12.93% | 10.44% | 15.00% | 17.13% | 10.06% | 13.11% | 0.28% |

Appendix 6: Player Analysis Excel, Valuation Ratios

These quarterly figures are taken from Yahoo Finance and Bloomberg.

| P/E | 31/03/2015 | 30/06/2015 | 31/09/2015 | 31/12/2015 | 31/03/2016 | 30/06/2016 | 31/09/2016 | 31/12/2016 | 31/03/2017 | 30/06/2017 | 31/09/2017 | 31/12/2017 | 31/03/2018 | 30/06/2018 | 31/09/2018 | 31/12/2018 | 31/03/2019 | 30/06/2019 | 31/09/2019 | 31/12/2019 |
|------------------|---------------|---------------|---------------|---------------|--------------|--------------|---------------|--------------|---------------|---------------|---------------|---------------|--------------|---------------|---------------|---------------|---------------|---------------|--------------|---------------|
| NVIDIA | 19.24 | 20.48 | 25.73 | 26.66 | 29.96 | 37.16 | 36.92 | 42.49 | 34.43 | 45.79 | 51.09 | 50.8 | 37.3 | 35.65 | 28.09 | 21.68 | 34.22 | 38.09 | 51.41 | 52.31 |
| INTEL | 11.82 | 11.58 | 11.66 | 13.44 | 12.67 | 14.72 | 16.66 | 16.21 | 14.89 | 12.37 | 12.83 | 22.6 | 22.1 | 17.61 | 14.55 | 10.41 | 12.15 | 11.16 | 12.1 | 12.68 |
| TAIWAN SEMI | 11.07 | 10.38 | 9.63 | 10.96 | 13.33 | 14.42 | 15.62 | 13.37 | 14.15 | 15.61 | 16.92 | 17.62 | 19.01 | 16.11 | 19.54 | 16.4 | 20.08 | 19.78 | 22.78 | 27.15 |
| TEXAS INSTR | 18.74 | 16.8 | 16.26 | 17.86 | 18.59 | 19.65 | 20.86 | 20.43 | 20.73 | 18.56 | 20.14 | 28.07 | 25.4 | 24.81 | 22.62 | 16.75 | 19.25 | 20.98 | 24.02 | 24.53 |
| ASML | 25.92 | 29.08 | 23.75 | 24.44 | 32 | 32.35 | 33.4 | 28.9 | 28.49 | 28.26 | 33.6 | 31.38 | 33.24 | 30.6 | 27.61 | 21.73 | 26.71 | 31.13 | 38.34 | 40.32 |
| AVERAGE | 17.358 | 17.664 | 17.406 | 18.672 | 21.31 | 23.66 | 24.692 | 24.28 | 22.538 | 24.118 | 26.916 | 30.094 | 27.41 | 24.956 | 22.482 | 17.394 | 22.482 | 24.228 | 29.73 | 31.398 |
| NASDAQ | 25.65 | 22.5 | 23.66 | 21.98 | 19.49 | 21.4 | 22.69 | 104.14 | 80.86 | 54.26 | 49.83 | 17.45 | 19.4 | 20.17 | 19.23 | 29.99 | 27.77 | 29.87 | 31.54 | 23.13 |
| EV | | | | | | | | | | | | | | | | | | | | |
| NVIDIA | 8.36 | 7.418 | 9.674 | 14.8 | 15.73 | 21.26 | 32.22 | 59.6 | 60.04 | 83.22 | 101.63 | 115.17 | 129.26 | 137.78 | 156.64 | 75.93 | 103.83 | 86.44 | 99.48 | 136.22 |
| TXN | 56.38 | 54.84 | 50.36 | 59.24 | 58.61 | 61.84 | 70.75 | 75.31 | 80.7 | 76.98 | 88.52 | 103.16 | 99.8 | 106.49 | 104.24 | 90.06 | 100.39 | 106.38 | 120.99 | 119.99 |
| EBITDA | | | | | | | | | | | | | | | | | | | | |
| NVIDIA | 237 | 132 | 301 | 303 | 298 | 370 | 693 | 760 | 601 | 737 | 944 | 1127 | 1352 | 1216 | 1126 | 372 | 449 | 663 | 1019 | 1096 |
| TXN | 1449 | 1451 | 1233 | 1373 | 1645 | 1559 | 1482 | 1559 | 1482 | 1705 | 2013 | 1787 | 1777 | 1945 | 2180 | 1765 | 1637 | 1773 | 1864 | 1499 |
| EV/EBITDA | | | | | | | | | | | | | | | | | | | | |
| NVIDIA | 3.53% | 5.62% | 3.21% | 4.88% | 5.28% | 5.75% | 4.65% | 7.84% | 9.99% | 11.29% | 10.77% | 10.22% | 9.56% | 11.33% | 13.91% | 20.41% | 23.12% | 13.04% | 9.76% | 12.43% |
| TXN | 3.89% | 3.78% | 4.08% | 4.31% | 3.56% | 3.97% | 4.77% | 4.83% | 5.45% | 4.51% | 4.40% | 5.77% | 5.62% | 5.48% | 4.78% | 5.10% | 6.13% | 6.00% | 6.49% | 8.00% |

| Company | Date | Price | EPS | EV | EBITDA | FCF/Share | P/E | P/FCF | EV/EBITDA |
|---------------|------------|--------|-------|---------|---------|-----------|---------------------|------------------|--------------|
| NVIDIA | 31/12/2019 | 235.3 | 4.59 | 145.039 | 3.386 | 6.91 | 51.26 | 34.05 | 42.83 |
| INTEL | 31/12/2019 | 59.85 | 4.33 | 270.2 | 42.14 | 3.78 | 29.63 | 15.83 | 6.41 |
| BROADCOMM | 31/12/2019 | 316.02 | 8.51 | 149.52 | 10.42 | 22.32 | 37.14 | 14.16 | 14.35 |
| TAIWAN SEMI | 31/12/2019 | 58.1 | 13.39 | 8193.15 | 660.209 | 0.99 | 4.34 | 58.69 | 12.41 |
| TEXAS INSTR | 31/12/2019 | 128.29 | 5.25 | 120.32 | 6.88 | 6.126 | 11.40 | 20.94 | 17.49 |
| ASML | 31/12/2019 | 295.94 | 6.16 | 109.3 | 3.32 | 6.66 | 48.04 | 44.44 | 32.92 |
| Median | | | | | | | 33.38 | 27.50 | 15.92 |
| | | | | | | | Target Price | Target EV | |
| NVIDIA | | | | | | | 153.22 | 190.00 | 53.90 |
| TXN | | | | | | | 175.25 | 168.45 | 109.52 |