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Nordic Semiconductor – Remaining a market leader by overcoming macroeconomic and industry specific risks.

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Abstract

The semiconductor industry has been a dynamic and growing market in an increasingly digital economy where the Internet of Things is indispensable to most individuals. With the pandemic, semiconductors established themselves as a critical industry, with many smaller companies, as the one at the core of this paper, growing exponentially. Such thriving of the industry led a shortage of the raw materials underlying each semiconductor chip, creating an imbalance between supply and demand, thus hindering the industry's growth. This research paper focuses on the Equity Research of Nordic Semiconductor, a Norwegian fabless semiconductor company specializing in wireless communication technologies powering the Internet of Things and a global market leader of short-range wireless solutions employing the Bluetooth technology. Throughout this paper, one finds a company overview, an explanation of the forecasts performed to value the company, a target price for Nordic Semiconductor's stock as of the year-end of 2023 through the discounted cash flow, multiples, and precedent transactions valuation methods, as well as the analysts' final remarks and recommendations to investors considering the expected outlook for the company.

Keywords: Semiconductors, Valuation, Nordic Semiconductor ASA, Discounted Cash Flow, Risks.

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This report is part of the “Nordic Semiconductor – Relief in sight driving a rebound in growth” report (annexed), developed by Maria Leonor da Anunciação Moreira Paiva Ferreira and Ilda Margarida Cordeiro das Neves Duarte and should be read as an integral part of it.

Table of Contents

INTRODUCTION	5
INDUSTRY OVERVIEW	6
COMPETITION.....	8
PROFITABILITY, LIQUIDITY & CAPITAL STRUCTURE.....	10
INVESTMENT RISKS SUMMARY.....	12
CYCLICAL NATURE OF THE SEMICONDUCTOR INDUSTRY	12
SUPPLY CHAIN AND GEOPOLITICAL RISK	13
INTRINSIC VALUATION	14
DCF: COST OF DEBT, COST OF EQUITY, AND WACC	14
TERMINAL VALUE	15
DISCOUNTED CASH FLOW VALUATION & CONCLUSIONS	16
SENSITIVITY ANALYSIS	17

Introduction

The purpose of this joint report is to thoroughly analyse and evaluate a Norwegian company specialized in the design of semiconductors, Nordic Semiconductor, for the sake of advising an investor in the best possible way on whether to buy, sell or hold the company's stock by the end of FY2023. This company is the market leader of Bluetooth Low-Energy products and is now exploring the cellular IoT segment as well. Such assessment considers the company's business model, financial situation, future projections, and industry trends.

The report ultimately recommends a "hold" rating with a target price of \$10.94 per share by the end of 2023, which would provide investors with an expected return of approximately 6.75%, compared to the current share price of \$10.25 as of May 12th, 2023.

The joint report encompasses two main sections: a qualitative and a more quantitative one. The qualitative section provides the reader with an overview of not only the industry and how the supply chains work but also of Nordic Semiconductor's core business and the risks it poses. On the other hand, the quantitative part assesses factors such as profitability, liquidity, capital structure, future projections on both the income statement and balance sheet and the valuation assumptions and computations.

This individual report provides information on the semiconductor industry and its trends by analysing the company's competitive environment, evaluating both the company and the industry's specific risks and also contains an analysis of Nordic Semiconductor (NOD) financial ratios, including profitability, liquidity and capital structure as measures of performance. Furthermore, there is also a section of this report dedicated to some aspects of the discounted cash flow valuation component. The report concludes with a sensitivity analysis that explores potential uncertainties and their impact on the analysts' conclusions.

On the other hand, the other individual report focuses on providing an overview of NOD, covering its business model, value chain, segments, and near-term outlook. Moreover, it also analyses in great detail the main components of NOD's (projected) financial statements. It further explains how the target share price for FY2023 was attained through both peer multiples.

The analysts conclude the report by sharing their final thoughts on the company's prospects and recommending investors to hold its stock, as the expected return between the current date and December 2023 is estimated to be between 0 and 10%.

Industry Overview

Over the past two years, the semiconductor industry has been negatively impacted by up-and-coming forces, whether they be macroeconomic trends and geopolitical events affecting the whole economy, or the industry-specific features, such as the wafers' shortage¹ issues that have become relevant from 2020 until 2022, as the sector is still recovering from such disturbance. Indeed, the effect it had on the industry is reflected on the Philadelphia Semiconductor Sector Index² (SOX), as this was c. 36% down from the beginning of 2022 until the year end (figure 1).

In fact, when focusing on NOD's business, the company had a major setback due to said shortage, as its main source of revenue (BLE products, with c. 86% of revenues in 2022) was highly damaged³, since this segment uses silicon wafers to assemble its semiconductors. Prior to the wafer shortage, in 2019, NOD had made the projection that it would become a \$1 billion revenue company within the next five years (this deadline was shortened to 2023 after the pandemic)⁴, which implied a CAGR of c. 28% in revenues between 2021 and 2023. However, NOD recently reported a y-o-y decrease of c. 21% in revenues for Q1₂₀₂₃. Furthermore, at the same time, it forecasted that its revenues for the next quarter would range from \$140m to \$160m, whereas its total revenue for Q2₂₀₂₂ was c. \$200m. Hence, taking the midpoint of this range and comparing it to the amount recorded in 2022, one can acknowledge a c. 25% decrease year-on-year. This does not pose a favorable outlook so to accomplish the firm's projection, meaning that NOD is likely to fail to become a \$1 billion revenue company by the year-end. Upon announcing that it would no longer achieve such goal until the end of the year, NOD's share price decreased by c. 24% (figure 2).

Moreover, as NOD is a fabless company, it relies on third-party foundries to manufacture its semiconductors and subsequently be able to sell its final product. Given that NOD's revenue is only incurred when its final product is sold to distributors, its ability to incur revenue is at stake with foundries not being able to manufacture. Hence, the shortage of an essential raw material negatively impacted the company's supply chain, affecting NOD's capacity to grow its sales at a faster pace and thus accomplishing its \$1 billion revenue projection as it had previously planned, had it not been for such event. However, recently, this concern has been smoothing out, not entirely due to an increase in supply but rather due to a decline in demand. In fact, the global economy has been experiencing a period of cool down since 2021. This is observable through the global real GDP growth rate (figure 3) which has decreased by 3.5 percentage points (p.p.) from 2021 to 2023⁵ (figure 4). This downturn has led to a decrease in demand by the end-consumers, and, therefore, supply was able to meet, the now lower, demand.

These not so favorable prospects on the global economy were also caused by (i.) higher inflation as the average annual inflation rate in the U.S. increased c. 6.8 p.p. from 2020 to 2022⁶; (ii.) higher interest rates, with the federal funds rate increasing by c. 4.38 p.p. from 2020 to May 2023⁷



Figure 1: Philadelphia Semiconductor Index from the January 2018 until May 2023.

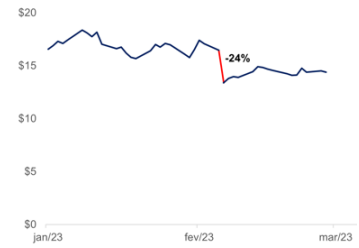


Figure 2: Stock price impact after Q4 2022 announcement. Source: Refinitiv.

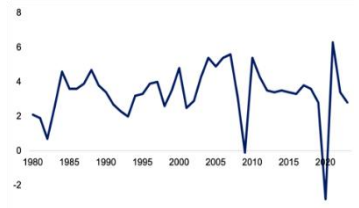


Figure 19: Global real GDP growth from 1980 until 2023e. Source: International Monetary Fund.

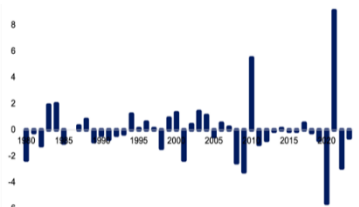


Figure 4: Annual percentage change of the global real GDP growth from 1980 until 2023e.

¹ King, Ian, Debby Wu, and Demetrios Pogkas. 2021. "How a Chip Shortage Snarled Everything from Phones to Cars." Bloomberg.com, March 29, 2021.

² The Philadelphia Semiconductor Index (SOX) is an index composed by 30 companies whose main business consists of the design, manufacture, distribution and sale of semiconductors. It intends to track the performance of listed semiconductors.

³ Delivery capacity was hindered by constraints in wafer demand. Nordic Semiconductor 2022 Annual Report – Message from the CEO (page 4)

⁴ Nordic Semiconductor 2019 Annual Report – Message from the CEO (page 4)

⁵ Real GDP growth – IMF (https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/WEO_WORLD)

⁶ "Historical Inflation Rates: 1914-2023." 2019. US Inflation Calculator. April 10, 2019. <https://www.usinflationcalculator.com/inflation/historical-inflation-rates/>.

⁷ Macrotrends. 2022. "Federal Funds Rate - 62 Year Historical Chart." Macrotrends.net. 2022. <https://www.macrotrends.net/2015/fed-funds-rate-historical-chart>.

and the 1-year London interbank offered rate increasing c. 4.92 p.p. for the same period⁸; (iii.) decreasing customer confidence⁹; and (iv.) sagging market when it comes to tech stocks¹⁰ (figure 17).

Furthermore, from a geopolitical standpoint, the industry outlook does not seem encouraging enough. Firstly, the war in Ukraine has not only unsettled supply chains, but also limited the access to necessary raw materials¹¹. Secondly, both the lockdown in China¹² and its tensions with Taiwan further impacted semiconductors' supply chains given that the two countries are in the top-5 of the world's most producing semiconductor manufacturers¹³ (7% and 64% in 2021, respectively). Lastly, the recent U.S. trade sanctions on China have not contributed for the industry's prosperity as these also contributed to disrupt supply chains. Nonetheless, total demand is still outrunning the available supply¹⁴.

All these factors combined have contributed to the loss in market capitalization of the top-10 global chip companies combined which, in 2022, has decreased by 34%³⁷. Such a decrease is a result of decreases in earnings, increases in cost of capital, and inventory drawdowns (cf. "Investment Risks Summary"). As a response, semiconductor companies started to cut costs, increasing the number of layoffs and postponing investment and capital expenditures³⁷.

Nevertheless, when focusing on NOD's operations, there are additional revenue segments that one should consider. The company has recently betted, in 2018, on a new segment, Cellular IoT, as it is a "massive and growing market across hardware, connectivity and services"¹⁵. However, for NOD, this new market experienced a slowdown due to many cellular IoT consumers, mainly start-ups and growth companies, not finding appropriate financing in the current macro environment. This slowdown is assumed to be temporary considering the high amount of potential volume of pre-commercial cellular IoT projects¹⁶. What is more, the IoT market is expected to keep on growing as the supply constraints ease – twenty-seven billion connected IoT devices are expected to exist by 2025¹⁷.

Moreover, another source of revenue that is worth evaluating in terms of growth prospects are NOD's proprietary products, such as keyboards and personal computer (PC) accessories. These goods had experienced a vigorous growth during the pandemic years given that working from home was enforced, causing the demand for such products to increase, especially in 2021¹⁸ (increasing c. 10% from 2020 to 2021). However, as workers began to return to the offices, such demand decreased so much that NOD expects that the revenue percentage (out of total revenues) for this segment to completely migrate into the BLE segment¹⁹.

As stated by the company, the industry's addressable market, and, subsequently, that of NOD's, is sizable and is expected to keep on expanding quickly. The growth is supported by megatrends including smart homes, industrial IoT, and platform ecosystems, which will increase the number

⁸ "LIBORUSD12M Data | 1 Year London Interbank Offered Rate in USD (LIBOR) Price Data." n.d. MarketWatch. Accessed May 14, 2023. <https://www.marketwatch.com/investing/interestrates/liborUSD12m/download-data?startDate=1/1/2020&endDate=5/12/2023&countryCode=mr>.

⁹ Deloitte's 2023 Semiconductor Industry Outlook (page 3)

¹⁰ Financial Times. 2023. "Tech Stock Retreat Leads Wall Street Indices Lower," March 28, 2023.

¹¹ Both countries are major producers of key raw materials used in the manufacture of semiconductors (neon and palladium). Ukraine represents c. 70%-80% of neon's world supply and Russia represents c. 35%-45% of palladium's world supply. - "Russia-Ukraine War: Impact on the Semiconductor Industry - KPMG Ukraine." 2022. KPMG. September 8, 2022.

¹² China's Chip Output Shrinks as Lockdowns Hurt Production – Bloomberg <https://www.bloomberg.com/news/articles/2022-04-18/china-s-chip-output-shrinks-as-lockdowns-hurt-production#xj4y7vzkg>

¹³ Alsop, Thomas. 2022. "Semiconductor Foundry Market Share by Country 2021." Statista. June 29, 2022.

¹⁴ Deloitte's 2023 Semiconductor Industry Outlook (page 3)

¹⁵ Nordic Semiconductor 2022 Credit Investor Presentation (page 54)

¹⁶ NOD currently has approximately 250 different cellular IoT projects across different segments such as smart cities and payment systems. – NOD Q3 2022 report.

¹⁷ IoT analytics: market insights for the internet of things <https://iot-analytics.com/number-connected-iot-devices/>

¹⁸ Nordic Semiconductor 2022 4th quarter report (page 5)

¹⁹ Ibid

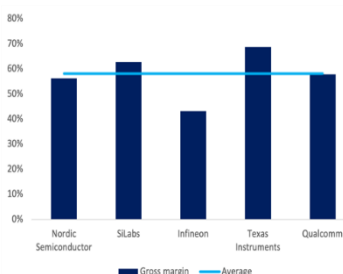


Figure 5: Nordic Semiconductor and peers' gross margin compared against the peers' average.
Source: Respective companies' 2022 annual reports; Own computations.

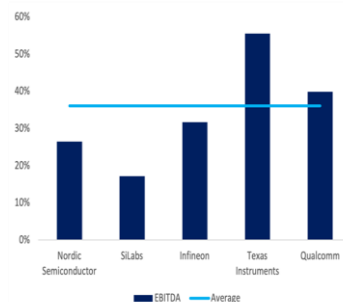


Figure 6: Nordic Semiconductor and peers' EBITDA margin compared against the peers' average.
Source: Respective companies' 2022 annual report; Own computations.

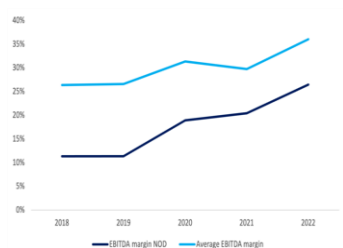


Figure 7: Nordic Semiconductor's EBITDA margin evolution compared against the peers' average.
Source: Respective companies' annual reports from 2018 to 2022; Own computations.

Operating expenses (2022)		% total sales
NOD	231,125.00	30%
Silabs	523,318.17	51%
Infineon	3,554,476.00	23%
Texas Instruments	3,374,000.00	17%
Qualcomm	10,764,000.00	24%

Figure 8: Nordic Semiconductor and peers' operating expenses in 2022 and expressed as a percentage of their total revenues.
Source: Respective companies' 2022 annual report; Own computations.

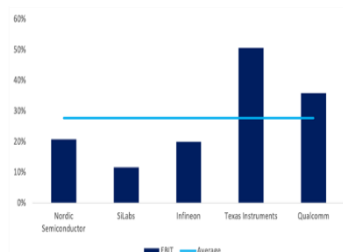


Figure 9: Nordic Semiconductor and peers' EBIT margin compared against the peers' average.
Source: Respective companies' 2022 annual reports; Own computations.

of connected devices and foster demand for semiconductors in the future²⁰. To sum up, the semiconductor industry is expected to grow so to reach \$1 trillion in revenues by 2030²¹. However, given the reasons presented above, one can acknowledge that the industry is suffering from a range of macroeconomic trends and geopolitical events that are likely to linger on its short-term growth. As a result, the analysts have projected a decrease in NOD's market share going into 2023 (from c. 0.14% to c. 0.11%), with this value is expected to increase in 2024 (cf. "Financial Statements Forecasts").

Competition

NOD's markets are highly competitive regarding price, technology solutions, and due to the threat of new Chinese entrants²², tackling some of the Bluetooth verticals in which the company is weaker.

When analyzing NOD's current competitive landscape, one focused on the firm's peers in its short-range segment, as the company's revenues are mainly derived from the sale of BLE components which, in 2022, corresponded to **c. 86%** of the company's total revenues, with NOD obtaining **c. 44%** of its revenues from its top-10 Bluetooth consumers²³. According to DNB Markets data, NOD had, in 2022, a combined market share of c. 39% of new design certifications in the BLE market, making it the industry player with most end-product certifications of the year, followed by companies such as SLAB, TXN, IFXGn, QCOM, among others, but all of which with far less certifications when compared to NOD. Certifications play an important role in this industry given that all electronic devices that oscillate above 9 kilohertz need the approval of the FCC²⁴ to be sold within the United States, otherwise the company selling them is fined and its products are recalled. Furthermore, with this consistent market share over the last five years in the BLE market, NOD is a clear market leader in terms of the number of new design certifications and number of units sold. This strong market share is backed up by NOD's diverse portfolio of Bluetooth and multiprotocol solutions, as the company sets itself apart from its competitors by offering a wide range of product alternatives, within this segment, to cater to different customer requirements.

To get a more tangible measure so to position NOD relatively to its peers, one analyzed their profitability from operations ratios. Firstly, in terms of gross margin (figure 5), NOD is slightly below the average of its peers (c. 56% compared to 58% in 2022), which means that its cost of goods sold amounted to c. 44% of revenues. NOD's gross margin is in-line with its target, as it aims to achieve a margin above 50%²⁵ at all times so that it can be more flexible in terms of customer and technology mix as it is still establishing itself in its smaller revenue segments (i.e., cellular IoT and Wi-Fi). However, due to the wafer shortage, NOD focused its wafer allocations towards tier-1 customers as it is still restrained from a high degree of customer concentration.

Considering the EBITDA margin (figures 6 and 7), NOD is placed below the average of its peers (c. 26% compared to c. 36% in 2022). Therefore, given its gross margin, one can acknowledge that NOD has incurred higher operating expenses than its peers. Indeed, IFXGn, QCOM and TXN's

²⁰ Nordic Semiconductor 2022 Credit Investor Presentation (page 11)

²¹ Burkacky, Ondrej, Julia Dragon, and Nikolaus Lehmann. 2022. "The Semiconductor Decade: A Trillion-Dollar Industry | McKinsey." www.mckinsey.com, April 1, 2022.

²² China gives chipmakers new powers to guide industry recovery – Financial Times <https://www.ft.com/content/d97ca301-f766-48c0-a542-e1d522c7724e>

²³ The Bluetooth revenue shared from this pool of consumers increased 4 percentage points when compared to the previous year.

²⁴ FCC stands for the Federal Communications Commission. Its approval is granted upon the verification that such devices do not pose any harm to the public nor interfere with other technologies.

²⁵ Nordic Semiconductor 2022 Annual Report – report from the board of directors (page 21)

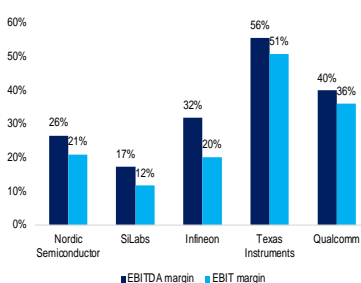


Figure 10: Nordic Semiconductor and peers' EBITDA and EBIT margins for FY22. Source: Respective companies' 2022 annual reports; Own computations.

PP&E and machinery (2022)		% total sales
NOD	57,019.00	7%
Silabs	152,016.00	15%
Infineon	5,948,121.50	39%
Texas instruments	6,876,000.00	34%
Qualcomm	5,168,000.00	12%

Figure 11: Nordic Semiconductor and peers' levels of PP&E in 2022 as a percentage of total sales. Source: Respective companies' 2022 annual reports; Own computations.

Depreciation (2022)		% total sales
NOD	44,067.00	6%
Silabs	56,595.00	6%
Infineon	1,784,972.80	12%
Texas instruments	979,000.00	5%
Qualcomm	1,762,000.00	4%

Figure 12: Nordic Semiconductor and peers' depreciation expenses in 2022 as a percentage of total sales. Source: Respective companies' 2022 annual reports; Own computations.

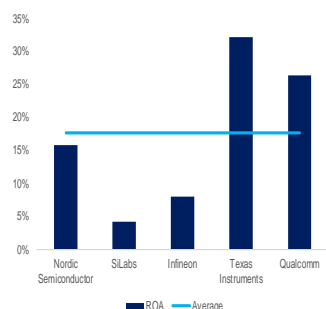


Figure 13: Nordic Semiconductor and peers' ROA compared against the peers' average. Source: Respective companies' 2022 annual reports; Own computations.

$$r_e = r_a + \frac{D}{E}(r_a - r_d)$$

Figure 14: Cost of equity formula through the WACC method. Source: Koller, Tim, Marc H Goedhart, David Wessels, and McKinsey And Company. 2020. Valuation : Measuring and Managing the Value of Companies. Hoboken, New Jersey: John Wiley & Sons, Inc.

business model is optimized to the extent that their operating costs as a percentage of sales are lower than both NOD and SLAB's as a percentage of sales (figure 8). This leads to an EBITDA margin below the average of its comparable firms. Differences in margins can be explained by the fact that even though both the analysts and NOD identify these companies as NOD's peers, some have more operations, business segments, and sources of revenue, other than the design of semiconductors. Indeed, some of them are highly diversified in the product mix they offer, namely TXN²⁶, IFXGn²⁷, and QCOM²⁸ whereas NOD and SLAB's product mix is relatively smaller. Furthermore, TXN and IFXGn are not fabless and thus integrate other verticals of the business, such as manufacture and sale. Therefore, one can see through the peers' financials, that their size does vary. NOD has yet to become a \$1 billion revenue company and SLAB has only accomplished that in 2022, whereas the remainder have recorded over \$1 billion in sales for the last five years.

Regarding the other margins (i.e., EBIT and Net margin), NOD places itself in the average of its peers and, as of last year, TXN's profitability margins are the highest within the industry by a great amount (figures 9 and 10), which is a result from its higher operating leverage in comparison to the remaining peer companies. It is also worth mentioning that the companies that do have in-house production have higher depreciation and amortization expenses, in relative terms, given their greater PP&E needs for factories and machinery (figure 11). Thus, the decrease from the EBITDA to the EBIT margin is usually more accentuated than NOD's, with these values corresponding to depreciation as a percentage of sales (figure 12). However, this does not apply to TXN as it benefits from a reduction in depreciation as a result of government incentives²⁹ in the U.S. (where c. 61% of their facilities are located).

Furthermore, concerning NOD's Return on assets (ROA), one can see that it has been substantially improving over the past five years (increasing from c. 3% to c. 16%), which implies that NOD is increasingly more able to make an effective and efficient use of its capital resources. Nonetheless, it is still below the industry's average (figure 13) and, once again, TXN shows the highest ROA (c. 32%), which shows prosperity and growth potential given the reason previously presented.

Furthermore, NOD's capital structure is characterized by having no issued debt. Indeed, it presents a negative net debt due to having more cash than debt-related items on its balance sheet. Bearing this in mind, it is plausible to assume that (cf. "Intrinsic Valuation"), since NOD has less liabilities towards its creditors, it poses less risk for potential ones. Hence, when compared to its peers, NOD presents a lower cost of debt by improving its credit rating. However, when it comes to the company's cost of equity, one can conjecture that it is higher than the one of its peers (figure 14), with this being a result of it not being such a mature and stable company, meaning that it is still experiencing a phase of substantial growth and, as such, shareholders demand a higher return for their investment so to compensate for the risk they are bearing.

²⁶ Texas Instruments offers other products such as computer software, graphing calculators, amplifiers, data converters, motor drivers, sensors, interface...

²⁷ Infineon offers other products such as sensors, wireless connectivity, transceivers, memories.

²⁸ Qualcomm offers other products such as wireless networks, smartphones, laptops, tablets, cameras...

²⁹ Incentives related to the acquisition or construction of fixed assets are recognized as a reduction in the carrying amounts of the related assets and reduce depreciation expense over the useful lives of the assets. Cited from "Earnings & Annual Reports | Investor Relations | TI.com." n.d. [Investor.ti.com](https://investor.ti.com).

Profitability, liquidity & capital structure

Over the scope of analysis, NOD has been able to maintain its gross margin at around 50%. Hence, the increasing cost of raw materials has been offset by the increasing revenue of its core operations. More specifically, in the BLE segment in which it keeps on thriving (revenue CAGR₂₀₁₈₋₂₀₂₂ of c. 38%). In fact, excluding the period from 2018 to 2019 (as the shortage period only begun in 2019), the cost of materials per unit shipped has kept on increasing, recording a peak in 2022 with a CAGR of c. 8%. However, the gross margin is expected to increase given that cellular IoT revenues are expected to grow in the future³⁰ and the proprietary segment, which had only experienced an increase of c. 27% and c. 10% during the pandemic years (2020 and 2021) is most likely to liquidate now that it recorded a decrease of c. 10% in 2022. What is more, one can see that it has been becoming less significant throughout the analysis period given that, in 2018, it represented almost 21% of total sales and only c. 10% in 2022.

On the other hand, both the EBITDA and the EBIT margins have increased during the observation period (figure 15) as, even though net payroll expenses and depreciation kept on increasing, with a CAGR of c. 23% and c. 27% respectively, the increase in revenues was able to mitigate such increment.

Concerning **liquidity** (figures 16, 17, and 18), NOD can be perceived as a very liquid company given its high, and above-average current, quick, and cash ratios³¹ when compared to its peers with two exceptions: (i.) the FY 2019 as NOD decreased its current assets as a result of a decrease of its cash holding by c. 13% (for the remaining years of the analysis period the value of cash and cash equivalents presents an increasing trend with a CAGR₂₀₁₉₋₂₀₂₂ of c. 61%) so to invest in the development of the Cellular IoT technology (invested capital increased by c. 39% from 2018 to 2019) and; (ii.) the FY 2022 as the liquidity ratios are slightly below the average of the comparable firms only because SLAB had an atypical year given that the value of its total assets increased by c. 129% in 2021 due to having sold discontinued operations³², thus boosting the average of the comparable firms. As such, one should focus its analysis on the median of the peers as it is not influenced by outliers. When comparing NOD's liquidity ratios with the median of the comparable firms for 2022, one can see that NOD outperforms them (figure 19).

Firstly, it is important to mention that NOD has a current ratio above 1.00 throughout the whole analysis period (c. 3.81 for 2022) which means it complies with the minimum short-term financial equilibrium rule³³. This means that it is, theoretically, capable of meeting its short-term liabilities only recurring to short-term assets. However, this might not actually happen in practice given that there may be restrictions on the execution of current assets depending on the firm's financial situation. Nevertheless, having a current ratio above 1.00 is a good indicator for liquidity purposes.

Secondly, NOD presents a quick ratio of c. 3.23 for FY 2022. The main difference between this ratio and the current ratio is that, instead of relying on current assets, it is based on the current available cash flow, i.e., the assets that are easier to liquidate³⁴. Thus, it is plausible to assume

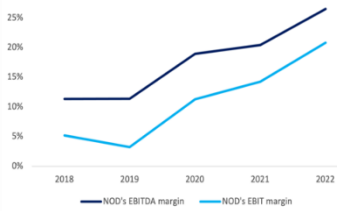


Figure 15: Nordic Semiconductor EBIT and EBITDA margins evolution. Source: Respective companies' 2022 annual reports; Own computations.

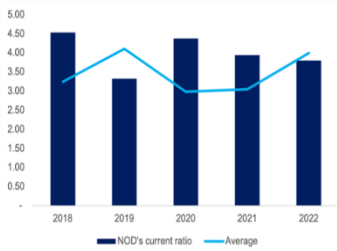


Figure 16: Nordic Semiconductor's current ratio compared against the peers' average. Source: Respective companies' annual reports from 2018 to 2022; Own computations.

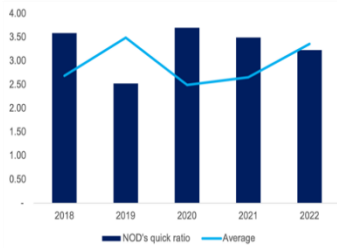


Figure 17: Nordic Semiconductor's quick ratio compared against the peers' average. Source: Respective companies' annual reports from 2018 to 2022; Own computations.

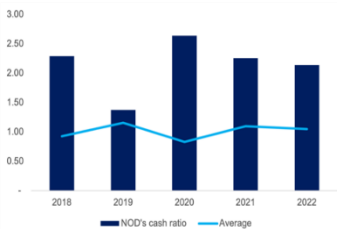


Figure 18: Nordic Semiconductor's cash ratio compared against the peers' average. Source: Respective companies' annual reports from 2018 to 2022; Own computations.

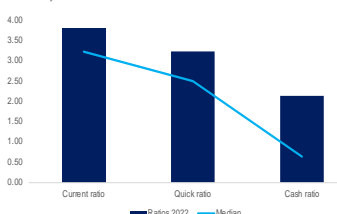


Figure 19: Nordic Semiconductor's current, quick and cash ratios compared against the peers' average for FY22. Source: Respective companies' annual reports from 2018 to 2022; Own computations.

³⁰ NOD expects that the revenue from the Cellular IoT to increase given its amount of pre-commercialization projects with "high volume potential". – [Nordic semiconductor 2022 annual report](#).
³¹ NOD's cash ratio is always above the average of its comparable firms given that it has a higher level of cash holding, in relative terms, than the rest of its peers.
³² In 2022, SLAB sold discontinued operations which led to a net income of 2,117,399 for that year. This represents a c. 16,797% increase when compared to the previous year.
³³ The minimum short-term financial equilibrium rule is an empirical rule that implies that whenever a company has a current ratio equal or above one, it is capable of meeting its short-term financial obligations only through short-term assets.
³⁴ The quick ratio usually excludes current assets whose execution may be hinged given the firm's financial position. These assets include inventories, for instance.

that NOD can meet its short-term obligations through its short-term assets in case it is unable to sell its inventories.

Lastly, a cash ratio of c. 2.14 in 2022 also poses a positive signal, implying that the firm can meet its short-term obligations through its available excess cash. In a way, having a larger amount of cash and cash equivalents allows companies to have better access to credit when needed (as they can prove they are liquid enough to meet its obligations) and lowers the level of net debt.

Furthermore, regarding what concerns NOD's **capital structure** ratios, given that the company has negative net debt, its gearing ratio, debt-to-equity, and debt-to-EBITDA ratios are negative (c. -1.42, c. -0.59, and c. -1.66, respectively for 2022). These ratios are important to understand how a company funds its operations: (i.) through the gearing ratio one concludes that NOD does not have any invested capital financed through debt; (ii.) the debt-to-equity ratio shows the portion of the company that is financed through debt in contrast to the one financed through equity, which is negative and; (iii.) the debt-to-EBITDA ratio compares the level of debt with the level of activity of the firm rather than its external financing, which is negative, because NOD has larger cash holding than debt servicing.

Additionally, both NOD's solvency and financial autonomy ratios (c. 3.03 and c. 0.75 for 2022, respectively) indicate independence from creditors. Such a high solvency ratio implies that the firm can meet its financial obligations through the capital that has been either invested or generated by it. Furthermore, a greater financial autonomy ratio hedges the firm against increasing interest rates as it does not rely heavily on creditors.

Moreover, both in 2022 and 2021, NOD's board of directors was authorized to direct a share capital increase to selected investors up to an amount 19,200,000 shares issued with a total par value of NOK 192,000³⁵ if it wishes to raise capital quickly. This is the method preferred by NOD, when it wishes to strengthen its shareholder's equity, carry out a merger or acquisition, among others, so to preserve its capital structure. However, it is not the preferred method in general as the value of the company could increase if debt was issued (through the present value of interest tax shields³⁶). One question that arises from this analysis is why NOD keeps on having such high levels of excess cash instead of distributing it among its shareholders. The most valid explanation for said query is that the company's management finds this capital structure to be adequate for NOD's long-term goals to be met³⁷. The company prioritizes providing returns to its shareholders in the form of increasing the value of their shares rather than through the distribution of dividends. The excess cash currently held by NOD is intended to be (re)invested first and foremost in R&D and CAPEX investments. However, NOD intends to distribute dividends³⁸, based on its excess cash, in the long-term since its cash generation is expected to increase so that the company can pursue and eventually achieve its strategic priorities and materialize growth opportunities.

Additionally, the analysts have computed another metric to measure the profitability, prosperity, and overall growth for this specific firm – profitability, i.e., total comprehensive income, per R&D employee. One can acknowledge the relevance of such ratio given that NOD is a fabless company and most of its invested capital reverts to R&D, namely human capital, since it does not

³⁵ This authorization is limited to 10% of NOD's share capital and the value at which it buys its shares back is capped between the par value and NOK 300 - Nordic Semiconductor 2022 Annual report – report from the board of directors (page 59). Furthermore, at the exchange as of the 17th of May, NOK 192,000 corresponds to c. USD 17,936.

³⁶ Debt issuance decreases the value of income taxes by decreasing the amount of taxable income.

³⁷ According to NOD's management team, a strong balance sheet, high equity ratio, and substantial liquidity are needed to meet its growth ambitions.

³⁸ The last time NOD has distributed dividends was in 2011.

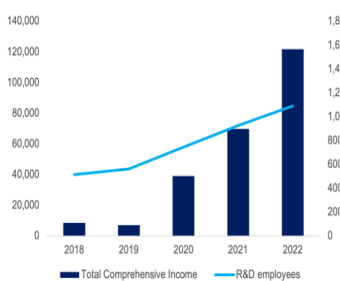


Figure 20: Nordic Semiconductor's total comprehensive income and number of R&D employees. Source: NOD's annual reports from 2018 to 2022; Own computations.

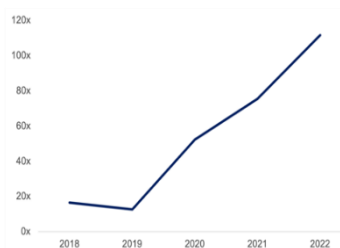


Figure 21: Nordic Semiconductor's profitability per R&D employee ratio. Source: NOD's annual reports from 2018 to 2022; Own computations.

have high machinery nor factory needs. In fact, in 2022, the percentage of both right of use assets and fixed assets³⁹ combined solely represents c. 7% out of total assets, whereas the average of the peers which have in-house production is c. 20%. When evaluating this ratio, one concludes that NOD is progressively becoming more efficient, as the amount of profit attributable to each employee is increasing (figures 20 and 21). The analysts have considered this ratio to be a good proxy when assessing whether NOD should keep investing in new projects and it also serves as a measure for potential investors to determine the attractiveness and overall stability of the company. Being mindful of that, this ratio shows that NOD is healthy and prosperous as it keeps on growing, hence implying a sustainable business model and efficient operations' management.

The return on invested capital (ROIC) was also computed as standard practice. However, given that NOD is a fabless semiconductor company, it relies on third-parties to produce the semiconductors it designs and sells. As such, when thinking about its invested capital (IC) needs, one acknowledges that it does not require as much IC as a manufacturing company to carry out its operations or to exploit growth opportunities⁴⁰. As such, the analysts have considered this ratio to have less materiality when evaluating NOD's profitability.

NOD's ROA increased from c. 3% to c. 16% in the last five years as a result of NOD's increase in assets through the on Cellular IoT⁴¹ technology and given that it was also able to capitalize on it starting on 2020 even though it only represented c. 2% of total sales for that same year and c. 3% for the following ones. Moreover, one can perceive the return on equity ratio (ROE) as being equivalent to the ROA⁴² and thus illustrates the efficiency of the company to generate profit from its equity financing. Considering NOD's negative net debt, the ROE will be greater than the ROA although it will still display the same trend: increasing over the analysis' scope (from c. 3.84% to c. 20.87%), inferring that the company is making a more efficient use of its capital resources.

Investment risks summary

The semiconductor industry poses several risks that are prevailing in all companies that integrate said industry. Some of them were already mentioned before (cf. "Industry Overview"), with this section entailing a more detailed analysis on the two most material risks that affect NOD's business.

Cyclical nature of the semiconductor industry

NOD's industry is in constant development as new and innovative technologies frequently emerge. As the needs of end-consumers change, it is important that NOD can sustain a high level of innovation so that its products do not become obsolete upon the development of more recent and faster technologies and applications. This implies that semiconductors have a relatively short life-cycle⁴³. Because of that, downturns are common in the industry, usually being a result of inventory build-up, which leads companies to decrease their prices and ultimately incurring lower revenues. However, the opposite also occurs, whenever there is a high demand for semiconductors, there are supply shortages, driving prices up and boosting revenues. As a result,

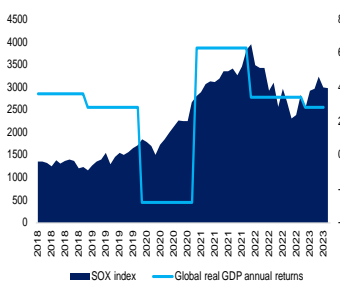


Figure 22: SOX index plotted against the global real GDP growth rate from the January 2018 until May 2023. Data retrieved from Yahoo finance and Macrotrends

³⁹ Even though NOD outsources its testing, it also has testing facilities for own R&D purposes.

⁴⁰ NOD's IC has only amounted to c. 31% out of the total assets in 2022 whereas the average of its peers amounted to c. 127% for the same year.

⁴¹ Cellular IoT – NOD's 2021 annual report (page 10)

⁴² ROE is measured by dividing comprehensive result by equity and equity can be attained by subtracting debt from total assets.

⁴³ Nordic Semiconductor 2022 Annual Report – Risk Management (page 65)

one can say that this industry is rather cyclical and, besides this, there is another main trigger for such cyclicity: economic growth.

Periods of high demand tend to occur whenever economic growth, i.e., GDP, is high as it leads to industrial growth thus increasing the need for new IT⁴⁴ products, most of which include semiconductors in their assembly process. Contrastingly, during periods of economic slowdown, the demand for those products tends to decrease, alongside with consumers purchasing power and thereafter, overall consumption. Figure 22 depicts the correlation between the SOX index and GDP. One can conclude that during the period of 1998-2000 as PCs and other devices started to become integrated in several industries and appliances, the SOX experienced an increase, whereas, during the period of financial crisis (2008-2009) the index decreased due to the decreasing need for tech products by end-consumers. Nonetheless, in its annual reports, NOD discloses that it attempts to maintain a close communication with its consumers so to better predict and understand the market demand. However, the buyer group has a high negotiation leverage, given that most of NOD's products are standardized (or undifferentiated), as switching costs tend to be low. However, despite differentiation being limited due to the nature of semiconductors, NOD is constantly trying to be ahead of its competitors when it comes to innovation so to preserve customer loyalty. Such can be observed through NOD's R&D efforts (the value of invested capital on core operations amounted to c. \$235m in 2022 and has grown at a CAGR of 19% throughout the analysis period), the fact that it developed and started the commercialization of two new product segments during the analysis period (Cellular IoT and Wi-Fi⁴⁵) and through NOD's market share on BLE products as it is still the market leader for said technology.

Supply chain and geopolitical risk

NOD's supply chain is complex, with many interdependent parties and with its raw materials and suppliers scattered across the whole globe. It comprises several stages such as design, harvesting of raw materials, manufacturing, testing, packaging, and shipping (figure 23).

Firstly, when it comes to raw materials⁴⁶, semiconductors mainly rely on two of them: germanium⁴⁷ and silicon, which are used due to their capacity of regulating electrical current. However, NOD solely operates with silicon, which is the main element present in its wafers. As mentioned, in the past couple of years, the silicon wafers' shortage has been an issue that has impacted the industry, which affected NOD's most efficient and most profitable sector – BLE (cf. "Industry Overview"). The main driver for this shortage was the global COVID-19 pandemic as the demand for semiconductors that would be integrated in PCs, smartphones, routers, and recreational products increased due to lockdowns and in-home offices. This can be observed through the Dow Jones U.S. Technology Index, which increased by c. 102% from May 2020 until then end of 2021 (figure 24). As a result, supply was not enough to meet demand, thus resulting in a shortage.

In addition, there were also a range of extraordinary events that have contributed for this shortage such as: (i.) the 2022 ice storm in Texas that led foundries, such as Samsung and Infineon, to



Figure 23: Illustrative image of NOD's supply chain.
Source: [NOD's website](#).



Figure 24: Dow Jones U.S. Technology Index from May 2018 until May 2023.
Source: [Yahoo Finance](#).

⁴⁴ IT stands for Information Technology and is defined as: "the use of any computers, storage, networking and other physical devices, infrastructure and processes to create, process, store, secure and exchange all forms of electronic data" - [Castagna, Rich, 2021. "What Is Information Technology? Definition and Examples." SearchDataCenter, August 2021.](#)

⁴⁵ In 2018 and 2020, NOD included Cellular IoT and Wi-Fi solutions for long- and medium-range connectivity. - [NOD's annual reports from 2018 and 2020.](#)

⁴⁶ "Semiconductor Manufacturing Process: How Are Semiconductor Chips Made?" 2023. <https://www.mrlcg.com>, February 15, 2023

⁴⁷ Germanium is classified as a metalloid, falls in the same category and group as carbon but also as tin, for instance.

shut down⁴⁸; (ii.) Renesas Electronic, another foundry which operates in Japan, caught fire in 2021 and was forced to halt production from March until June of the same year⁴⁹; (iii.) labour shortages due to lockdowns in China⁵⁰; (iv.) a cargo ship stuck in the Suez Canal⁵¹, thus delaying the shipment of semiconductors, among others.

As a result of this shortage, the price of these materials increased. Indeed, NOD registered a CAGR₂₀₁₈₋₂₀₂₂ of c. 26% for its cost of materials. However, just like most of the firms in the industry, NOD's revenues kept increasing due to the increment in its average selling prices (CAGR₂₀₁₈₋₂₀₂₂ of c. 5.3%) in an attempt to counteract and offset the increase in costs. Currently, the industry is still recovering from this shortage, with players from all levels of the supply chain still being affected. Given that NOD must rely on third-parties to manufacture its products, one can conclude that there is a large dependence risk for the company, being fabless. Foundries tend to be mostly located in Asia, meaning that they are not only incurring risk factors related to supply constraints but also geopolitical ones, which ultimately can disrupt supply chains and affect NOD's operations. Indeed, NOD's main supplier is the Taiwan Semiconductor Manufacturing Company (TSMC). This company has a market share of c. 58.5%⁵² as of 2022 and is headquartered in Taiwan, which poses a risk given its current trade tensions with China. On the other hand, China's trade tensions with the U.S. also pose negative prospects given that China is the world's leading supplier of silicon (c. 69% of total silicon materials in 2020⁵³).

To solve such problem, some larger firms in the industry are planning to relocate the factories in which their semiconductors are manufactured, moving them from Asia to the U.S.⁵⁴. Furthermore, both the Chips for America Act⁵⁵ (2021) and the EU Chips Act⁵⁶ (2022) serve as a protection implemented as a government regulation to try to minimize supply chain disruptions.

Intrinsic Valuation

DCF: cost of debt, cost of equity, and WACC

Unlike its peers, NOD does not have any issued debt (such as bonds) nor interest-bearing debt (such as loans). Instead, its non-current liabilities mainly consist of leases (which amounted to c. 3% in 2022). Therefore, given its negative net debt, the analysts assumed the risk-free rate as the company's cost of debt, as the possibility of NOD failing to comply with its obligations is close to zero when considering its liquidity position. As such, one considered 3.88%⁵⁷ as the cost of debt and, consequently, as the risk-free rate. This value was retrieved from the 10-year US treasury bond as the obligations backed by the U.S. government are not expected incur default (virtually posing zero risk) and have the same currency as NOD's cash flows. The 10Y treasury was chosen over the 30Y one or another with the same maturity as the forecasts, given the nature of the industry and segment. In other words, given that the tech industry is known to be fast-paced as innovation is its main driver, the analysts have found the 10Y yield on a U.S. treasury

⁴⁸ "Texas Power Failures Shut down Chip Factories, Which Could Send Shock Waves up the Supply Chain." n.d. *Fortune*.

⁴⁹ *Reuters*. 2021. "Japan's Renesas Sees Fire-Damaged Chip Plant back to Full Capacity by Mid-June." *Reuters*, June 1, 2021, sec. Technology.

⁵⁰ *Washington Post*. 2022. "Everything Is Halted: Shanghai Shutdowns Are Worsening Shortages." April 26, 2022.

⁵¹ *Yee, Vivian, and James Glanz*. 2021. "How One of the World's Biggest Ships Jammed the Suez Canal." *The New York Times*, July 17, 2021, sec. World.

⁵² *Alsop, Thomas*. 2023. "Top Semiconductor Foundries Market Share Worldwide 2017-2019 | Statista." *Statista*, Statista, March 14, 2023.

⁵³ *U.S. Geological Survey*. n.d. "Silicon Statistics and Information | U.S. Geological Survey."

⁵⁴ Apple's semiconductors will still be manufactured and managed by the TSMC, however, they will be produced in a new factory in the U.S. to avoid risks that operations in Asia may impose (trade tensions, lockdown constraints...) *Leswing, Kif*. 2022. "Tim Cook Says Apple Will Use Chips Built in the U.S. At Arizona Factory." *CNBC*, December 6, 2022.

⁵⁵ "This bill establishes investments and incentives to support the U.S. semiconductor manufacturing, research and development, and supply chain security".

⁵⁶ "The European chips act will bolster Europe's competitiveness and resilience in semiconductor technologies and help achieve both the digital and green transition".

⁵⁷ Data retrieved for the 30th of December 2022. - *Board of Governors of the Federal Reserve System (US)*. 1962. "10-Year Treasury Constant Maturity Rate." *FRED, Federal Reserve Bank of St. Louis*, January 2, 1962.

Equity beta computations		to be more tradeable and liquid than the 30Y one.
NOD's raw β_E	1.85	NOD's cost of equity was computed based on its historical returns between the end of FY 2019 and the end of FY 2022. Moreover, the Morgan Stanley Capital International world index (MSCI) was chosen as a proxy for the market portfolio ⁵⁸ . Furthermore, when NOD's historical returns were regressed against the MSCI world index returns, it presented a raw equity beta of c. 1.85, which is relevant at the 95% confidence level (with a confidence interval of [1.59, 2.12]) and with an R-squared of about 55%, which means that 55% of the variation observed in the past returns are explained by the regression model.
NOD's raw unlevered β_E	1.96	
Industry β_E (median)	1.24	
NOD's relevered β_E	1.17	
Bloomberg-adjusted β_E for NOI	1.11	

Figure 25: Summarized NOD's equity beta assumptions.
Source: Own analysis.

Terminal value assumptions		
WACC	11.16%	used to relever the NOD's equity beta, which yielded a value of approximately 1.17. Thereafter, the Bloomberg-adjusted beta ⁶¹ was computed and a beta of roughly 1.11 was attained. This smoothing process is made to smooth the raw regression estimates towards one, as theoretically equity betas converge to one in the long-term, given its mean-reverting tendency (Figure 25).
Global GDP growth rate	3.48%	
Terminal real growth rate	-1.83%	
Terminal nominal growth rate	0.22%	

Figure 26: Summarized NOD's terminal value assumptions.
Source: own analysis.

Lastly, one computed NOD's cost of equity through the Capital Asset Pricing Model⁶² (CAPM) method, which yielded a value of c. 10.29%. To apply this method, the above-mentioned risk-free rate of 3.88% was chosen and one has considered a market risk premium (MRP) of 5.75%⁶³ as suggested by KPMG⁶⁴.

Furthermore, the enterprise value (EV) was computed through NOD's market capitalization⁶⁵ as of FY 2022 and the book value of net debt for the same period.

To sum up, after considering a corporate tax rate of 22.00%⁶⁶, through the CAPM, a value of c. 11.16% was attained for the company's weighted average cost of capital (WACC). These values are applicable in all scenarios as the inputs are retrieved from historical data (Figure 26).

Terminal value

The analysts have chosen to make the forecasts up until 2040, considering the fast-moving pace of the tech industry and consequently, tech companies. As a player in this industry, NOD's prospects are those of a company that is still expected to grow over the medium-term (cf. "Financial Statements Forecasts"), making it necessary to extend the forecasting period so to stabilize growth prospects in the long-term.

Through the valuation model, one can observe that, by 2040, the real growth rate on the

⁵⁸ The MSCI world index is representative of the market portfolio as it "represents large and mid-cap equity performance across 23 developed markets countries" - "[MSCI World Index - MSCI](https://www.msci.com/)." 2019. [Msci.com](https://www.msci.com/), 2019. Additionally, a standard practice would be to use the Standard & Poor's 500 (S&P500). However, this index only tracks the 500 best performing stock in the U.S. and since NOD is listed in the Oslo stock exchange, the MSCI world index was considered a better fit.

⁵⁹ The Dow Jones U.S. Semiconductors Index (DJUSSC), a member of the Dow Jones Global Indices® family, is designed to measure the performance of U.S. companies in the semiconductors subsector.

⁶⁰ S&P Select Industry Indices are designed to measure the performance of narrow GICS® sub-industries. The Index comprises stocks in the S&P Total Market Index that are classified in the GICS global industry classification standard) semiconductor sub-industry. GICS = global industry classification standard
61 Chapter 15 - "Estimating the Cost of Capital" McKinsey's Valuation book, 7th edition

⁶² The CAPM states that the difference between expected returns depend on the covariance between them (β) and the market portfolio, given that specific risk can be diversified away. As such, the following formula was used so to compute the return on equity: $r_e = r_f + \beta_e * MRP$

⁶³ As per 31 December 2022

⁶⁴ This value was attained through the implied MRP methodology which tracks the "implied equity returns for a number of major equity markets over time" such as the S&P 500 and the FTSE. Thus, it incorporates expectations, market developments and can be retrieved from the data available in the market. (<https://kpmg.com/nl/en/home/topics/equity-market-risk-premium.html>)

⁶⁵ As per 30 December 2022, NOD had 191,575 thousand shares outstanding and a price per share of \$16.7305, which yielded a market capitalization of \$3,205,140 (in thousands)

⁶⁶ [PwC](https://www.pwc.com/worldwide-tax-summaries), 2021. "Worldwide Tax Summaries Online." [Taxsummaries.pwc.com](https://www.pwc.com/worldwide-tax-summaries), 2021.

unlevered FCFs has stabilized (starting in 2036), reaching a value of c. -1.83%. This negative growth rate implies that the company is decreasing in profit. In fact, even though total revenue is still increasing in the predicted stable period (2036 to 2040), excluding the year of 2040 in which revenues decrease as a result of a decrease in the worldwide semiconductors' revenues combined with a decrease of NOD's market share, the company's total comprehensive income starts decreasing by 2039 for the base case, in 2036 for the bear case and only by 2040 for the bull case. This is a result of a higher amount, in absolute terms, of net payroll expenses which, for the base case, are expected to increase by c. 3.5% between 2039 and 2040 when compared to the previous year due to the increasing cost per employee driven by the compounding effect of inflation.

Subsequently, the Fisher's equation⁶⁷ was used to compute the nominal value of the company's terminal growth rate (c. 0.2%). Thereafter, a growing perpetuity was applied to determine the terminal value on the operating FCF.

Furthermore, the reinvestment rate of the core business is at c. -13% by the end of the forecasted period, which indicates that it is no longer profitable to invest in the company as it is not expected to create value going into the future. This goes in line with NOD's negative real growth rate of its core FCFs, i.e., c. 9%, and thus implies that the company will not be able to attract external funding.

Lastly, note that both the WACC and the global GDP growth rate are above the terminal nominal growth rate for all scenarios (figure 27), which implies that NOD will not outgrow the global economy, hence the value computed can be considered a fair and feasible proxy of the terminal value of the company.

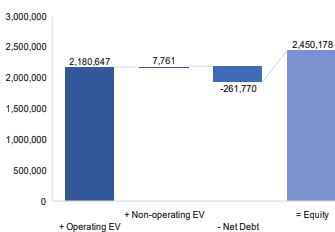


Figure 27: EV-to-Equity bridge from NOD's DCF.
Source: own analysis

Discounted cash flow valuation & conclusions

Most firms, similarly to NOD, disclose a financing strategy such as their debt-to-equity target ratio. Whenever a firm opts for a stable capital structure, the most suitable valuation model is the discounted cash flow method (DCF). This model was chosen to value NOD, given that it intends to maintain a target capital structure (equity ratio of at least 50%) which implies that the cost of capital, measured by the WACC, is constant for all the analysis years of the forecast. Once NOD is already complying with this target ratio (with an equity ratio of c. 75% by the end of 2022), the weights used for debt and equity in regards to enterprise value (EV) were the ones the company had as of the end of FY 2022, i.e., market capitalization and book value of debt.

Therefore, the value of the company's operating EV should be measured by the present value of its future operating FCFs, adjusted for its WACC and long-term growth rate. After computing NOD's operating EV through the DCF, one estimated the EV-to-equity bridge to compute its share price as of FY 2023 (Figure 52). The operating EV (i.e., c. \$2.2m) was then adjusted with non-core and financing operations to best represent NOD's market value. Regardless, both were obtained through book value captions (extracted from the forecasted balance sheet), given that on one hand, the value of the non-operating EV is less than 1% of the value of the operating EV and is thus not so significant and on the other hand, since debt is not traded (no issued debt).

⁶⁷ Describes the relation between nominal and real rates through inflation.

Sensitivity analysis

To better understand and assess how some factors might affect NOD's value and, consequently, its share price, one has conducted a sensitivity analysis (*Appendix*) that shows how the final investment decision would be altered in case some factors were to be changed: growth rate and cost of capital. Furthermore, given how important R&D is for the future of NOD (which mostly consists of human capital), another sensitivity analysis was conducted to evaluate and determine how sensitive the profitability per R&D employee ratio is to the average cost per employee.

Firstly, one can see how the growth rate impacts the price per share given that, keeping everything else constant and a growth rate range from 0.07% to 0.52%, the price per share varies between \$12.78 and \$12.95 (base case), i.e., a change of 0.45 p.p. in the growth rate leads to a change of 1.34% in the share price. Moreover, by solely changing the cost of capital between a range of 10.86% to 11.56%, the value of the share price would be comprised between \$12.45 and \$13.14 as the WACC rate decreases, i.e., a change of 0.70 p.p. in the WACC leads to a share price change of 5.55%. Hence, being more significant and of greater impact than the change in growth rate. Nevertheless, none of these changes alter the investment decision for the base case as the shareholders' return is always above 10%. Furthermore, the investment decision does not change under any scenario, (it will always be "Buy" for the bull case and "Sell" for the bear case). Given these results, one concludes that the scenario chosen highly influences the investment decision as the share price is greatly sensitive to the assumptions attributed to each scenario (cf. "Discounted cash flow conclusions") and not so sensitive to the changes in both the WACC nor the growth rate.

Moreover, keeping the number of R&D employees constant and equal to 2,862, (i.e., 76% of NOD's employees in 2040 working in R&D), as one increases (decreases) the average cost per employee by \$10, the profitability ratio changes by c. 4%. However, as one moves into higher average costs, the change in the profitability ratio becomes slightly more accentuated (going from c. -3.65% to c. -3.79%, to c. -3.94 for the average costs of 195, 205, and 215, respectively).

NORDIC SEMICONDUCTOR, ASA

COMPANY REPORT

SEMICONDUCTOR INDUSTRY

17TH MAY 2023

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NORDIC SEMICONDUCTOR: STORM IN SIGHT...

... DELAYING A REBOUND IN GROWTH

- Nordic Semiconductor's equity story is dictated by global industry trends, which are capping the company's financial results, forcing it to grow at lower rates than it has done in the past (currently, c. -21% revenue growth year-on-year). Weaker demand from end-consumers, especially in China, and persisting supply chain constraints, are some of the trends preventing Nordic to reach its long-awaited objective of becoming a \$1 billion revenue company.
- Through this paper, one performed three valuation methods: discounted cash flow, multiples, and precedent transactions. While this paper's investment recommendation is based on Nordic's intrinsic valuation, the relative valuation methods signalled disparities between NOD and its most similar peer group, i.e., companies within the Bluetooth Low Energy segment (c. 86% of the firm's revenues in 2022) and led one to acknowledge how NOD is one of lowest valued companies of said group.
- Nordic's 2023 outlook, built upon insufficient visibility over the year, has not been transmitting confidence to investors, with the company's share price currently recording a c. 42% decrease since the beginning of the year.
- Coverage is initiated at Hold, supported by a target price of \$10.94, obtained through the discounted cash flow valuation, implying a return of c. 6.75%.

Company description

Nordic Semiconductor is a Norwegian fabless semiconductor company, which specializes in wireless communication technologies that use Bluetooth, cellular IoT, and Wi-Fi, and which power the Internet of Things (IoT). It is market leader of Bluetooth Low-Energy solutions, with a market share of c. 39%, which enhances its leadership position in terms of number of new design certifications and number of units sold.

Recommendation: **HOLD**

Total Shareholder Return 6.75%

Price Target FY23: **10.94 \$**

Price (as of 12-9-Jul-23) **10.25 \$**

Reuters / Refinitiv: NOD.OL, Bloomberg: NOD:NO

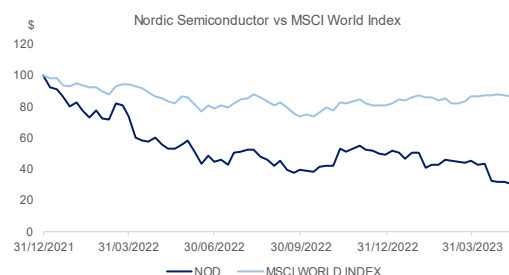
52-week range (\$) 9.86-17.83

Market Cap (\$m) 1.9532

Outstanding Shares (m) 190.959

IPO Date 25th April 1996

Source: Refinitiv



Source: Refinitiv; 31st December 2021 as base quarter (100)

(Values in \$ millions)	2022	2023E	2024E
Revenues	776.7	668.0	842.0
EBITDA	205.7	91.0	160.0
EBIT	161.6	43.0	105.0
Net profit	122.34	36.0	86.0
EPS	0.64	0.19	0.45
DPS	0	0	0
Net Debt	-372.7	-261.2	-382.9

Source: Refinitiv, Arctic Securities as contributor

THIS REPORT WAS PREPARED EXCLUSIVELY FOR ACADEMIC PURPOSES BY LEONOR FERREIRA AND MARGARIDA DUARTE, A MASTER IN FINANCE STUDENT OF THE NOVA SCHOOL OF BUSINESS AND ECONOMICS. THE REPORT WAS SUPERVISED BY A NOVA SBE FACULTY MEMBER, ACTING IN A MERE ACADEMIC CAPACITY, WHO REVIEWED THE VALUATION METHODOLOGY AND THE FINANCIAL MODEL. (PLEASE REFER TO THE DISCLOSURES AND DISCLAIMERS AT END OF THE DOCUMENT)

Table of Contents

COMPANY OVERVIEW	3
PRODUCT OVERVIEW	3
VALUE CHAIN.....	4
INNOVATION AS A CORE PILLAR	4
REVENUES OVERVIEW BY GEOGRAPHY.....	6
CURRENT FINANCIAL POSITION AND FUTURE PROSPECTS	6
INDUSTRY OVERVIEW	7
COMPETITION.....	10
PROFITABILITY, LIQUIDITY & CAPITAL STRUCTURE.....	12
INVESTMENT RISKS SUMMARY.....	16
CYCLICAL NATURE OF THE SEMICONDUCTOR INDUSTRY	16
SUPPLY CHAIN AND GEOPOLITICAL RISK	17
FINANCIAL STATEMENTS FORECASTS.....	18
INCOME STATEMENT CAPTIONS: ANALYSIS AND FORECASTS.....	19
BALANCE SHEET CAPTIONS: ANALYSIS AND FORECASTS.....	23
LONG-TERM VALUE DRIVERS.....	24
INTRINSIC VALUATION	24
DCF: COST OF DEBT, COST OF EQUITY, AND WACC	24
TERMINAL VALUE	26
DISCOUNTED CASH FLOW VALUATION & CONCLUSIONS	27
RELATIVE VALUATION	28
TRADING MULTIPLES.....	28
PRECEDENT TRANSACTIONS	30
SENSITIVITY ANALYSIS	31
INVESTMENT RECOMMENDATION	32
APPENDIX	33



NORDIC[®]
SEMICONDUCTOR

Key management:

Svann-Tore Larsen, CEO & President
Pål Elstad, CFO
Svein-Egil Nielsen, Chief Technology Officer & EVP R&D and Strategy

Ownership structure:

c. 191m shares outstanding. Government Pension Fund Norway (8.9%), Capital Research and Management (6.0%), DNB Asset Management (4.9%), Danske Bank (3.1%), the Vanguard Group (2.9%). 20 largest shareholders hold 52.1%. Free float shares correspond to c. 47.9%.

Figure 1: NOD's corporate structure. Source: [NOD's Annual Report of 2022](#).

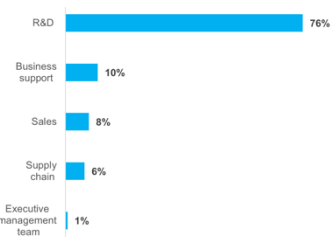


Figure 2: Employees' headcount by function. Source: [NOD's Annual Report of 2022](#).

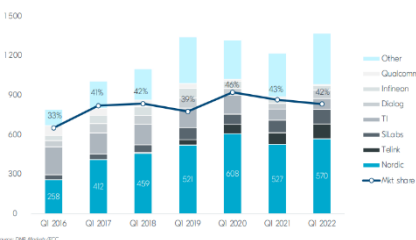


Figure 3: Evolution of NOD's market share within the BLE segment. Source: [NOD's Creditor Investor Presentation](#).

Company overview

Established in 1983 in Trondheim, Nordic Semiconductor (NOD) is a Norwegian **fabless semiconductor** company¹ (Figure 1), which specializes in **wireless communication** technologies powering the **Internet of Things (IoT)**². With over 1,500 employees across the world, of which c. 76% work in R&D (Figure 2), NOD is a **market leader in the short-range IoT**³ due to its award-winning **Bluetooth Low Energy (BLE)**⁴ solutions that pioneered the ultra-low power wireless segment⁵, in which it currently detains a **market share of c. 39%**⁶ (Figure 3).

Throughout the years, NOD expanded its connectivity portfolio with **Bluetooth** and multiprotocol technologies⁷ to complement its ultra-low power proprietary solutions, with which it started to operate within **short-range connectivity**. In 2018 and 2021, NOD included **cellular IoT** and **Wi-Fi** solutions for **long**-³ and **medium-range**³ connectivity, respectively. These additions enlarged its presence in the IoT and unlocked long-term growth opportunities in emergent segments. Due to its R&D efforts, NOD is one of the few companies that offers the world's most **sought-after** wireless IoT technologies, i.e., Bluetooth, Wi-Fi, and cellular IoT (Figure 4).

Listed on the **Oslo Stock Exchange** (ticker: NOD), the company's semiconductors are integrated by global brands⁸ in a variety of **everyday applications**, namely consumer electronics (i.e., personal computers, phones, etc.), gaming and fitness devices, toys, and healthcare and industrial gadgets (Figure 5). With offices in sixteen countries, NOD sold **over two million chips** during each day of 2022, thus shipping more than **seven hundred million units** during the year, to its broad pool of consumers, ranging from single and smaller developers to industry-leading companies, reflecting NOD's **integration in billions of IoT devices worldwide**.

Product overview

With solely one business segment, consisting of the **design and sale** of integrated circuits⁹ and related solutions, known as **semiconductors** or chips, NOD's

¹ NOD designs and sells semiconductors and related solutions but does not manufacture them, outsourcing their production to a foundry. A semiconductor is a material that conducts electricity and makes electronic devices (for e.g., personal computers, smartphones, appliances...) communicate with each other.
² ["The network of physical objects - "things" - that are embedded with sensors, software, and other technologies to connect and exchange data with other devices \(...\) over the internet."](#)
³ Technologies can provide connectivity across different distances. Short-range technologies are devices connected by radio frequencies with a range of up to 100 meters. Medium-range technologies cover a range between 100 meters and 1km. Long-range technologies cover distances over 1km - their maximum coverage depends on the strength of the device.
⁴ Bluetooth is a wireless technology that transmits data over a short distance using radio frequency. It can be used to transfer documents or make connections between Bluetooth-enabled gadgets. Bluetooth Low Energy is a power-saving variation of the Bluetooth technology developed for IoT devices and applications.
⁵ Ultra-low power devices can process data using the smallest amount of system power.
⁶ Market share computed by the Den Norske Bank for newly certified Bluetooth and multiprotocol products. The formula divides the number of new design certifications for Bluetooth-related products awarded to NOD by the total number of new design certifications that were awarded during a specific year for all Bluetooth-related products.
⁷ Multiprotocol technologies allow devices to connect and communicate using different wireless protocols and frequencies.
⁸ Examples are Apple, Samsung, Huawei, and Amazon. These range of firms are called tier-1 consumers: they are global firms and market leaders in different verticals.
⁹ Set of electronic circuits placed into one single semiconductor.

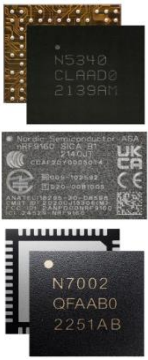


Figure 4: Main products – BLE, cellular IoT, Wi-Fi semiconductors, respectively. Source: NOD's website

products can be found at different stages of the **product life cycle**¹⁰ framework (Figure 6). Across the short-range segment, NOD's products are in opposite phases: while its **Bluetooth**-based solutions are on the upper end of the “**growth stage**”, with the firm patenting c. 40% of new designs every year⁶, its **proprietary** solutions are in the “**decline stage**” with consumers preferring more modern technologies. Regarding the medium- and long-range applications, both are in the “**introduction stage**”, with NOD's **Wi-Fi** products being in the pre-commercial development stage and its **cellular IoT** products being in early commercial development.

Value chain

As a fabless company, NOD designs, markets, sells, and provides technical support to hardware¹¹ products, software¹¹, and cloud-based services¹² (Figure 7). NOD's value chain starts with the company conducting its Research and Development (R&D) in-house to design new semiconductors and solutions, and to improve its existing ones. Subsequently, NOD sources the raw materials that constitute its chips from third-party suppliers and outsources their manufacturing, assembly, testing, and packaging to third-party foundries, mainly located in Taiwan. Once produced, distribution partners, mainly from Asia, are engaged to sell NOD's solutions to electronic manufacturers and end-users around the world. These range from consumer electronics companies to automotive, industrial, or medical devices manufacturers, which ultimately build the end-products that are sold to the mass market. NOD's revenues are recognized once its semiconductors leave its suppliers' warehouses, as goods are transferred to the distributors' facilities. NOD's sales team works from Hong Kong, the United States, and Europe with distributors to make NOD's products available to its c. 6,000 end-customers.



Figure 5: Examples of devices that use NOD's semiconductors. Source: NOD's Creditor Investor Presentation - June 2022.

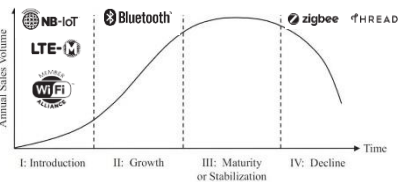


Figure 6: Illustrative image of NOD's life cycle curve. Source: CXL



Figure 7: Illustrative image of NOD's value chain. Source: NOD's website

Innovation as a core pillar

As a fabless company, R&D is a crucial part of NOD's value chain as innovation drives revenues and long-term margins. Thus, the firm puts its R&D operations at the core of its corporate strategy: it aims to annually allocate between 15% to 20% of its revenues to its R&D activity (Figure 8) and, during the past five years, it invested **c. \$525 million** to keep up with customer requirements. In 2022, of its R&D expenditures, c. 40% of its were made towards the cellular IoT and Wi-Fi technologies (c. 4% of NOD's total revenues)¹³, which enhances NOD's strategy

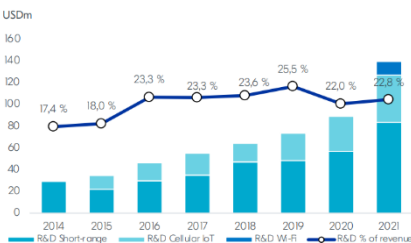


Figure 8: R&D investments by technology. Source: NOD's Creditor Investor Presentation.

¹⁰ Product Life Cycle framework refers to the length of time between the introduction of a product to the market and it is removed from it. It encompasses four stages, from introduction to decline. - <https://www.investopedia.com/terms/p/product-life-cycle.asp>
¹¹ Hardware is the tangible components of an electronic device (for e.g., speakers, keyboards). Software is the operating systems that are installed for the hardware devices to function.
¹² Cloud is an infrastructure hosted by third-party providers and made available to individuals. It is a permanent data storage infrastructure accessible through the internet.
¹³ Please recall the product overview section, where it states: “Wi-Fi products being in the pre-commercial development stage and its cellular IoT products being in the early commercial development.” This justifies why these two segments still represented a small percentage of NOD's revenues.

R&D investments	2018-2022	"Times" above NOD
NOD	526,500	1.0x
SiLabs	1,336,200	2.5x
Infineon	6,955,250	13.2x
Texas Instruments	7,857,000	14.9x
Qualcomm	32,368,000	61.5x
Average	9,808,590	18.6x
Median	6,955,250	13.2x

Figure 9: Absolute sums of R&D investments from NOD and its peers.
Source: Respective companies' annual reports from 2018 to 2022; Own computations.

of investing early-on in high-growth opportunities.

Compared with its peers, i.e., Silicon Laboratories (SLAB), Infineon (IFXGn), Texas Instruments (TXN), and Qualcomm (QCOM) (cf. "Competitors")¹⁴, NOD had one of the **lowest sums** of R&D investments from 2018 to 2022 (Figure 9), with its peers having invested from **c. 2.5x to c. 61.5x** more over the same period¹⁵. Moreover, solely NOD and IFXGn kept increasing their R&D year-on-year.

R&D intensity	2018	2019	2020	2021	2022
NOD	24%	25%	22%	23%	21%
SiLabs	27%	31%	27%	38%	32%
Infineon	11%	12%	13%	13%	13%
Texas Instruments	10%	11%	11%	8%	8%
Qualcomm	25%	22%	25%	21%	19%
Average	19%	20%	19%	21%	19%
Median	24%	22%	22%	21%	19%

Figure 10: R&D intensity ratio for NOD and its peers.
Source: Respective companies' annual reports from 2018 to 2022; Own computations.

To compensate for size differences, one looked at NOD's **R&D intensity ratio** (Figure 10), measured as R&D spending over revenues. The company is mostly in-line with QCOM between 2018 and 2022 (c. 23%). Comparatively, IFXGn and TXN have lower R&D intensity ratios (c. 12% and c. 10%, respectively), while SLAB has the highest R&D intensity ratio, (c. 31%). This shows that, despite its smaller size, NOD's R&D investments out of its revenues are above three out of four competitors and that the fabless companies, i.e., NOD, SLAB, and QCOM, are the ones recording the largest R&D expenditures, as it constitutes the core of their business.

R&D coverage multiple	2018	2019	2020	2021	2022
NOD	1.6x	1.2x	2.7x	2.0x	2.4x
SiLabs	0.8x	0.9x	0.9x	3.9x	1.5x
Infineon	0.9x	1.1x	1.7x	1.2x	0.8x
Texas Instruments	1.6x	1.6x	2.0x	3.0x	1.8x
Qualcomm	2.1x	2.2x	1.1x	1.0x	0.3x
Average	1.4x	1.4x	1.7x	2.2x	1.4x
Median	1.6x	1.2x	1.7x	2.0x	1.5x

Figure 11: R&D coverage multiple for NOD and its peers.
Source: Respective companies' annual reports from 2018 to 2022; Own computations.

Looking at the **R&D coverage multiple** (Figure 11), which divides a company's cash balance by its R&D spending for the year, one assesses how much pressure is put on its cash balance if it pays for its R&D expenses solely using cash. NOD **targets** an R&D coverage ratio **c. 2.0x**, which has been happening since 2020. Compared with its peers, NOD had in 2020 and 2022, the highest ratio, which reflects its strategy of having more cash than operating expenses¹⁶, here R&D. A plausible explanation for QCOM's larger-than-usual cash balances in 2018 and 2019 can be a legal settlement with Apple, in which QCOM was indemnified¹⁷. In 2021, SLAB held the highest ratio, due to the sale of its infrastructure and automotive businesses for \$2.8bn in cash. Both in 2019 and 2021, NOD also came after TXN, but TXN's cash balance for those years is in-line with the remaining years.

NOD	2018	2019	2020	2021	2022
Total Comprehensive Income	8,518	7,145	39,014	69,870	121,806
R&D employees	514	563	746	926	1,091
Profitability / R&D employee	17x	13x	52x	75x	112x

Figure 12: NOD's profitability per R&D employee over the observation period (i.e., 2018 to 2022).
Source: Respective annual reports from 2018 to 2022; Own computations.

The effectiveness of NOD's R&D investments is measured by the **profitability per R&D employee ratio** (Figure 12), from which one sees how much profit is generated per year by each R&D employee. Since NOD's R&D expenses are mainly included in its "payroll expenses" caption (c. 60% in 2022), this shows if human capital investments in R&D generate profitability. This ratio has been increasing, which reflects the increased efficiency of NOD's R&D employees in generating profits. Regarding the peers, one solely found the number of R&D employees for SLAB and IFXGn (Figure 13). SLAB's ratios are well below those of NOD, implying its lower efficiency in generating returns from its R&D employees. The opposite happens

SLAB	2018	2019	2020	2021	2022
Total Comprehensive Income	83,591	19,265	12,531	2,117,399	91,402
R&D employees	-	-	1,103	1,000	1,316
Profitability / R&D employee	-	-	11x	-	69x

IFXGn	2018	2019	2020	2021	2022
Total Comprehensive Income	1,234,315	976,314	449,549	1,329,270	2,337,413
R&D employees	7,161	7,755	9,262	10,372	12,005
Profitability / R&D employee	172x	126x	49x	128x	195x

Figure 13: Peers profitability per R&D employee over the observation period (i.e., 2018 to 2022).
Source: Respective annual reports from 2018 to 2022; Own computations.

¹⁴ SLAB and QCOM are fabless semiconductor companies, while TXN and IFXGn are manufacturers. All are NOD's competitors within the BLE segment.

¹⁵ In terms of market capitalization (as of FY 2022), SLAB is c. 1.4x larger than NOD, IFXGn is c. 12.4x larger, TXN is c. 46.7x larger, QCOM is 38.5x larger.

¹⁶ NOD is the sole company, within its peers, to have negative net debt. This shows it has large cash balances, and little debt. In 2022, it had 18x more times cash than debt. NOD's management believes in holding cash to realise the company's long-term growth opportunities.

¹⁷ Settlement over royalties Apple had been paying QCOM for the use of its technology in its devices. The exact timing of settlement was not publicly disclosed but it is possible that part of the indemnity was received in 2018, as some final trials occurred until the year end.

for IFXGn, with the firm presenting substantially higher ratios, which shows that it needs less employees to generate profits, which due to its larger scale seems reasonable, as operations (especially manufacturing) may be more robotized.

Revenues overview by geography

Looking at the geographical breakdown of the industry's sales from 2013 to 2022¹⁸, one can see that each geography has been contributing the same proportion to the global semiconductor industry value, with **Asia / Pacific** being the largest market (Figure 14). The region is home of the "Asia / Pacific **big four countries**"¹⁹, i.e., China, Japan, South Korea, and Taiwan, which englobes manufacturing powerhouses (Taiwan and China), specialty experts (Japan), and countries in which the largest semiconductor enterprises are headquartered (South Korea)²⁰.

In NOD's geographical revenue breakdown (Figure 15), one can observe this overall steadiness but a slightly different composition, with NOD relying more on Asia / Pacific, and less on the Americas. Over 2022, NOD recorded **higher sales** coming from tier-1 customers located in the **U.S.** and **Europe**, while **China** registered **lower sales** from small and medium-sized companies. Chinese consumers moved from accounting c. 20% of revenues in 2021 to c. 10% in 2022. This shift was atypical as, before 2022, the Asian region represented c. 80% of NOD's revenues.

Current financial position and future prospects

As of 2022, NOD has an **improved income statement**, with increased revenues (c. 27% year-on-year), gross margin (c. 34%), and net profit (c. 72%) (Figure 16). As the quantity of semiconductors produced did not change over the year (c. 700m units shipped) such increases are attributable to average selling prices being higher (c. \$1.11 in 2022 vs. c. \$0.87 in 2021) to absorb increases in raw materials' costs (c. \$0.49 in 2022 vs. \$0.41 in 2021). Thus, its gross margin was slightly higher year-on-year (y-o-y) since the **absolute product price increases** were **c. 3x higher than the increase in cost of materials** (i.e., c. \$0.24 and c. \$0.08, respectively). The increase in net profit is due to the magnitude of the increase in revenues (c. \$166m), which was well above all other expenses (c. \$115m). Comparatively to its peers, NOD recorded the third largest y-o-y increase in revenues during 2022, behind SLAB and QCOM, with a c. 42% and c. 32% increase, respectively. Both SLAB²¹ and QCOM²² attributed these increases to

Worldwide semiconductor revenues			
	2018	2019	2020
Revenues	468,778,000	412,307,000	440,389,000
Americas	102,997,000	78,619,000	95,366,000
% of total revenues	22%	19%	22%
Europe	42,957,000	39,816,000	37,520,000
% of total revenues	9%	10%	9%
Asia/Pacific	322,824,000	293,872,000	307,503,000
% of total revenues	69%	71%	70%

Worldwide semiconductor revenues			
	2021	2022	
Revenues	555,892,000	574,100,000	
Americas	121,481,000	121,347,152	
% of total revenues	22%	21%	
Europe	47,757,000	51,570,387	
% of total revenues	9%	9%	
Asia/Pacific	386,654,000	401,182,461	
% of total revenues	70%	70%	

Figure 14: Worldwide semiconductor revenues by predominant geography.
Source: [World Semiconductor Trade Statistics](#)

	2018	2019	2020	2021	2022
Total revenues	271,134	288,395	405,217	610,528	776,734
Americas	32,810	29,417	34,038	61,663	107,966
% of total revenues	12%	10%	8%	10%	14%
Europe	33,608	29,229	37,726	53,116	97,868
% of total revenues	12%	10%	9%	9%	13%
Asia / Pacific	204,716	229,749	333,453	495,749	570,899
% of total revenues	76%	80%	82%	81%	73%

Figure 15: NOD's revenues by geography.
Source: respective annual reports from 2018 to 2022.

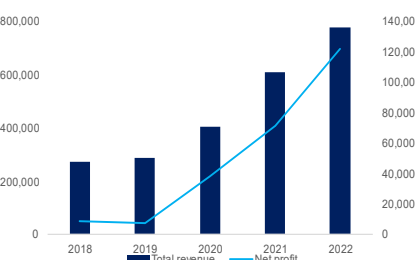


Figure 16: NOD's revenues and net profits evolution from 2018 to 2022.
Source: respective annual reports from 2018 to 2022

¹⁸ Retrieved from 2013 to 2022: [World Semiconductor Trade Statistics \(WSTS\). 2022. "WSTS Semiconductor Market Forecast Fall 2022." Www.wsts.org. November 29, 2022.](#)

¹⁹ Nomenclature given by Deloitte. This region is home to semiconductor giants, such as Samsung Electronics (from South Korea), Sony (from Japan), TSMC (from Taiwan). [Deloitte China, Taiwan, Korea. 2020. "Rise of The Big 4 – The semiconductor industry in Asia Pacific." Deloitte. 2020.](#)

²⁰ South Korea headquarters Samsung Electronics and SK Hynix, which are within the top three Asian semiconductor vendors by revenue - [Deloitte China, Taiwan, Korea. 2020. "Rise of The Big 4 – The semiconductor industry in Asia Pacific." Deloitte. 2020.](#)

²¹ [Silicon Laboratories. 2022. "Silicon Laboratories Inc. - Financials - Annual Reports & Proxies." Siliconlabs2022cr.q4web.com. December 31, 2022.](#)

²² [Qualcomm. 2022. "Historical Financial Results." QUALCOMM Incorporated. December 31, 2022.](#)

higher volume sold and to larger average selling prices to absorb higher costs of materials. While NOD did not increase its volume sold y-o-y, the **increase in raw materials' costs** seems to be **transversal across the industry**.

Despite NOD's yearly increases, it presented 2022 results below the market's expectations, with its **stock price decreasing** by **c. 19%** upon the announcement of its Q4 2022 results. Indeed, historically and prior to the pandemic, NOD's financial results tended to be modest (c. 6% revenue and c. -62% net profit growth between 2018 and 2019). However, Covid-19 enabled **widespread digital adoption** causing NOD to thrive (compounded annual growth rate₂₀₁₉₋₂₀₂₁ – CAGR – of c. 45% for revenue and c. 212% for net profit) and allowing it to become increasingly relevant within its industry (market share of c. 0.14% in 2022 vs c. 0.06% in 2018). This indicator confirms NOD's future potential to grow at double-digits again. However, current industry trends are preventing NOD from realising its full potential (cf. "Investment Risk Summary")²³.

Industry Overview

Over the past two years, the semiconductor industry has been negatively impacted by up-and-coming forces, whether they be macroeconomic trends and geopolitical events affecting the whole economy, or the industry-specific features, such as the wafers' shortage²⁴ issues that have become relevant from 2020 until 2022, as the sector is still recovering from such disturbance. Indeed, the effect it had on the industry is reflected on the Philadelphia Semiconductor Sector Index²⁵ (SOX), as this was c. 36% down from the beginning of 2022 until the year end (figure 17).

In fact, when focusing on NOD's business, the company had a major setback due to said shortage, as its main source of revenue (BLE products, with c. 86% of revenues in 2022) was highly damaged²⁶, since this segment uses silicon wafers to assemble its semiconductors. Prior to the wafer shortage, in 2019, NOD had made the projection that it would become a \$1 billion revenue company within the next five years (this deadline was shortened to 2023 after the pandemic)²⁷, which implied a CAGR of c. 28% in revenues between 2021 and 2023. However, NOD recently reported a y-o-y decrease of c. 21% in revenues for Q1₂₀₂₃. Furthermore, at the same time, it forecasted that its revenues for the next quarter would range

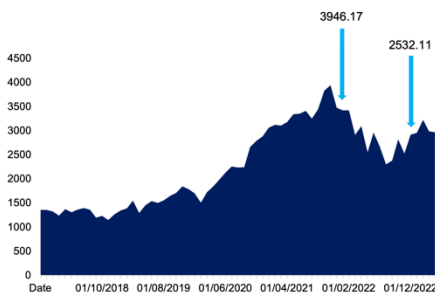


Figure 17: Philadelphia Semiconductor Index from the January 2018 until May 2023.
Source: [Yahoo finance](https://finance.yahoo.com).

²³ NOD's delivery capacity has been affected by the shortage of components that NOD uses in its BLE and cellular IoT products. NOD's order backlog (i.e., the quantity of products that has been ordered and that has not been shipped yet due to delays in production) was in, Q4 2021, c. 1,500% higher than that in Q4 2019. Thus, demand for NOD's products has been well above what it has been able to deliver, with its revenues being capped by the existence of global supply constraints, which cause an accumulation of orders and delays in production. As of Q4 2022, NOD's backlog still c. 800% higher than that of Q4 2019, with this decrease being attributed to higher wafer production.

²⁴ [King, Ian, Debby Wu, and Demetrios Pogkas. 2021. "How a Chip Shortage Snarled Everything from Phones to Cars." Bloomberg.com, March 29, 2021.](https://www.bloomberg.com/news/articles/2021-03-29/how-a-chip-shortage-snarled-everything-from-phones-to-cars)

²⁵ The Philadelphia Semiconductor Index (SOX) is an index composed by 30 companies whose main business consists of the design, manufacture, distribution and sale of semiconductors. It intends to track the performance of listed semiconductors.

²⁶ Delivery capacity was hindered by constraints in wafer demand. Nordic Semiconductor 2022 Annual Report – Message from the CEO (page 4)

²⁷ Nordic Semiconductor 2019 Annual Report – Message from the CEO (page 4)

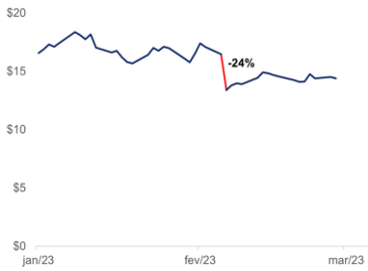


Figure 18: Stock price impact after Q4 2022 announcement.
Source: [Refinitiv](#).

from \$140m to \$160m, whereas its total revenue for Q2₂₀₂₂ was c. \$200m. Hence, taking the midpoint of this range and comparing it to the amount recorded in 2022, one can acknowledge a c. 25% decrease year-on-year. This does not pose a favorable outlook so to accomplish the firm’s projection, meaning that NOD is likely to fail to become a \$1 billion revenue company by the year-end. Upon announcing that it would no longer achieve such goal until the end of the year, NOD’s share price decreased by c. 24% (figure 18).

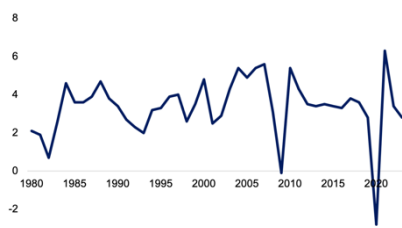


Figure 19: Global real GDP growth from 1980 until 2023e.
Source: [International Monetary Fund](#).

Moreover, as NOD is a fabless company, it relies on third-party foundries to manufacture its semiconductors and subsequently be able to sell its final product. Given that NOD’s revenue is only incurred when its final product is sold to distributors, its ability to incur revenue is at stake with foundries not being able to manufacture. Hence, the shortage of an essential raw material negatively impacted the company’s supply chain, affecting NOD’s capacity to grow its sales at a faster pace and thus accomplishing its \$1 billion revenue projection as it had previously planned, had it not been for such event. However, recently, this concern has been smoothing out, not entirely due to an increase in supply but rather due to a decline in demand. In fact, the global economy has been experiencing a period of cool down since 2021. This is observable through the global real GDP growth rate (figure 19) which has decreased by 3.5 percentage points (p.p.) from 2021 to 2023²⁸ (figure 20). This downturn has led to a decrease in demand by the end-consumers, and, therefore, supply was able to meet, the now lower, demand.

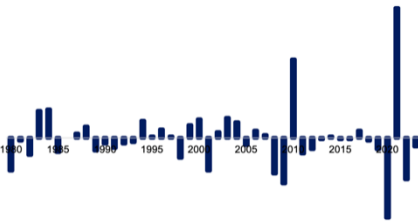


Figure 20: Annual percentage change of the global real GDP growth from 1980 until 2023e.
Source: [International Monetary Fund](#).

These not so favorable prospects on the global economy were also caused by (i.) higher inflation as the average annual inflation rate in the U.S. increased c. 6.8 p.p. from 2020 to 2022²⁹; (ii.) higher interest rates, with the federal funds rate increasing by c. 4.38 p.p. from 2020 to May 2023³⁰ and the 1-year London interbank offered rate increasing c. 4.92 p.p. for the same period³¹; (iii.) decreasing customer confidence³²; and (iv.) sagging market when it comes to tech stocks³³ (figure 17).

Furthermore, from a geopolitical standpoint, the industry outlook does not seem encouraging enough. Firstly, the war in Ukraine has not only unsettled supply chains, but also limited the access to necessary raw materials³⁴. Secondly, both the lockdown in China³⁵ and its tensions with Taiwan further impacted

28 Real GDP growth – IMF (https://www.imf.org/external/datamapper/NGDP_RPCH@WEO/WEO_WORLD)

29 “Historical Inflation Rates: 1914-2023.” 2019. US Inflation Calculator. April 10, 2019. <https://www.usinflationcalculator.com/inflation/historical-inflation-rates/>.

30 Macrotrends. 2022. “Federal Funds Rate - 62 Year Historical Chart.” Macrotrends.net. 2022. <https://www.macrotrends.net/2015/fed-funds-rate-historical-chart>.

31 “LIBORUSD12M Data | 1 Year London Interbank Offered Rate in USD (LIBOR) Price Data.” n.d. MarketWatch. Accessed May 14, 2023. <https://www.marketwatch.com/investing/interestrate/liborUSD12m/download-data?startDate=1/1/2020&endDate=5/12/2023&countryCode=mr>.

32 Deloitte’s 2023 Semiconductor Industry Outlook (page 3)

33 Financial Times. 2023. “Tech Stock Retreat Leads Wall Street Indices Lower,” March 28, 2023.

34 Both countries are major producers of key raw materials used in the manufacture of semiconductors (neon and palladium). Ukraine represents c. 70%-80% of neon’s world supply and Russia represents c. 35%-45% of palladium’s world supply. - “[Russia-Ukraine War: Impact on the Semiconductor Industry - KPMG Ukraine.” 2022. KPMG. September 8, 2022.](#)

35 China’s Chip Output Shrinks as Lockdowns Hurt Production – Bloomberg <https://www.bloomberg.com/news/articles/2022-04-18/china-s-chip-output-shrinks-as-lockdowns-hurt-production#xj4y7vzkg>

semiconductors' supply chains given that the two countries are in the top-5 of the world's most producing semiconductor manufacturers³⁶ (7% and 64% in 2021, respectively). Lastly, the recent U.S. trade sanctions on China have not contributed for the industry's prosperity as these also contributed to disrupt supply chains. Nonetheless, total demand is still outrunning the available supply³⁷.

All these factors combined have contributed to the loss in market capitalization of the top-10 global chip companies combined which, in 2022, has decreased by 34%³⁷. Such a decrease is a result of decreases in earnings, increases in cost of capital, and inventory drawdowns (cf. "Investment Risks Summary"). As a response, semiconductor companies started to cut costs, increasing the number of layoffs and postponing investment and capital expenditures³⁷.

Nevertheless, when focusing on NOD's operations, there are additional revenue segments that one should consider. The company has recently betted, in 2018, on a new segment, Cellular IoT, as it is a "massive and growing market across hardware, connectivity and services"³⁸. However, for NOD, this new market experienced a slowdown due to many cellular IoT consumers, mainly start-ups and growth companies, not finding appropriate financing in the current macro environment. This slowdown is assumed to be temporary considering the high amount of potential volume of pre-commercial cellular IoT projects³⁹. What is more, the IoT market is expected to keep on growing as the supply constraints ease – twenty-seven billion connected IoT devices are expected to exist by 2025⁴⁰.

Moreover, another source of revenue that is worth evaluating in terms of growth prospects are NOD's proprietary products, such as keyboards and personal computer (PC) accessories. These goods had experienced a vigorous growth during the pandemic years given that working from home was enforced, causing the demand for such products to increase, especially in 2021⁴¹ (increasing c. 10% from 2020 to 2021). However, as workers began to return to the offices, such demand decreased so much that NOD expects that the revenue percentage (out of total revenues) for this segment to completely migrate into the BLE segment⁴².

As stated by the company, the industry's addressable market, and, subsequently, that of NOD's, is sizable and is expected to keep on expanding quickly. The growth is supported by megatrends including smart homes, industrial IoT, and platform ecosystems, which will increase the number of connected devices and

³⁶ [Alsop, Thomas. 2022. "Semiconductor Foundry Market Share by Country 2021." Statista. June 29, 2022.](#)

³⁷ Deloitte's 2023 Semiconductor Industry Outlook (page 3)

³⁸ Nordic Semiconductor 2022 Credit Investor Presentation (page 54)

³⁹ NOD currently has approximately 250 different cellular IoT projects across different segments such as smart cities and payment systems. – NOD Q3 2022 report.

⁴⁰ IoT analytics: market insights for the internet of things <https://iot-analytics.com/number-connected-iot-devices/>

⁴¹ Nordic Semiconductor 2022 4th quarter report (page 5)

⁴² Ibid

foster demand for semiconductors in the future⁴³. To sum up, the semiconductor industry is expected to grow so to reach \$1 trillion in revenues by 2030⁴⁴. However, given the reasons presented above, one can acknowledge that the industry is suffering from a range of macroeconomic trends and geopolitical events that are likely to hinder on its short-term growth. As a result, the analysts have projected a decrease in NOD’s market share going into 2023 (from c. 0.14% to c. 0.11%), with this value is expected to increase in 2024 (cf. “Financial Statements Forecasts”).

Competition

NOD’s markets are highly competitive regarding price, technology solutions, and due to the threat of new Chinese entrants⁴⁵, tackling some of the Bluetooth verticals in which the company is weaker.

When analyzing NOD’s current competitive landscape, one focused on the firm’s peers in its short-range segment, as the company’s revenues are mainly derived from the sale of BLE components which, in 2022, corresponded to c. 86% of the company’s total revenues, with NOD obtaining c. 44% of its revenues from its top-10 Bluetooth consumers⁴⁶. According to DNB Markets data, NOD had, in 2022, a combined market share of c. 39% of new design certifications in the BLE market, making it the industry player with most end-product certifications of the year, followed by companies such as SLAB, TXN, IFXGn, QCOM, among others, but all of which with far less certifications when compared to NOD. Certifications play an important role in this industry given that all electronic devices that oscillate above 9 kilohertz need the approval of the FCC⁴⁷ to be sold within the United States, otherwise the company selling them is fined and its products are recalled. Furthermore, with this consistent market share over the last five years in the BLE market, NOD is a clear market leader in terms of the number of new design certifications and number of units sold. This strong market share is backed up by NOD’s diverse portfolio of Bluetooth and multiprotocol solutions, as the company sets itself apart from its competitors by offering a wide range of product alternatives, within this segment, to cater to different customer requirements.

To get a more tangible measure so to position NOD relatively to its peers, one analyzed their profitability from operations ratios. Firstly, in terms of gross margin (figure 21), NOD is slightly below the average of its peers (c. 56% compared to 58% in 2022), which means that its cost of goods sold amounted to c. 44% of revenues.

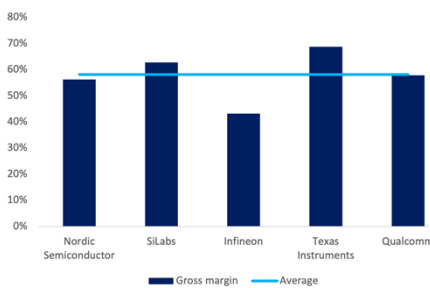


Figure 21: Nordic Semiconductor and peers’ gross margin compared against to the peers’ average. Source: Respective companies’ 2022 annual reports; Own computations.

⁴³ Nordic Semiconductor 2022 Credit Investor Presentation (page 11)

⁴⁴ [Burkacky, Ondrej, Julia Dragon, and Nikolaus Lehmann. 2022. "The Semiconductor Decade: A Trillion-Dollar Industry | McKinsey." www.mckinsey.com. April 1, 2022.](https://www.mckinsey.com)

⁴⁵ China gives chipmakers new powers to guide industry recovery – Financial Times <https://www.ft.com/content/d97ca301-f766-48c0-a542-e1d522c7724e>

⁴⁶ The Bluetooth revenue shared from this pool of consumers increased 4 percentage points when compared to the previous year.

⁴⁷ FCC stands for the Federal Communications Commission. Its approval is granted upon the verification that such devices do not pose any harm to the public nor interfere with other technologies.

NOD's gross margin is in-line with its target, as it aims to achieve a margin above 50%⁴⁸ at all times so that it can be more flexible in terms of customer and technology mix as it is still establishing itself in its smaller revenue segments (i.e., cellular IoT and Wi-Fi). However, due to the wafer shortage, NOD focused its wafer allocations towards tier-1 customers as it is still restrained from a high degree of customer concentration.

Considering the EBITDA margin (figures 22 and 23), NOD is placed below the average of its peers (c. 26% compared to c. 36% in 2022). Therefore, given its gross margin, one can acknowledge that NOD has incurred higher operating expenses than its peers. Indeed, IFXGn, QCOM and TXN's business model is optimized to the extent that their operating costs as a percentage of sales are lower than both NOD and SLAB's as a percentage of sales (figure 24). This leads to an EBITDA margin below the average of its comparable firms. Differences in margins can be explained by the fact that even though both the analysts and NOD identify these companies as NOD's peers, some have more operations, business segments, and sources of revenue, other than the design of semiconductors. Indeed, some of them are highly diversified in the product mix they offer, namely TXN⁴⁹, IFXGn⁵⁰, and QCOM⁵¹ whereas NOD and SLAB's product mix is relatively smaller. Furthermore, TXN and IFXGn are not fabless and thus integrate other verticals of the business, such as manufacture and sale. Therefore, one can see through the peers' financials, that their size does vary. NOD has yet to become a \$1 billion revenue company and SLAB has only accomplished that in 2022, whereas the remainder have recorded over \$1 billion in sales for the last five years.

Regarding the other margins (i.e., EBIT and Net margin), NOD places itself in the average of its peers and, as of last year, TXN's profitability margins are the highest within the industry by a great amount (figures 25 and 26), which is a result from its higher operating leverage in comparison to the remaining peer companies. It is also worth mentioning that the companies that do have in-house production have higher depreciation and amortization expenses, in relative terms, given their greater PP&E needs for factories and machinery (figure 27). Thus, the decrease from the EBITDA to the EBIT margin is usually more accentuated than NOD's, with these values corresponding to depreciation as a percentage of sales (figure 28). However, this does not apply to TXN as it benefits from a reduction in depreciation

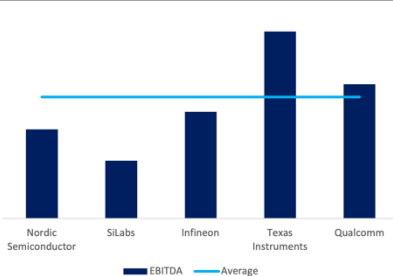


Figure 22: Nordic Semiconductor and peers' EBITDA margin compared against the peers' average. Source: Respective companies' 2022 annual report; Own computations.

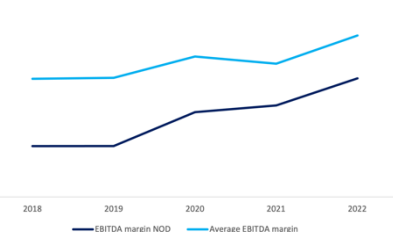


Figure 23: Nordic Semiconductor's EBITDA margin evolution compared against the peers' average. Source: Respective companies' annual reports from 2018 to 2022; Own computations.

Operating expenses (2022)		% total sales
NOD	231,125.00	30%
Silabs	523,318.17	51%
Infineon	3,554,476.00	23%
Texas instruments	3,374,000.00	17%
Qualcomm	10,764,000.00	24%

Figure 24: Nordic Semiconductor and peers' operating expenses in 2022 and expressed as a percentage of their total revenues. Source: Respective companies' 2022 annual report; Own computations.

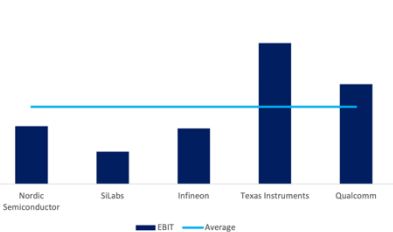


Figure 25: Nordic Semiconductor and peers' EBIT margin compared against the peers' average. Source: Respective companies' 2022 annual reports; Own computations.

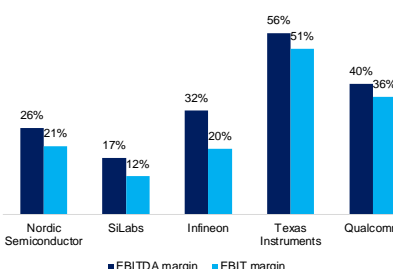


Figure 26: Nordic Semiconductor and peers' EBITDA and EBIT margins for FY22. Source: Respective companies' 2022 annual reports; Own computations.

⁴⁸ Nordic Semiconductor 2022 Annual Report – report from the board of directors (page 21)

⁴⁹ Texas Instruments offers other products such as computer software, graphing calculators, amplifiers, data converters, motor drivers, sensors, interface...

⁵⁰ Infineon offers other products such as sensors, wireless connectivity, transceivers, memories.

⁵¹ Qualcomm offers other products such as wireless networks, smartphones, laptops, tablets, cameras...

PP&E and machinery (2022)		% total sales
NOD	57,019.00	7%
Silabs	152,016.00	15%
Infinion	5,948,121.50	39%
Texas instruments	6,876,000.00	34%
Qualcomm	5,168,000.00	12%

Figure 27: Nordic Semiconductor and peers' levels of PP&E in 2022 as a percentage of total sales. Source: Respective companies' 2022 annual reports; Own computations.

Depreciation (2022)		% total sales
NOD	44,067.00	6%
Silabs	56,595.00	6%
Infinion	1,784,972.80	12%
Texas instruments	979,000.00	5%
Qualcomm	1,762,000.00	4%

Figure 28: Nordic Semiconductor and peers' depreciation expenses in 2022 as a percentage of total sales. Source: Respective companies' 2022 annual reports; Own computations.

as a result of government incentives⁵² in the U.S. (where c. 61% of their facilities are located).

Furthermore, concerning NOD's Return on assets (ROA), one can see that it has been substantially improving over the past five years (increasing from c. 3% to c. 16%), which implies that NOD is increasingly more able to make an effective and efficient use of its capital resources. Nonetheless, it is still below the industry's average (figure 29) and, once again, TXN shows the highest ROA (c. 32%), which shows prosperity and growth potential given the reason previously presented.

Furthermore, NOD's capital structure is characterized by having no issued debt. Indeed, it presents a negative net debt due to having more cash than debt-related items on its balance sheet. Bearing this in mind, it is plausible to assume that (cf. "Intrinsic Valuation"), since NOD has less liabilities towards its creditors, it poses less risk for potential ones. Hence, when compared to its peers, NOD presents a lower cost of debt by improving its credit rating. However, when it comes to the company's cost of equity, one can conjecture that it is higher than the one of its peers (figure 30), with this being a result of it not being such a mature and stable company, meaning that it is still experiencing a phase of substantial growth and, as such, shareholders demand a higher return for their investment so to compensate for the risk they are bearing.

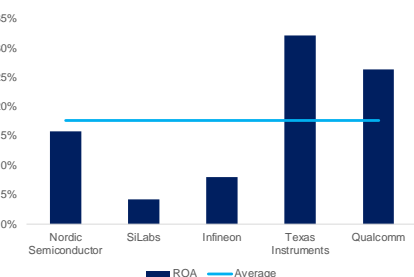


Figure 29: Nordic Semiconductor and peers' ROA compared against the peers' average. Source: Respective companies' 2022 annual reports; Own computations.

Profitability, liquidity & capital structure

$$r_e = r_a + \frac{D}{E}(r_a - r_d)$$

Over the scope of analysis, NOD has been able to maintain its gross margin at around 50%. Hence, the increasing cost of raw materials has been offset by the increasing revenue of its core operations. More specifically, in the BLE segment in which it keeps on thriving (revenue CAGR₂₀₁₈₋₂₀₂₂ of c. 38%). In fact, excluding the period from 2018 to 2019 (as the shortage period only begun in 2019), the cost of materials per unit shipped has kept on increasing, recording a peak in 2022 with a CAGR of c. 8%. However, the gross margin is expected to increase given that cellular IoT revenues are expected to grow in the future⁵³ and the proprietary segment, which had only experienced an increase of c. 27% and c. 10% during the pandemic years (2020 and 2021) is most likely to liquidate now that it recorded a decrease of c. 10% in 2022. What is more, one can see that it has been becoming less significant throughout the analysis period given that, in 2018, it represented almost 21% of total sales and only c. 10% in 2022.

Figure 30: Cost of equity formula through the WACC method. Source: Koller, Tim, Marc H Goedhart, David Wessels, and Mckinsey And Company. 2020. Valuation : Measuring and Managing the Value of Companies. Hoboken, New Jersey: John Wiley & Sons, Inc.

⁵² Incentives related to the acquisition or construction of fixed assets are recognized as a reduction in the carrying amounts of the related assets and reduce depreciation expense over the useful lives of the assets. Cited from "[Earnings & Annual Reports | Investor Relations | TI.com](#)," n.d. [Investor.ti.com](#).

⁵³ NOD expects that the revenue from the Cellular IoT to increase given its amount of pre-commercialization projects with "high volume potential". – [Nordic semiconductor 2022 annual report](#).

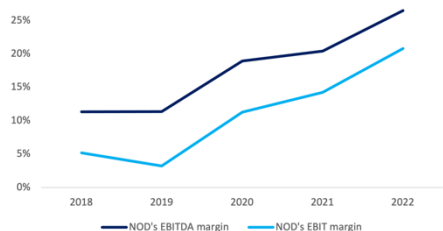


Figure 31: Nordic Semiconductor EBIT and EBITDA margins evolution. Source: Respective companies' 2022 annual reports; Own computations.

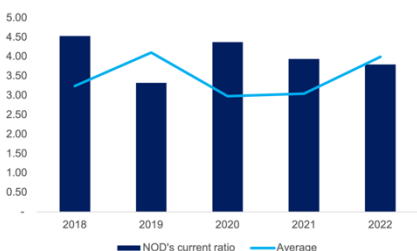


Figure 32: Nordic Semiconductor's current ratio compared against the peers' average. Source: Respective companies' annual reports from 2018 to 2022; Own computations.

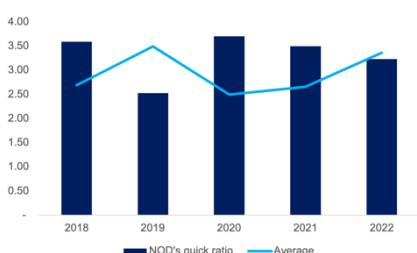


Figure 33: Nordic Semiconductor's quick ratio compared against the peers' average. Source: Respective companies' annual reports from 2018 to 2022; Own computations.

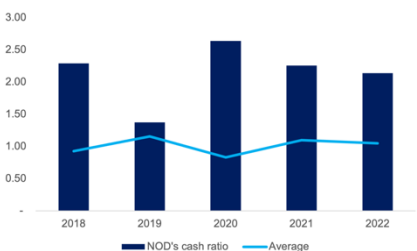


Figure 34: Nordic Semiconductor's cash ratio compared against the peers' average. Source: Respective companies' annual reports from 2018 to 2022; Own computations.

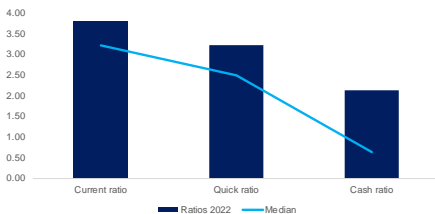


Figure 35: Nordic Semiconductor's current, quick and cash ratios compared against the peers' average for FY22. Source: Respective companies' annual reports from 2018 to 2022; Own computations.

On the other hand, both the EBITDA and the EBIT margins have increased during the observation period (figure 31) as, even though net payroll expenses and depreciation and amortization kept on increasing, with a CAGR of c. 23% and c. 27% respectively, the increase in revenues was able to mitigate such increment.

Concerning **liquidity** (figures 32, 33, and 34), NOD can be perceived as a very liquid company given its high, and above-average current, quick, and cash ratios⁵⁴ when compared to its peers with two exceptions: (i.) the FY 2019 as NOD decreased its current assets as a result of a decrease of its cash holding by c. 13% (for the remaining years of the analysis period the value of cash and cash equivalents presents an increasing trend with a CAGR₂₀₁₉₋₂₀₂₂ of c. 61%) so to invest in the development of the Cellular IoT technology (invested capital increased by c. 39% from 2018 to 2019) and; (ii.) the FY 2022 as the liquidity ratios are slightly below the average of the comparable firms only because SLAB had an atypical year given that the value of its total assets increased by c. 129% in 2021 due to having sold discontinued operations⁵⁵, thus boosting the average of the comparable firms. As such, one should focus its analysis on the median of the peers as it is not influenced by outliers. When comparing NOD's liquidity ratios with the median of the comparable firms for 2022, one can see that NOD outperforms them (figure 35).

Firstly, it is important to mention that NOD has a current ratio above 1.00 throughout the whole analysis period (c. 3.81 for 2022) which means it complies with the minimum short-term financial equilibrium rule⁵⁶. This means that it is, theoretically, capable of meeting its short-term liabilities only recurring to short-term assets. However, this might not actually happen in practice given that there may be restrictions on the execution of current assets depending on the firm's financial situation. Nevertheless, having a current ratio above 1.00 is a good indicator for liquidity purposes.

Secondly, NOD presents a quick ratio of c. 3.23 for FY 2022. The main difference between this ratio and the current ratio is that, instead of relying on current assets, it is based on the current available cash flow, i.e., the assets that are easier to liquidate⁵⁷. Thus, it is plausible to assume that NOD can meet its short-term obligations through its short-term assets in case it is unable to sell its inventories.

Lastly, a cash ratio of c. 2.14 in 2022 also poses a positive signal, implying that the firm can meet its short-term obligations through its available excess cash. In a way, having a larger amount of cash and cash equivalents allows companies to have

⁵⁴ NOD's cash ratio is always above the average of its comparable firms given that it has a higher level of cash holding, in relative terms, than the rest of its peers.

⁵⁵ In 2022, SLAB sold discontinued operations which led to a net income of 2,117,399 for that year. This represents a c. 16,797% increase when compared to the previous year.

⁵⁶ The minimum short-term financial equilibrium rule is an empirical rule that implies that whenever a company has a current ratio equal or above one, it is capable of meeting its short-term financial obligations only through short-term assets.

⁵⁷ The quick ratio usually excludes current assets whose execution may be hinged given the firm's financial position. These assets include inventories, for instance.

better access to credit when needed (as they can prove they are liquid enough to meet its obligations) and lowers the level of net debt.

Furthermore, regarding what concerns NOD's **capital structure** ratios, given that the company has negative net debt, its gearing ratio, debt-to-equity, and debt-to-EBITDA ratios are negative (c. -1.42, c. -0.59, and c. -1.66, respectively for 2022). These ratios are important to understand how a company funds its operations: (i.) through the gearing ratio one concludes that NOD does not have any invested capital financed through debt; (ii.) the debt-to-equity ratio shows the portion of the company that is financed through debt in contrast to the one financed through equity, which is negative and; (iii.) the debt-to-EBITDA ratio compares the level of debt with the level of activity of the firm rather than its external financing, which is negative, because NOD has larger cash holding than debt servicing.

Additionally, both NOD's solvency and financial autonomy ratios (c. 3.03 and c. 0.75 for 2022, respectively) indicate independence from creditors. Such a high solvency ratio implies that the firm can meet its financial obligations through the capital that has been either invested or generated by it. Furthermore, a greater financial autonomy ratio hedges the firm against increasing interest rates as it does not rely heavily on creditors.

Moreover, both in 2022 and 2021, NOD's board of directors was authorized to direct a share capital increase to selected investors up to an amount 19,200,000 shares issued with a total par value of NOK 192,000⁵⁸ if it wishes to raise capital quickly. This is the method preferred by NOD, when it wishes to strengthen its shareholder's equity, carry out a merger or acquisition, among others, so to preserve its capital structure. However, it is not the preferred method in general as the value of the company could increase if debt was issued (through the present value of interest tax shields⁵⁹). One question that arises from this analysis is why NOD keeps on having such high levels of excess cash instead of distributing it among its shareholders. The most valid explanation for said query is that the company's management finds this capital structure to be adequate for NOD's long-term goals to be met⁶⁰. The company prioritizes providing returns to its shareholders in the form of increasing the value of their shares rather than through the distribution of dividends. The excess cash currently held by NOD is intended to be (re)invested first and foremost in R&D and CAPEX investments. However, NOD intends to distribute dividends⁶¹, based on its excess cash, in the long-term

⁵⁸ This authorization is limited to 10% of NOD's share capital and the value at which it buys its shares back is capped between the par value and NOK 300 - Nordic Semiconductor 2022 Annual report – report from the board of directors (page 59). Furthermore, at the exchange as of the 17th of May, NOK 192,000 corresponds to c. USD 17,936.

⁵⁹ Debt issuance decreases the value of income taxes by decreasing the amount of taxable income.

⁶⁰ According to NOD's management team, a strong balance sheet, high equity ratio, and substantial liquidity are needed to meet its growth ambitions.

⁶¹ The last time NOD has distributed dividends was in 2011.

since its cash generation is expected to increase so that the company can pursue and eventually achieve its strategic priorities and materialize growth opportunities.

Additionally, the analysts have computed another metric to measure the profitability, prosperity, and overall growth for this specific firm – profitability, i.e., total comprehensive income, per R&D employee. One can acknowledge the relevance of such ratio given that NOD is a fabless company and most of its invested capital reverts to R&D, namely human capital, since it does not have high machinery nor factory needs. In fact, in 2022, the percentage of both right of use assets and fixed assets⁶² combined solely represents c. 7% out of total assets, whereas the average of the peers which have in-house production is c. 20%. When evaluating this ratio, one concludes that NOD is progressively becoming more efficient, as the amount of profit attributable to each employee is increasing (figures 36 and 37). The analysts have considered this ratio to be a good proxy when assessing whether NOD should keep investing in new projects and it also serves as a measure for potential investors to determine the attractiveness and overall stability of the company. Being mindful of that, this ratio shows that NOD is healthy and prosperous as it keeps on growing, hence implying a sustainable business model and efficient operations' management.

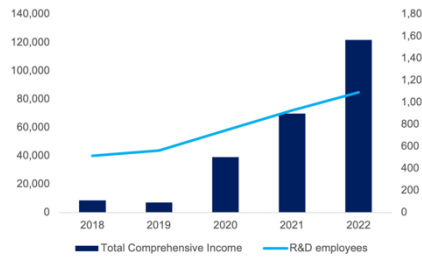


Figure 36: Nordic Semiconductor's total comprehensive income and number of R&D employees. Source: NOD's annual reports from 2018 to 2022; Own computations.

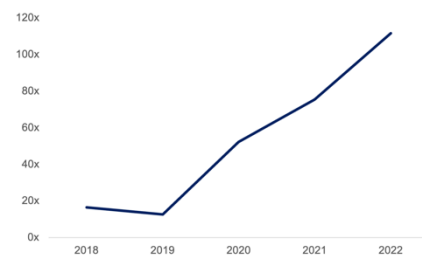


Figure 37: Nordic Semiconductor's profitability per R&D employee ratio. Source: NOD's annual reports from 2018 to 2022; Own computations.

The return on invested capital (ROIC) was also computed as standard practice. However, given that NOD is a fabless semiconductor company, it relies on third-parties to produce the semiconductors it designs and sells. As such, when thinking about its invested capital (IC) needs, one acknowledges that it does not require as much IC as a manufacturing company to carry out its operations or to exploit growth opportunities⁶³. As such, the analysts have considered this ratio to have less materiality when evaluating NOD's profitability.

NOD's ROA increased from c. 3% to c. 16% in the last five years as a result of NOD's increase in assets through the on Cellular IoT⁶⁴ technology and given that it was also able to capitalize on it starting on 2020 even though it only represented c. 2% of total sales for that same year and c. 3% for the following ones. Moreover, one can perceive the return on equity ratio (ROE) as being equivalent to the ROA⁶⁵ and thus illustrates the efficiency of the company to generate profit from its equity financing. Considering NOD's negative net debt, the ROE will be greater than the ROA although it will still display the same trend: increasing over the analysis' scope (from c. 3.84% to c. 20.87%), inferring that the company is making a more efficient use of its capital resources.

⁶² Even though NOD outsources its testing, it also has testing facilities for own R&D purposes.

⁶³ NOD's IC has only amounted to c. 31% out of the total assets in 2022 whereas the average of its peers amounted to c. 127% for the same year.

⁶⁴ Cellular IoT – NOD's 2021 annual report (page 10)

⁶⁵ ROE is measured by dividing comprehensive result by equity and equity can be attained by subtracting debt from total assets.

Investment risks summary

The semiconductor industry poses several risks that are prevailing in all companies that integrate said industry. Some of them were already mentioned before (cf. “Industry Overview”), with this section entailing a more detailed analysis on the two most material risks that affect NOD’s business.

Cyclical nature of the semiconductor industry

NOD’s industry is in constant development as new and innovative technologies frequently emerge. As the needs of end-consumers change, it is important that NOD can sustain a high level of innovation so that its products do not become obsolete upon the development of more recent and faster technologies and applications. This implies that semiconductors have a relatively short life-cycle⁶⁶. Because of that, downturns are common in the industry, usually being a result of inventory build-up, which leads companies to decrease their prices and ultimately incurring lower revenues. However, the opposite also occurs, whenever there is a high demand for semiconductors, there are supply shortages, driving prices up and boosting revenues. As a result, one can say that this industry is rather cyclical and, besides this, there is another main trigger for such cyclicity: economic growth.

Periods of high demand tend to occur whenever economic growth, i.e., GDP, is high as it leads to industrial growth thus increasing the need for new IT⁶⁷ products, most of which include semiconductors in their assembly process. Contrastingly, during periods of economic slowdown, the demand for those products tends to decrease, alongside with consumers purchasing power and thereafter, overall consumption. Figure 38 depicts the correlation between the SOX index and GDP. One can conclude that during the period of 1998-2000 as PCs and other devices started to become integrated in several industries and appliances, the SOX experienced an increase, whereas, during the period of financial crisis (2008-2009) the index decreased due to the decreasing need for tech products by end-consumers. Nonetheless, in its annual reports, NOD discloses that it attempts to maintain a close communication with its consumers so to better predict and understand the market demand. However, the buyer group has a high negotiation leverage, given that most of NOD’s products are standardized (or undifferentiated), as switching costs tend to be low. However, despite differentiation being limited due to the nature of semiconductors, NOD is constantly trying to be ahead of its

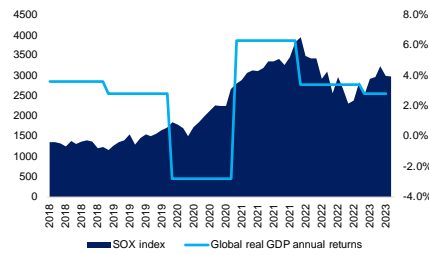


Figure 38: SOX index plotted against the global real GDP growth rate from the January 2018 until May 2023. [Data retrieved from Yahoo finance and Macrotrends](#)

⁶⁶ Nordic Semiconductor 2022 Annual Report – Risk Management (page 65)

⁶⁷ IT stands for Information Technology and is defined as: “the use of any computers, storage, networking and other physical devices, infrastructure and processes to create, process, store, secure and exchange all forms of electronic data” - [Castagna, Rich, 2021. “What Is Information Technology? Definition and Examples.” SearchDataCenter. August 2021.](#)

competitors when it comes to innovation so to preserve customer loyalty. Such can be observed through NOD’s R&D efforts (the value of invested capital on core operations amounted to c. \$235m in 2022 and has grown at a CAGR of 19% throughout the analysis period), the fact that it developed and started the commercialization of two new product segments during the analysis period (Cellular IoT and Wi-Fi⁶⁸) and through NOD’s market share on BLE products as it is still the market leader for said technology.

Supply chain and geopolitical risk

NOD’s supply chain is complex, with many interdependent parties and with its raw materials and suppliers scattered across the whole globe. It comprises several stages such as design, harvesting of raw materials, manufacturing, testing, packaging, and shipping (figure 39).

Firstly, when it comes to raw materials⁶⁹, semiconductors mainly rely on two of them: germanium⁷⁰ and silicon, which are used due to their capacity of regulating electrical current. However, NOD solely operates with silicon, which is the main element present in its wafers. As mentioned, in the past couple of years, the silicon wafers’ shortage has been an issue that has impacted the industry, which affected NOD’s most efficient and most profitable sector – BLE (cf. “Industry Overview”). The main driver for this shortage was the global COVID-19 pandemic as the demand for semiconductors that would be integrated in PCs, smartphones, routers, and recreational products increased due to lockdowns and in-home offices. This can be observed through the Dow Jones U.S. Technology Index, which increased by c. 102% from May 2020 until then end of 2021 (figure 40). As a result, supply was not enough to meet demand, thus resulting in a shortage.

In addition, there were also a range of extraordinary events that have contributed for this shortage such as: (i.) the 2022 ice storm in Texas that led foundries, such as Samsung and Infineon, to shut down⁷¹; (ii.) Renesas Electronic, another foundry which operates in Japan, caught fire in 2021 and was forced to halt production from March until June of the same year⁷²; (iii.) labour shortages due to lockdowns in China⁷³; (iv.) a cargo ship stuck in the Suez Canal⁷⁴, thus delaying the shipment of semiconductors, among others.

As a result of this shortage, the price of these materials increased. Indeed, NOD registered a CAGR₂₀₁₈₋₂₀₂₂ of c. 26% for its cost of materials. However, just like

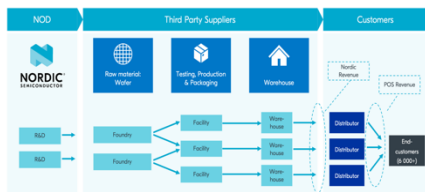


Figure 39: Illustrative image of NOD’s supply chain. Source: [NOD’s website](#).

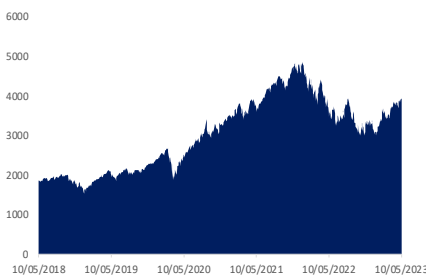


Figure 40: Dow Jones U.S. Technology Index from May 2018 until May 2023. Source: [Yahoo Finance](#).

⁶⁸ In 2018 and 2020, NOD included Cellular IoT and Wi-Fi solutions for long- and medium-range connectivity. - [NOD’s annual reports from 2018 and 2020](#).

⁶⁹ [“Semiconductor Manufacturing Process: How Are Semiconductor Chips Made?” 2023. <https://www.mrlcg.com>, February 15, 2023.](#)

⁷⁰ Germanium is classified as a metalloid, falls in the same category and group as carbon but also as tin, for instance.

⁷¹ [“Texas Power Failures Shut down Chip Factories, Which Could Send Shock Waves up the Supply Chain.” n.d. \[Fortune\]\(#\).](#)

⁷² [Reuters, 2021. “Japan’s Renesas Sees Fire-Damaged Chip Plant back to Full Capacity by Mid-June.” Reuters, June 1, 2021, sec. Technology.](#)

⁷³ [Washington Post, 2022. “‘Everything Is Halted’: Shanghai Shutdowns Are Worsening Shortages.” April 26, 2022.](#)

⁷⁴ [Yee, Vivian, and James Glanz, 2021. “How One of the World’s Biggest Ships Jammed the Suez Canal.” The New York Times, July 17, 2021, sec. World.](#)

most of the firms in the industry, NOD's revenues kept increasing due to the increment in its average selling prices (CAGR₂₀₁₈₋₂₀₂₂ of c. 5.3%) in an attempt to counteract and offset the increase in costs. Currently, the industry is still recovering from this shortage, with players from all levels of the supply chain still being affected. Given that NOD must rely on third-parties to manufacture its products, one can conclude that there is a large dependence risk for the company, being fabless. Foundries tend to be mostly located in Asia, meaning that they are not only incurring risk factors related to supply constraints but also geopolitical ones, which ultimately can disrupt supply chains and affect NOD's operations. Indeed, NOD's main supplier is the Taiwan Semiconductor Manufacturing Company (TSMC). This company has a market share of c. 58.5%⁷⁵ as of 2022 and is headquartered in Taiwan, which poses a risk given its current trade tensions with China. On the other hand, China's trade tensions with the U.S. also pose negative prospects given that China is the world's leading supplier of silicon (c. 69% of total silicon materials in 2020⁷⁶).

To solve such problem, some larger firms in the industry are planning to relocate the factories in which their semiconductors are manufactured, moving them from Asia to the U.S.⁷⁷. Furthermore, both the Chips for America Act⁷⁸ (2021) and the EU Chips Act⁷⁹ (2022) serve as a protection implemented as a government regulation to try to minimize supply chain disruptions.

Financial statements forecasts

NOD's financials were projected considering a growth period of thirteen years, from 2023 to 2035, where the firm grows in line with its current short- and medium-term strategy, and a stable period of five years, from 2036 to 2040, where it continues to grow, but at a slower pace to mimic its long-term state. Such window of projections was selected as NOD is a technological company, undergoing significant growth (market share increasing by c. 133% between 2018 and 2022). Moreover, industry- and company-level trends support NOD's growth until the end of the 2020s, corroborating the need for a longer forecasting period. After 2040, NOD is expected to continue operating, despite it reaching the **maturity stage** of its business life cycle curve⁸⁰ by 2035 (Figure 41), with its revenues beginning to decrease y-o-y in 2040, profit margins getting thinner (from 2035-onwards) and stagnant but sufficient cash flows to avoid liquidation (from 2035-onwards in net

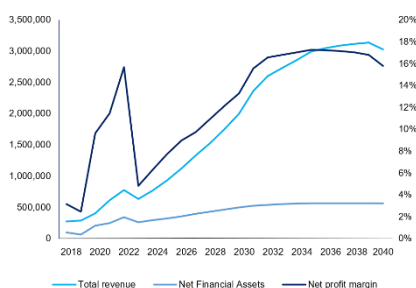


Figure 41: NOD's business life cycle curve, which shows decreasing revenues and profit margins, and stagnant net financial assets (i.e., the firm's negative net debt).
Source: Company's annual reports for 2018 to 2022; Own computations.

⁷⁵ Alsop, Thomas. 2023. "Top Semiconductor Foundries Market Share Worldwide 2017-2019 | Statista." Statista. Statista. March 14, 2023.

⁷⁶ U.S. Geological Survey. n.d. "Silicon Statistics and Information | U.S. Geological Survey."

⁷⁷ Apple's semiconductors will still be manufactured and managed by the TSMC, however, they will be produced in a new factory in the U.S. to avoid risks that operations in Asia may impose (trade tensions, lockdown constraints...) Leswing, Kif. 2022. "Tim Cook Says Apple Will Use Chips Built in the U.S. At Arizona Factory." CNBC. December 6, 2022.

⁷⁸ "This bill establishes investments and incentives to support the U.S. semiconductor manufacturing, research and development, and supply chain security".

⁷⁹ "The European chips act will bolster Europe's competitiveness and resilience in semiconductor technologies and help achieve both the digital and green transition".

⁸⁰ Business Life Cycle framework and its five stages. This curve reflects the progression of a business over time, from the moment it is launched to when it reaches a declining phase. <https://corporatefinanceinstitute.com/resources/valuation/business-life-cycle/>

financial assets⁸¹). With the business maturing, the company's size becomes smaller (market share decreasing from 2032-onwards), but one does not expect NOD to reinvest in new technologies after 2040 attempting to revamp its growth.

NOD's financial projections were conducted according to three possible scenarios, them being a base, a bear, and a bull scenario. While the base case reflects the current state of the economy, the bear and the bull cases test future expectations around the current economic panorama. Indeed, the base scenario represents the statistical mode, i.e., the business as one believes it will go forward, and the economy state "as is" is assumed as the norm. Thus, it incorporates assumptions of (i.) rising interest rates (ECB refinancing interest rate at 3.75% and forecasted to increase in June⁸²), (ii.) inflation forecasts "remaining too high, for too long [...] and inflationary pressures remaining strong"⁸³, (iii.) shortages of raw semiconductor materials persisting over 2023 and 2024⁸⁴, and (iv.) that advancements in IoT and artificial intelligence will continue driving demand for chips⁸⁵. The bear case considers a more conservative outlook, with relatively higher inflation and interest rates, and lower sales growth⁸⁶. It was created since one is not certain about when interest rates will start decreasing⁸⁷, as inflation continues to increase (Eurozone inflation increased 1 p.p. between March and April 2023⁸⁸), but also due to uncertainty regarding how the industry will behave with different trends impacting each geography⁸⁹. In contrast, the bull case reflects a more opportunistic scenario in which some of the constraints observed in the base case are relaxed, with relatively lower inflation and interest rates, and higher sales growth⁸⁶. This scenario was essentially created due to the industry's fast-paced nature, which could foster enough demand to offset some of the trends that are currently more likely to cap future industry growth.

Income statement captions: analysis and forecasts

- Revenues

NOD's **revenues** were forecasted according to a top-down approach in which one started to project the overall industry value, followed by the company's future

⁸¹ The net financial assets caption includes almost entirely cash, as the company has no interest-bearing debt and is not forecasted to issue in the future. The caption also includes leases, but these have been contributing a minority to the total sum of the caption: on average c. 9% between 2020 and 2022.

⁸² [Caetano, Edgar. 2023. "BCE. 'Não Estamos a Pausar \[Na Subida Dos Juros\], Isso é Muito Claro'. Garante Christine Lagarde." Observador. May 4, 2023.](#)

⁸³ Ibid. Transcribed from BCE statement upon May interest rate increases.

⁸⁴ [J.P. Morgan. 2023. "How Long Will the Chip Shortage Last? | J.P. Morgan Research." Www.jpmorgan.com. April 18, 2023.](#)

⁸⁵ [Lincoln, Clark. 2023. "Global Semiconductor Industry Outlook for 2023." Advisory.kpmg.us. February 1, 2023.](#)

⁸⁶ The rationale behind the association of higher inflation with lower sales, and vice-versa, comes from the idea that when inflation increases, each unit of currency buys less goods and services. Thus, consumers tend to reduce their spending, especially on non-essential goods such as electronics, due to their lower purchasing power, which ultimately translates into lower sales for electronics companies. NOD's Q1 2023 financials show decreased sales in all its product segments due to weaker demand, as consumers are spending less on electronics.

⁸⁷ [SIC Notícias. 2023. "Banco de Portugal Avisava Que Taxas de Juro Vão Subir Até Ao Verão E Só Descem Em 2024." SIC Notícias. May 10, 2023.](#)

⁸⁸ [Caetano, Edgar. 2023. "BCE. 'Não Estamos a Pausar \[Na Subida Dos Juros\], Isso é Muito Claro'. Garante Christine Lagarde." Observador. May 4, 2023.](#)

⁸⁹ New manufacturing plants being built in the U.S. and Europe to boost domestic production, or the possibility of TSMC shutting operations in case China invades Taiwan ([Habershon, Alfie. 2022. "TSMC Shuts If China Invades Taiwan, Says Boss - Focus Taiwan." Asia Financial. August 2, 2022.](#)), which would halt the global semiconductor production, as TSMC is responsible for over 60% of this production ([The Economist. 2023. "Taiwan's Dominance of the Chip Industry Makes It More Important." The Economist. March 6, 2023.](#)).

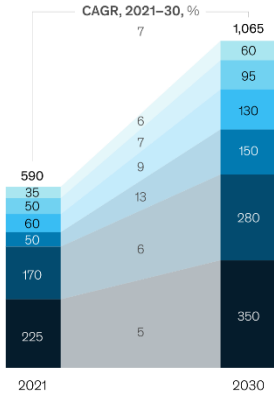


Figure 42: McKinsey's & Company projection for the semiconductor industry value in 2030. Source: [McKinsey & Company article](#).

market share within each geography of the industry, ultimately allowing to compute the market share that NOD will occupy on the industry. This angle mimics a funnel vision, from which one looks at the industry-level first and subsequently at NOD. As the main trends impacting the industry tend to be the ones impacting NOD, this seemed adequate to transfer the industry's prosperity and hardship onto the firm.

Starting with the **industry value forecasts**, according to McKinsey & Company⁹⁰, the **worldwide semiconductor industry** is expected to reach a market value of **\$1 trillion by 2030**, assuming a CAGR₂₀₂₂₋₂₀₃₀ of c. 8% in real terms (Figure 42). One is confident about this study's underlying assumptions due to: (i.) the inflation rate is in-line with the long-term average inflation rate between 1997 to 2028⁹¹, i.e., c. 2.08%; (ii.) the megatrends are supported by a 125% increase in the number of connected IoT devices between 2021 and 2025⁹² and by the global spending on the IoT being forecasted to reach \$1.1 trillion in 2023 (i.e., a c. 13% CAGR₂₀₁₉₋₂₀₂₃); and (iii.) the convergence between supply and demand is supported by the near-term stabilization of the shortages by 2024⁹³.

For the years remaining **until 2040**, one considered a **KPMG**⁹⁴ study that forecasts the value of the automotive semiconductor industry in 2040 to be between **\$200 and \$250 billion** (Figure 43). To reach such value, one predicted this sub-segment to correspond to **c. 10%** of the overall semiconductor industry value between 2023 and 2039. Despite the increasing need of semiconductors to produce cars (100 chips used per car in mid-2000s vs. 1,400-1,500 used today), this has been the case since 2013 (Figure 44). Following that, one assumed a CAGR₂₀₂₂₋₂₀₄₀ of c. 8% in real terms to forecast the value of the automotive semiconductor industry between 2023 and 2039, which is in line with KPMG's projection for 2040⁹⁵. From this value, one extrapolated the semiconductor industry value from 2031-onwards.

Depending on which forecasting scenario is chosen, revenues evolve differently. Regarding the market value of the semiconductor industry in 2030 (predicted to be \$1 trillion), this value increases (decreases) by 5% in the bull (bear) scenario. Similarly, regarding the market value of the automotive semiconductor industry in 2040 (predicted to be \$225 billion), this value increases (decreases) by 30% in the bull (bear) scenario. Starting with the semiconductor industry projections, a 5% change was chosen since McKinsey's projection is consensual across the

2022 Projections

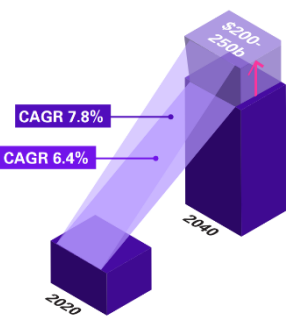


Figure 43: KPMG projection for the automotive semiconductor industry value in 2040. Source: [KPMG article](#).

	2018	2019	2020
Automotive semiconductor industry revenue	41.8	41.2	33.3
Automotive semiconductor industry market share	9%	10%	8%
	2021	2022	
Automotive semiconductor industry revenue	53.1	59.2	
Automotive semiconductor industry market share	10%	10%	

Figure 44: Evolution of the automotive semiconductor industry value. Source: [Statista & IHS Markit](#); and [Yahoo Finance & Contrive Datum Insights](#).

⁹⁰ [Burkacky, Ondrej, Dragon, Julia, and Lehmann, Nikolaus. 2022. "The Semiconductor Decade: A Trillion-Dollar Industry | McKinsey." Www.mckinsey.com. April 1, 2022.](#) This study's projections are based on forty-eight listed companies, an inflation rate of 2.0%, and upon the megatrends that support the vitality of the semiconductor industry. It also assumes the short-term stabilization of the supply and demand imbalance that is hindering the industry and sustains that most of the industry growth will be driven by the automotive, computation and data storage, and wireless segments, with autonomous driving, e-mobility, artificial intelligence, cloud computing, and the 5G network being the applications that drive such growth.

⁹¹ IMF data for Advanced Economies, Retrieved May 2023. <https://www.imf.org/external/datamapper/PCPIPCH@WEO/OEMDC/ADVEC/WEOORLD>

⁹² [Nordic Semiconductor ASA. 2022. "Credit Investor Presentation from Nordic Semiconductor." Www.nordicsemi.com. June 13, 2022.](#)

⁹³ [J.P. Morgan. 2023. "How Long Will the Chip Shortage Last? | J.P. Morgan Research." Www.jpmorgan.com. April 18, 2023.](#)

⁹⁴ [Silberg, Gary. 2022. "Growth in automotive semiconductors outpace expectations". KPMG. August 4, 2022.](#)

⁹⁵ KPMG's projections were based upon a proprietary model in which KPMG forecasted semiconductor demand by application, and product and vehicle type from 2019 to 2040, after conducting expert interviews and analysing Gartner's automotive semiconductor data. The model was validated against industry data and experts' opinion.

market⁹⁶. Regarding the automotive industry, a 30% change allows the projections to be above or below the two extremities of KPMG's projections⁹⁷.

The second value driver of NOD's revenues is the **industry's sales evolution per geography**. As explained, from 2013 to 2022, each region has been contributing relatively the same to the entire industry. Due to such stability, one forecasted the industry's value per geography as being the product between the forecasted total industry value and the forecasted share of each region within the industry.

Subsequently, one forecasted **NOD's respective market share in each region**. Firstly, its forecasts acknowledge a negative revenue growth in 2023 (c. -18% vs 2022) due to persisting raw materials shortages and to reflect weaker product demand, which has been translated into order cancellations⁹⁸. Considering Q1 2023 results and Q2 2023 outlook, quarterly revenue expectations are below those of 2022, justifying a negative growth rate year-on-year.

From **2024 until 2032**, NOD is forecasted to grow at a pace superior to later years due to: (i). the medium-term outlook for the BLE which entails the end of wafer supply constraints, (ii.) the R&D investments in smaller revenue segments starting to pay off, and (iii.) an increasing share of smaller segments gaining commercial traction. As such, NOD's revenue growth is foreseen to range between c. 19% and 22% during 2024-2027 and between c. 10% and 18% during 2028-2032. Thus, from **2024 to 2027**, NOD will enlarge its presence in the Americas and Europe at a higher pace than it will do in Asia / Pacific, due to the weaker demand it is seeing in its Chinese market⁹⁹ but also due to its suppliers' investing in plants in the U.S. and in Europe¹⁰⁰. From **2028 to 2032**, one foresees NOD's market share to increase more slowly, and with the Americas and Asia / Pacific growing at a faster pace than Europe. While the U.S. have been pro-active to revamp the domestic semiconductor industry to avoid future supply disruptions, Europe is focusing on expanding a co-operation with countries, such as the US, Japan, South Korea, and Taiwan, to increase its share within the stages of chips manufacturing¹⁰¹.

From **2033-onwards**, NOD's market share reflects slower annual revenue growth, i.e., ranging from c. 5% in 2033 to c. -3% in 2040, with its market share decreasing

⁹⁶ [Melvin, Cassandra. 2023. "Collaboration Key to Fueling Sustainable Chip Industry Growth to over \\$1 Trillion by 2030" SEMI. January 3, 2023.](#)

⁹⁷ Three considerations dictated this change. Firstly, one feels confident about KPMG's results as it has been tracking the automotive industry through an expert-validated model since 2019. Secondly, no other studies can be found on the matter, which calls for a larger increase than the one applied to McKinsey's projections. Thirdly, KPMG 2022 forecasts' revisions returned an increase of c. 30% with respect to 2019, as the model did not contemplate the existence of a pandemic and global semiconductor shortages. Thus, one also predicts a change of that magnitude to allow for variability regarding the industry's value until 2040.

⁹⁸ NOD has been suffering order cancellations especially from its Chinese consumers, with these mainly cancelling orders as households are seeking to save finances instead of spending them. [He, Laura. 2023. "China Has an Inflation Problem. It's Way Too Low | CNN Business." CNN. April 25, 2023.](#)

⁹⁹ Ibid. Chinese households continue to save money rather than spending it, and businesses are hesitant in making new investments, due to the economy's uncertainty.

¹⁰⁰ Taiwan Semiconductor Manufacturing Company is building a \$12bn new factory in Arizona, expected to start producing in 2024 and expected to have an annual capacity of 2.4 million wafers. Global Foundries is planning a second plant in Malta (NY, USA), which is to be developed in close partnership with the government. Additionally, the CHIPS for America Act (2021) and the EU Chips Act (2022) are bills that establish investment incentives to support manufacturing and R&D within the semiconductor industry. Information extracted from: [Nordic Semiconductor ASA. 2022. "Credit Investor Presentation from Nordic Semiconductor." Www.nordicsemi.com. June 13, 2022.](#)

¹⁰¹ [Lawson, Brian, et al. 2023. "The Shifting Global Semiconductor Landscape in Asia-Pacific." IHS Markit. February 10, 2023.](#)

y-o-y across all geographies to mimic its long-term stabilization.

Depending on which scenario is selected, NOD’s market share per region evolves differently. Indeed, relatively to the base case, the bear scenario accentuates decreases in market share by c. 3%, with the bull scenario attenuating such decreases by c. -3%. The opposite happens for market share increases, with the bear scenario projecting them more conservatively (c. -3% vs the base case) and the bull scenario accentuating such increases by c. 3%. Such values were chosen to reflect potential small fluctuations in NOD’s market share due to different macroeconomic trends pushing the industry towards a more bear or bull case.

- Payroll expenses

Payroll expenses¹⁰² were forecasted according to the expected number of NOD employees, the average cost per employee, and the inflation rate. From 2023 to 2030, the number of employees was projected given the previous year’s number plus 200 employees per year, similarly to what happened between 2019 and 2022 (Figure 45) to mimic the fact that NOD will need more human capital to meet its growth prospects. From 2031 to 2035, one expects NOD to solely need 100 additional employees per year, with this value decreasing to 50 new employees per year during 2036 to 2040 to mimic its stabilization during those years.

The average cost per employee was forecasted considering its historical average since it has been stable during the observation period. This cost is affected by the inflation rate of advanced economies and grows accordingly each year. If one feels more pessimistic about the global macroeconomic scenario (i.e., bear case), then a 0.5% increase in the inflation rate is seen, causing payroll expenses to increase. The opposite happens when the bull scenario is selected, with a 0.5% decrease in the inflation rate occurring, causing payroll expenses to decrease¹⁰³. Such changes mimic the size of some of the historical changes, i.e., from 1997 to 2020, the annual average change in inflation for advanced economies was -0.6pp. As such, ± 0.5% seems to be a fair proxy of ordinary changes in the inflation rate.

When computing NOD’s unitary employee costs (Figure 46), one can see stable values from 2018 to 2020. Starting in 2021, this conclusion shifts, with the unitary employee costs increasing by c. 21% y-o-y and decreasing by c. 10% y-o-y in 2022. This seems to be due to the proportion of employees out of total payroll expenditures being lower in 2021 (c. 0.8% vs c. 1.0% from 2018 to 2020), driving the unitary employee cost upwards. Indeed, before 2021, the total payroll

	2019	2020	2021	2022
Number of employees	767	977	1,197	1,435
Incremental value		+ 210	+ 220	+ 238

Figure 45: Evolution of NOD’s number of employees between 2019 and 2022. Source: Company’s respective annual reports from 2019 to 2022.

Amounts in 1,000	2018	2019	2020
Payroll expenses	70,048	80,281	101,211
Number of employees	685	767	977
Unitary cost	\$ 102.26	\$ 104.67	\$ 103.59
% of payroll expenses	1.0%	1.0%	1.0%

Amounts in 1,000	2021	2022
Payroll expenses	149,824	161,440
Number of employees	1,197	1,435
Unitary cost	\$ 125.17	\$ 112.50
% of payroll expenses	0.8%	0.9%

Figure 46: Evolution of NOD’s unitary employee costs. Source: Company’s respective annual reports from 2018 to 2022.

¹⁰² Caption includes employees’ yearly compensations in terms of salary, vacation pay, and other types of contributions, but also capitalized development expenses relating to employees’ hourly costs, defined contribution pension expenses, and payroll taxes.
¹⁰³ Similarly to what was mentioned before, payroll expenses increase when inflation increases (and vice-versa) as companies tend to raise wages to compensate for the general increase in the prices of goods and services that can be observed in the economy (i.e. to compensate for the increased cost of living).

IFXGn	2018	2019	2020
Payroll expenses	2,694,825	2,864,977	3,562,186
Number of employees	39,096	41,418	46,665
Unitary cost	\$ 68.93	\$ 69.17	\$ 76.34
% of payroll expenses	1.5%	1.4%	1.3%

IFXGn	2021	2022
Payroll expenses	4,145,867	4,473,159
Number of employees	50,288	56,194
Unitary cost	\$ 82.44	\$ 79.60
% of payroll expenses	1.2%	1.3%

TXN	2018	2019	2020
Payroll expenses	3,243,000	3,189,000	3,153,000
Number of employees	29,888	29,768	30,000
Unitary cost	\$ 108.51	\$ 107.13	\$ 105.10
% of payroll expenses	1.0%	1.0%	1.0%

TXN	2021	2022
Payroll expenses	3,220,000	3,374,000
Number of employees	31,000	33,000
Unitary cost	\$ 103.87	\$ 102.24
% of payroll expenses	1.0%	1.0%

QCOM	2018	2019	2020
Payroll expenses	8,611,000	7,593,000	8,049,000
Number of employees	35,400	37,000	41,000
Unitary cost	\$ 243.25	\$ 205.22	\$ 196.32
% of payroll expenses	0.4%	0.5%	0.5%

QCOM	2021	2022
Payroll expenses	9,515,000	10,764,000
Number of employees	45,000	51,000
Unitary cost	\$ 211.44	\$ 211.06
% of payroll expenses	0.5%	0.5%

SLAB	2018	2019	2020
Payroll expenses	436,191	598,927	634,614
Number of employees	1,505	1,545	1,838
Unitary cost	\$ 289.83	\$ 387.66	\$ 345.27
% of payroll expenses	0.3%	0.3%	0.3%

SLAB	2021	2022
Payroll expenses	458,230	523,297
Number of employees	1,667	1,964
Unitary cost	\$ 274.88	\$ 266.44
% of payroll expenses	0.4%	0.4%

Figure 47: Evolution of the peers' unitary employee costs.
Source: Companies' respective annual reports from 2018 to 2022.

expenses were diluted through a larger pool of employees thus implying lower unitary costs. When comparing NOD's unitary employee costs against those of its competitors (Figure 47) conclusions are slightly different and vary from peer to peer. IFXGn presents stability in its unitary employee costs from 2018 to 2020. In 2021, its unitary costs increased y-o-y by c. 8% and decreased by c. 3% y-o-y in 2022. Similarly to NOD, the proportion of employees out of payroll expenditures was lower in 2021, which made the total payroll expenses to be diluted through a lower proportion of employees (c. 1.2% in 2021 vs c. 1.4% the years before). TXN presents similar unitary costs to NOD (average unitary cost of c. \$105k between 2018 and 2022). In contrast, TXN did not present fluctuations as it kept its proportion of employees out of total payroll expenditures at c. 1%. For QCOM, costs solely presented fluctuations in 2018 (c. 19% increase y-o-y), as the proportion of employees out of total payroll expenses was lower (c. 0.4% vs c. 0.5% the following years). For SLAB, unitary costs were also higher in 2018 and 2019 (c. 10% increase y-o-y) due to a lower proportion of employees out of payroll expenses (c. 0.3% vs c. 0.4% the following years).

Balance sheet captions: analysis and forecasts

- Accounts receivables and other receivables

To project NOD's **accounts receivable and other receivables** caption, one considered the average collection period (ACP) as the forecasting driver. During the last four years, the ACP did not vary much with an amplitude of only eight days in between. Despite this, NOD's peers have much lower ACP, with an average value of 40 days from 2018 to 2022, i.e., c. 2.1x lower than NOD's ratio (Figure 48). NOD's larger ratio can be due to it having a larger consumer concentration than its peers. Indeed, in 2022, c. 46% of its total revenues were enabled by its two largest customers, while for SLAB, its ten largest customers represented c. 20% of the company's revenues, for TXN more than 40% of its revenues were derived from consumers outside their top 100 largest consumers, and for QCOM its two largest consumers represented c. 20% of its revenues¹⁰⁴. The peers' larger consumer diversification can enable them to negotiate lower payment periods, thus reducing their ACP. As NOD deals more frequently with a concentrated pool of consumers, it can be more permissive in granting them longer payment periods. One based this driver's forecasting on the consistency of the ratio: despite NOD trying to require its consumers to pay quicker, it seems difficult to make this ratio closer to the peers' values. Thus, one believes this ratio will be kept at average levels with

Average collection period	2018	2019	2020	2021	2022
Nordic Semiconductor	70	92	84	90	88
SilLabs	31	33	39	50	25
Infineon	47	40	51	49	48
Texas Instruments	28	27	36	34	35
Qualcomm	47	37	62	39	47
Average ratio of the peers	38	34	47	43	39
Median ratio of the peers	39	35	45	44	41

Figure 48: Evolution of the average collection period for NOD and its peers.
Source: Companies' respective annual reports from 2018 to 2022.

¹⁰⁴ Data retrieved from the respective 2022 annual reports: NOD - <https://www.nordicsemi.com/Investor-Relations/Reports/Annual?year=2022>, SLAB - <https://siliconlabs2022cr.q4web.com/financials/annual-reports-and-proxies/default.aspx>, TXN - <https://investor.ti.com/financial-information/earnings-annual-reports>, QCOM - <https://investor.qualcomm.com/financial-information/historical-financial-results>

a value of 85 days by 2040. Between 2023 and 2039, it was forecasted to mimic the pro-rata decrease from 2022’s average of 88 days to 2040’s ratio of 85 days.

- Intangible assets

Intangible assets¹⁰⁵ were forecasted considering two assumptions. Firstly, a decreasing trend can be seen in the past five years of intangible assets as a percentage of total revenues (from c. 16% in 2018 to c. 5% in 2022). Secondly, one foresees NOD will incur in continuous R&D investments over the near term, implying a need for more intangible assets until 2031. From 2032-onwards, NOD continues to invest in R&D but at a smaller pace and with reduced y-o-y investments (intangible assets’ CAGR₂₀₃₃₋₂₀₄₀ of c. -5%) which is-line with the company stagnating around 2035, due to solely producing its already existing products, and not bringing new ones to the market.

Long-term value drivers

The fast-paced nature of NOD’s industry required the firm’s financials to be forecasted until 2040 to allow it to reach a steady state, in which its unlevered free cash flows (FCFs) grow at a rate smaller than the world’s nominal long-term GDP growth rate. Such long-term cap was forecasted as the average long-term global GDP growth rate from 1997 to 2027, i.e., c. 3.5% (real terms) and c. 5.6% (nominal terms)¹⁰⁶. As such, the nominal growth rate of the firm’s unlevered FCFs in 2040 is equal to c. 0.2% (assuming the long-term average inflation rate between 1997 and 2028 of 2.08%), which is below the cap (*Figure 49*). Thus, in 2040, NOD is growing below the long-term average inflation rate, which explains why it is recording reduced profit margins from 2035-onwards (net profit CAGR₂₀₃₅₋₂₀₄₀ of c. -2%) as revenues are increasing below inflation from 2036-onwards but operating costs are rising with inflation (i.e., payroll expenses). With NOD growing below inflation, its shareholders’ value is reduced, with slower growth driving lower stock prices and investors not being willing to invest as it is not growing at the same rate as the economy. This leads to NOD’s reduced attractiveness over the long-term.

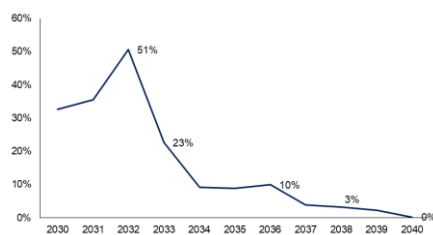


Figure 49: Evolution of NOD’s unlevered FCF nominal growth rate from 2030-onwards. Source: Own computations.

Intrinsic Valuation

DCF: cost of debt, cost of equity, and WACC

Unlike its peers, NOD does not have any issued debt (such as bonds) nor interest-bearing debt (such as loans). Instead, its non-current liabilities mainly consist of

¹⁰⁵ Caption consists of capitalized development expenses, software and other intangible assets, and goodwill.

¹⁰⁶ O’Neill, Aaron. 2023. “Growth of the Global Gross Domestic Product (GDP) from 1980 to 2022, with Forecasts until 2028.” Statista. May 10, 2023.

leases (which amounted to c. 3% in 2022). Therefore, given its negative net debt, the analysts assumed the risk-free rate as the company's cost of debt, as the possibility of NOD failing to comply with its obligations is close to zero when considering its liquidity position. As such, one considered 3.88%¹⁰⁷ as the cost of debt and, consequently, as the risk-free rate. This value was retrieved from the 10-year US treasury bond as the obligations backed by the U.S. government are not expected incur default (virtually posing zero risk) and have the same currency as NOD's cash flows. The 10Y treasury was chosen over the 30Y one or another with the same maturity as the forecasts, given the nature of the industry and segment. In other words, given that the tech industry is known to be fast-paced as innovation is its main driver, the analysts have found the 10Y yield on a U.S. treasury to be more tradeable and liquid than the 30Y one.

NOD's cost of equity was computed based on its historical returns between the end of FY 2019 and the end of FY 2022. Moreover, the Morgan Stanley Capital International world index (MSCI) was chosen as a proxy for the market portfolio¹⁰⁸. Furthermore, when NOD's historical returns were regressed against the MSCI world index returns, it presented a raw equity beta of c. 1.85, which is relevant at the 95% confidence level (with a confidence interval of [1.59, 2.12]) and with an R-squared of about 55%, which means that 55% of the variation observed in the past returns are explained by the regression model.

The raw betas of the comparable firms as well as the raw betas of relevant industry indices such as the SOX, the DJUSSC¹⁰⁹ and the SPSISC¹¹⁰ were also estimated. Given the wide range of values attained through these raw equity betas, the analysts computed an industry beta to improve precision. To do so, one computed the unlevered beta of each of the firms so that they would be comparable despite their capital structure (level of leverage) and, consequently, financial risk. Subsequently, the median of the unlevered raw betas (c. 1.24) was attained and used to relever the NOD's equity beta, which yielded a value of approximately 1.17. Thereafter, the Bloomberg-adjusted beta¹¹¹ was computed and a beta of roughly 1.11 was attained. This smoothing process is made to smooth the raw regression estimates towards one, as theoretically equity betas converge to one in the long-term, given its mean-reverting tendency (Figure 50).

Equity beta computations	
NOD's raw β_E	1.85
NOD's raw unlevered β_E	1.96
Industry β_E (median)	1.24
NOD's relevered β_E	1.17
Bloomberg-adjusted β_E for NOI	1.11

Figure 50: Summarized NOD's equity beta assumptions.
Source: Own analysis.

¹⁰⁷ Data retrieved for the 30th of December 2022. - [Board of Governors of the Federal Reserve System \(US\). 1962. "10-Year Treasury Constant Maturity Rate." FRED. Federal Reserve Bank of St. Louis. January 2, 1962.](#)

¹⁰⁸ The MSCI world index is representative of the market portfolio as it "represents large and mid-cap equity performance across 23 developed markets countries" - "[MSCI World Index - MSCI." 2019. Msci.com. 2019.](#) Additionally, a standard practice would be to use the Standard & Poor's 500 (S&P500). However, this index only tracks the 500 best performing stock in the U.S. and since NOD is listed in the Oslo stock exchange, the MSCI world index was considered a better fit.

¹⁰⁹ The Dow Jones U.S. Semiconductors Index (DJUSSC), a member of the Dow Jones Global Indices® family, is designed to measure the performance of U.S. companies in the semiconductors subsector.

¹¹⁰ S&P Select Industry Indices are designed to measure the performance of narrow GICS® sub-industries. The Index comprises stocks in the S&P Total Market Index that are classified in the GICS global industry classification standard) semiconductor sub-industry. GICS = global industry classification standard

¹¹¹ Chapter 15 - "Estimating the Cost of Capital" McKinsey's Valuation book, 7th edition

Terminal value assumptions	
WACC	11.16%
Global GDP growth rate	3.48%
Terminal real growth rate	-1.83%
Terminal nominal growth rate	0.22%

Figure 51: Summarized NOD's terminal value assumptions.

Source: own analysis.

Lastly, one computed NOD's cost of equity through the Capital Asset Pricing Model¹¹² (CAPM) method, which yielded a value of c. 10.29%. To apply this method, the above-mentioned risk-free rate of 3.88% was chosen and one has considered a market risk premium (MRP) of 5.75%¹¹³ as suggested by KPMG¹¹⁴.

Furthermore, the enterprise value (EV) was computed through NOD's market capitalization¹¹⁵ as of FY 2022 and the book value of net debt for the same period.

To sum up, after considering a corporate tax rate of 22.00%¹¹⁶, through the CAPM, a value of c. 11.16% was attained for the company's weighted average cost of capital (WACC). These values are applicable in all scenarios as the inputs are retrieved from historical data (Figure 51).

Terminal value

The analysts have chosen to make the forecasts up until 2040, considering the fast-moving pace of the tech industry and consequently, tech companies. As a player in this industry, NOD's prospects are those of a company that is still expected to grow over the medium-term (cf. "Financial Statements Forecasts"), making it necessary to extend the forecasting period so to stabilize growth prospects in the long-term.

Through the valuation model, one can observe that, by 2040, the real growth rate on the unlevered FCFs has stabilized (starting in 2036), reaching a value of c. -1.83%. This negative growth rate implies that the company is decreasing in profit. In fact, even though total revenue is still increasing in the predicted stable period (2036 to 2040), excluding the year of 2040 in which revenues decrease as a result of a decrease in the worldwide semiconductors' revenues combined with a decrease of NOD's market share, the company's total comprehensive income starts decreasing by 2039 for the base case, in 2036 for the bear case and only by 2040 for the bull case. This is a result of a higher amount, in absolute terms, of net payroll expenses which, for the base case, are expected to increase by c. 3.5% between 2039 and 2040 when compared to the previous year due to the increasing cost per employee driven by the compounding effect of inflation.

Subsequently, the Fisher's equation¹¹⁷ was used to compute the nominal value of the company's terminal growth rate (c. 0.2%). Thereafter, a growing perpetuity was

¹¹² The CAPM states that the difference between expected returns depend on the covariance between them (β) and the market portfolio, given that specific risk can be diversified away. As such, the following formula was used so to compute the return on equity: $r_e = r_f + \beta_e * MRP$

¹¹³ As per 31 December 2022

¹¹⁴ This value was attained through the implied MRP methodology which tracks the "implied equity returns for a number of major equity markets over time" such as the S&P 500 and the FTSE. Thus, it incorporates expectations, market developments and can be retrieved from the data available in the market. (<https://kpmg.com/nl/en/home/topics/equity-market-risk-premium.html>)

¹¹⁵ As per 30 December 2022, NOD had 191,575 thousand shares outstanding and a price per share of \$16.7305, which yielded a market capitalization of \$3,205,140 (in thousands)

¹¹⁶ PwC, 2021, "Worldwide Tax Summaries Online," [Taxsummaries.pwc.com/2021](https://taxsummaries.pwc.com/2021).

¹¹⁷ Describes the relation between nominal and real rates through inflation.

applied to determine the terminal value on the operating FCF.

Furthermore, the reinvestment rate of the core business is at c. -13% by the end of the forecasted period, which indicates that it is no longer profitable to invest in the company as it is not expected to create value going into the future. This goes in line with NOD’s negative real growth rate of its core FCFs, i.e., c. 9%, and thus implies that the company will not be able to attract external funding.

Lastly, note that both the WACC and the global GDP growth rate are above the terminal nominal growth rate for all scenarios (figure 52), which implies that NOD will not outgrow the global economy, hence the value computed can be considered a fair and feasible proxy of the terminal value of the company.

Discounted cash flow valuation & conclusions

Most firms, similarly to NOD, disclose a financing strategy such as their debt-to-equity target ratio. Whenever a firm opts for a stable capital structure, the most suitable valuation model is the discounted cash flow method (DCF). This model was chosen to value NOD, given that it intends to maintain a target capital structure (equity ratio of at least 50%) which implies that the cost of capital, measured by the WACC, is constant for all the analysis years of the forecast. Once NOD is already complying with this target ratio (with an equity ratio of c. 75% by the end of 2022), the weights used for debt and equity in regards to enterprise value (EV) were the ones the company had as of the end of FY 2022, i.e., market capitalization and book value of debt.

Therefore, the value of the company’s operating EV should be measured by the present value of its future operating FCFs, adjusted for its WACC and long-term growth rate. After computing NOD’s operating EV through the DCF, one estimated the EV-to-equity bridge to compute its share price as of FY 2023 (Figure 52). The operating EV (i.e., c. \$2.2m) was then adjusted with non-core and financing operations to best represent NOD’s market value. Regardless, both were obtained through book value captions (extracted from the forecasted balance sheet), given that on one hand, the value of the non-operating EV is less than 1% of the value of the operating EV and is thus not so significant and on the other hand, since debt is not traded (no issued debt).

The value of equity identified through the DCF valuation is the one obtained when considering the base scenario. Nonetheless, as the analysts created three scenarios, one attributed probabilities that stand for the likelihood of each scenario occurring, to obtain the expected equity value¹¹⁸ (Figure 53) – 40% probability for the

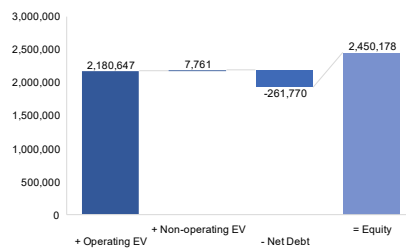


Figure 52: EV-to-Equity bridge from NOD’s DCF. Source: own analysis

	Bear	Base	Bull
Likelihood of each scenario	40%	50%	10%
Value of equity of each scenario (DCF)	935,013	2,450,178	4,900,826

Figure 53: Expected equity value computed as the sum between the probabilities of each scenario and the value of equity obtained from each scenario, under the DCF. Source: Own computations.

¹¹⁸ The expected equity value is the sum-product computation of the values of equity obtained for each scenario times each scenario’s respective probability of occurrence.

bear scenario occurring, 50% for the base scenario, and 10% for the bull scenario. The base case combines assumptions regarding how one expects both the industry and the global economy to evolve during the next eighteen years. As such, it represents the most likely scenario, as it was created to best mimic NOD’s activity over the forecasted years. The second most likely scenario corresponds to the bear case due to four factors: (i.) a global recession might be imminent, with c. 67% of the World Economic Forum’s chief economists believing it is likely to occur in 2023¹¹⁹; (ii.) there is an increased likelihood of China invading Taiwan during the medium-term, impacting growth in Asia / Pacific¹²⁰; (iii.) other chip shortages are likely to occur due to the mismatch between supply and demand not being quickly addressable as scaling up production takes its time¹²¹; and (iv.) inflation and interest rates continuing to increase with no foreseeable ending date¹²². These reflect some of the upcoming difficulties that NOD will face, which corroborate the increased likelihood of the bear scenario over the bull. This latter scenario was created as the industry’s unpredictability calls for the existence of a more optimistic scenario¹²³. However, one does not expect the benefits of these trends to be larger in magnitude than the economic risks contemplated in the bear and base cases.

Furthermore, this paper’s recommendation is based on the total expected shareholders’ return, which sums dividend yield and capital gain. As NOD has not paid dividends since 2011 and states that it does not expect to start paying them in 2023, one assumes the expected dividend for FY 2023 to be equal to \$0, making NOD’s dividend yield equal to 0%.¹²⁴

As such, computing the weighted average equity value, one obtains NOD’s expected equity value as of FY 2023. Dividing this value by the number of NOD’s shares outstanding, the expected share price for FY 2023 is \$10.94 (Figure 54).

Expected equity value	2,089,177
Number of shares	190,959
Expected price per share (end of 2023)	10.94
Share price as of May 12th 2023	10.25
Expected dividend (FY2023)	0
Dividend yield	0.0%
Capital gain	6.7%
Expected shareholders’ return	6.7%
Recommendation	Hold

Figure 54: Expected shareholder return under the DCF valuation.
Source: Own computations.

Relative valuation

Trading multiples

To triangulate the intrinsic valuation, one computed forward-looking multiples, i.e., EV/Sales₂₀₂₃, EV/EBITDA₂₀₂₃, and EV/EBIT₂₀₂₃ for NOD and its peers¹²⁵ (Figure 55).

¹¹⁹ Public Affairs. 2023. "Chief Economists Say Global Recession Likely in 2023, but Cost of Living Crisis close to Peaking." [World Economic Forum, January 16, 2023.](#)
¹²⁰ Smith, Helen-Ann. 2023. "China 'More Likely' to Invade Taiwan and Attack Could Come in 2027 Island's Foreign Minister Joseph Wu Warns." [Sky News, April 12, 2023.](#)
¹²¹ Kumar, Rakesh. 2023. "We're Going to Have Another Chip Shortage—despite the CHIPS Act." [Fortune, March 11, 2023.](#)
¹²² Caetano, Edqar. 2023. "BCE, 'Não Estamos a Pausar [Na Subida Dos Juros], Isso é Muito Claro', Garante Christine Lagarde - Como Aconteceu." [Observador, May 4, 2023.](#) – "[In June there will certainly be a new increase". Journalist Edqar Caetano explains that "there is still a great impetus within the ECB for interest rates to rise": "inflation remains very high".]
¹²³ Indeed, during the pandemic M&A semiconductor activity increased by c. 143% despite the global lockdowns of semiconductor foundries and plants. [Modrich, Stefan, and Joseph Williams. 2022. "Semiconductor M&a Activity Challenged amid Regulatory Pressures." \[www.spglobal.com, August 3, 2022.\]\(#\)](#)
¹²⁴ Besides dividends, shareholders are not expected to take part in any share capital increases during the year, nor is NOD expected to have fluctuations in its treasury shares’ accounts. Neither in 2021 nor 2022 did the firm have share capital increases or treasury share changes.
¹²⁵ For SiLabs, the EV for FY 2023 was estimated by Wells Fargo analysts, for NOD by Arctic Securities, for IFXGn by Bryan, Garnier & Co, for TXN and QCOM by Crispidea.

Trading multiples	EV/Sales	EV/EBITDA	EV/EBIT
NOD	2.6x	9.8x	12.5x
SiLabs	3.9x	22.9x	33.8x
Infineon	4.0x	12.5x	19.7x
Texas Instruments	8.1x	14.6x	16.0x
Qualcomm	3.4x	8.5x	9.5x
Quartile 1	3.0x	9.2x	11.0x
Average	4.4x	13.7x	18.3x
Quartile 2 (Median)	3.9x	12.5x	16.0x
Quartile 3	6.0x	18.7x	26.8x

Figure 55: Forward-looking trading multiples of NOD and its peers.

Source: For SiLabs, the EV for FY 2023 was estimated by Wells Fargo analysts, for NOD by Arctic Securities, for IFXGn by Bryan, Garnier & Co, for TXN and QCOM by Crispidea; Own computations.

Implicit valuation multiples	Bear	Base	Bull
Likelihood of each scenario	40%	50%	10%
Value of EV of each scenario (DCF)	835,119	2,188,408	4,377,235
Expected EV value	1,865,975		
Implicit EV/Sales	2.4x		
Implicit EV/EBITDA	9.1x		
Implicit EV/EBITDA	11.5x		

Figure 56: Implicit trading multiples of NOD from the DCF valuation.

Source: Own computations.

Starting with NOD's EV/Sales₂₀₂₃ multiple, which is the most comparable company to triangulate this paper's valuation, Arctic Securities¹²⁶ (Arctic) predicted NOD's EV, acknowledging that the outlooks for the evolution of NOD's profitability have been rapidly changing¹²⁷. With NOD announcing c. \$145.4m for Q1 2023 and predicting Q2 2023 revenues between \$140.0 and \$160.0m, there are no sufficient data points to sustain an y-o-y increase in demand. As a result, Arctic predicted an EV₂₀₂₃ of c. 2,021.3m, which combined with NOD's reported sales for FY 2022, yielded an EV/Sales₂₀₂₃ multiple of 2.6x. This multiple is in-line with the implicit multiple obtained from this paper's valuation, which considering a weighted-average EV₂₀₂₃ of c. \$1.866m¹²⁸ and Sales₂₀₂₂ of c. \$776.7m, yields an EV/Sales₂₀₂₃ multiple of c. 2.4x (Figure 56). Arctic's projections (higher by c. 8%) were more optimistic than those of this paper's analysts. For the remaining multiples, one obtained an EV/EBITDA₂₀₂₃ multiple of 9.8x and an EV/EBIT₂₀₂₃ multiple of 12.5x, using Arctic's EV. Both are in-line with the implicit multiples obtained from this paper's valuation, which yielded an EV/EBITDA₂₀₂₃ multiple of 9.1x and an EV/EBIT₂₀₂₃ multiple of 11.5x. This difference comes from the different EV₂₀₂₃ projections, which by being small, do not seem to imply that NOD is being slightly undervalued by the market or slightly overvalued by this papers' analysts.

Looking at the peers' multiples, and starting with the EV/Sales₂₀₂₃ multiple, differences in ratios do not seem very significant, except for TXN which trades at an EV/Sales₂₀₂₃ of 8.1x. Indeed, TXN's EV/Sales multiple has historically been higher (c. 7.7x in 2022¹²⁹) than its industry average (c. 4.0x¹²⁹) and such trend is forecasted to persist in the future (c. 8.3x in 2023 and c. 7.9x in 2024¹²⁹). While this could mean that it is being overvalued by the market, one believes that investors are willing to pay more for each dollar of the firm's revenue, due to believing in its future revenue growth and due to it having a dominant market position (6th largest semiconductor in the world by market capitalization¹³⁰).

Starting with the EV/EBITDA₂₀₂₃ multiple, more disparity can be observed, with the outlier seeming to be SLAB (c. 22.9x), while the rest of the peers trade between c. 8.5x and 14.6x. Indeed, SLAB is expected to decrease its y-o-y revenues, which means that despite a forecasted similar level of operating expenses, the lower magnitude in revenues implies a decrease in EBITDA. Overall, SLAB's multiple seems to imply that is it overvalued relative to its operating profitability since the

¹²⁶ Kristian Spetalen. 2023. "Equity company update – Wait for evidence in the through". Arctic Securities Investment Bank. April 20, 2023. Retrieved from Refinitiv.

¹²⁷ NOD's Q3 2022 report stated that demand outstripped supply and Q4 2022's report pushed the \$1bn revenue target further in the future, with no specific time of accomplishment, due to weakness across all segments (except BLE). However, even the BLE's resilience changed during Q1 2023, with a c. -24% decrease in revenues from the previous quarter.

¹²⁸ As this paper is based on three scenarios, one computed the expected EV as the sum-product between the EVs obtained for each scenario and their respective probabilities.

¹²⁹ Crispidea. 2023. "Equity Research - Weakness in end markets to continue". 19 February 2022. Retrieved from Refinitiv.

¹³⁰ Cheema, Ramish. 2023. "20 Largest Semiconductor Companies in the World." Yahoo Finance. March 16, 2023.

firm recorded, from 2019 to 2021, negative earnings per share when considering its continuing operations¹³¹ and since it has never paid dividends.

Regarding the EV/EBIT₂₀₂₃ multiple, the outlier is again SLAB, trading at a c. 33.8x ratio, while its peers trade between c. 9.5x and 19.7x. For this ratio, there is a larger gap between the two boundaries, but the explanations above hold.

Using the trading multiples described above, one can compute NOD's target share price of \$15.50 for FY 2023 (assuming the base scenario – Figure 57). This price is c. 42% higher than the implied target price obtained through NOD's DCF valuation, due to the intrinsic differences between the companies (cf. "Competition").

Value of equity	Bear	Base	Bull
Likelihood of each scenario	40%	50%	10%
Multiples (median)	2,837,015	2,998,891	3,260,712
	Expected equity value	Price per share	
	2,960,323	\$ 15.50	

Figure 57: Expected share price through multiples. Source: Own Computations.

Precedent transactions

After collecting six relevant industry transactions, from 2021 to 2022, one computed the forward-looking multiples above, using the EVs at which the acquirers valued the target companies (Figure 58). This approach yielded a target share price through precedent transactions of c. \$18.72 for FY 2023 (Figure 59), which is c. 71% higher than the implied price obtained through the intrinsic valuation. Indeed, through this valuation, one is mostly looking at the price paid in a past merger and acquisition (M&A), rather than at the target's intrinsic value. With this price being influenced by strategic factors and by the negotiation skills of the parties involved, it is not directly linked to the target's intrinsic value. Indeed, acquirers may pay premiums to acquire firms where the intangible benefits justify the higher transaction price (for e.g., to avoid incurring in a long R&D period and large costs to replicate a competitor's product).

Precedent transactions multiples	EV/Sales	EV/EBITDA	EV/EBIT
(1) Weltrend & Sentelic	3.0x	11.9x	13.1x
(2) Intel & Tower Semiconductor	3.6x	12.4x	32.4x
(3) Unimicron & Subtron	1.7x	8.0x	12.7x
(4) Renesas & Celeno	8.5x	N/A	N/A
(5) Rambus & PLDA	7.4x	18.7x	20.0x
(6) Analog Devices & Maxim Int. Products	9.6x	26.2x	30.4x
Quartile 1	2.7x	9.9x	12.9x
Average	5.6x	15.4x	21.7x
Quartile 2 (Median)	5.5x	12.4x	20.0x
Quartile 3	8.8x	22.4x	31.4x

Figure 58: Precedent transactions in the semiconductor industry from 2021 to 2022. Source: Arthos; Own Computations.

Value of equity	Bear	Base	Bull
Likelihood of each scenario	40%	50%	10%
Multiples (median)	3,451,965	3,613,841	3,875,662
	Expected equity value	Price per share	
	3,575,273	19	

Figure 59: Expected share price through precedent transactions. Source: Own Computations.

The motivation behind the transactions has essentially been the same across the acquirers, i.e., market expansion and diversification. Figure 59 shows less stability in multiples. As M&A activity in the industry did not decline during the pandemic (increased c. 143% from 2019 to 2020 and by c. 12% between 2019 and 2021 when disregarding 2020 – Figure 60)¹³², one cannot justify disparities with differences in transactions' closing times. However, it is worth noting that one is computing NOD's EV₂₀₂₃, through forward-looking multiples for FY 2021 and 2022.

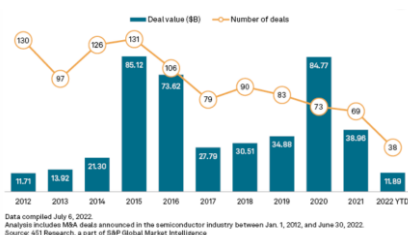


Figure 60: M&A activity in the semiconductor industry since 2012. Source: S&P Global; Own Computations.

Starting with the EV/Sales multiple, this ranged between c. 1.7x and c. 9.6x (median of c. 5.5x), which reflects the outlying characteristic of the Analog Devices & Maxim Integrated Products transaction multiple of c. 9.6x, through which the acquirer increased its offering in its industrial, automotive, and communications

¹³¹ In 2021, SLAB sold part of its automotive and infrastructure business. This inflated net income for 2021 when considering the added income of discontinued operations.
¹³² Modrich, Stefan, and Joseph Williams. 2022. "Semiconductor M&A Activity Challenged amid Regulatory Pressures." www.spglobal.com, August 3, 2022. When computing the growth rate in volume invested between 2019 and 2021, one disregarded the 2020 investment volume because it was abnormal in nature, and solely had occurred in 2015 and 2016.

segments¹³³. Thus, it seems the acquirer valued the target at a higher EV due to the prospect benefits this later can have under Analog's umbrella. Another outlying transaction is that of Unimicron acquiring Subtron, at a lower-than-average multiple, through which it increased its technology capabilities¹³⁴. This transaction was performed on a rather small company of the industry (market share of c. 0.03% in 2022) by a relatively larger company (market share of c. 0.82% in 2022), which may have been allowed Unimicron to reduce the price paid, thus reducing the transaction multiple. It is worth noting that four out of the six transactions were conducted to acquire relatively small companies presenting small financial results.

Regarding the EV/EBITDA multiple, this ranges between c. 8.0x and c. 26.2x. The lowest and highest EV/EBITDA pertain to Unimicron & Subtron and Analog & Maxim, respectively, from which the valuation motivations were explained above.

Regarding the EV/EBIT multiple, the highest multiple was that of Intel & Tower Semiconductor, with this latter being acquired to allow Intel to expand its foundry footprint in the U.S. and Asia¹³⁵. While this multiple was not an outlier previously, it is now the largest, due to Tower's small EBIT₂₀₂₁, solely representing c. 11% of the company's revenues. One does not believe that Intel is overvaluing Tower, but rather that it believes in the operational efficiency that both firms can have combined. The lowest EV/EBIT multiple pertains again to Unimicron & Subtron.

Sensitivity analysis

To better understand and assess how some factors might affect NOD's value and, consequently, its share price, one has conducted a sensitivity analysis (*Appendix*) that shows how the final investment decision would be altered in case some factors were to be changed: growth rate and cost of capital. Furthermore, given how important R&D is for the future of NOD (which mostly consists of human capital), another sensitivity analysis was conducted to evaluate and determine how sensitive the profitability per R&D employee ratio is to the average cost per employee.

Firstly, one can see how the growth rate impacts the price per share given that, keeping everything else constant and a growth rate range from 0.07% to 0.52%, the price per share varies between \$12.78 and \$12.95 (base case), i.e., a change of 0.45 p.p. in the growth rate leads to a change of 1.34% in the share price. Moreover, by solely changing the cost of capital between a range of 10.86% to 11.56%, the value of the share price would be comprised between \$12.45 and

¹³³ [Analog Devices. 2023. "Annual Reports & Proxy Statement | Analog Devices." Analog Devices. January 20, 2023.](#)

¹³⁴ [Cheng-hui, Chen. 2022. "Unimicron to Take over Subtron in Share Swap - Taipei Times." *www.taipetimes.com*. February 23, 2022.](#)

¹³⁵ [Intel Public Relations. 2022. "Intel to Acquire Tower Semiconductor for \\$5.4 Billion." Intel. February 15, 2022.](#)

\$13.14 as the WACC rate decreases, i.e., a change of 0.70 p.p. in the WACC leads to a share price change of 5.55%. Hence, being more significant and of greater impact than the change in growth rate. Nevertheless, none of these changes alter the investment decision for the base case as the shareholders’ return is always above 10%. Furthermore, the investment decision does not change under any scenario, (it will always be “Buy” for the bull case and “Sell” for the bear case). Given these results, one concludes that the scenario chosen highly influences the investment decision as the share price is greatly sensitive to the assumptions attributed to each scenario (cf. “Discounted cash flow conclusions”) and not so sensitive to the changes in both the WACC nor the growth rate.

Moreover, keeping the number of R&D employees constant and equal to 2,862, (i.e., 76% of NOD’s employees in 2040 working in R&D), as one increases (decreases) the average cost per employee by \$10, the profitability ratio changes by c. 4%. However, as one moves into higher average costs, the change in the profitability ratio becomes slightly more accentuated (going from c. -3.65% to c. -3.79%, to c. -3.94 for the average costs of 195, 205, and 215, respectively).

Investment recommendation

2023 will be a challenging year for NOD, not only due to the uncertain macroeconomic scenario but also due to the persisting supply chain constraints that will continue to affect its operations. Looking into 2023, one should expect lower demand for NOD’s products and weaker demand in the Chinese market. Nonetheless, a longer-term positive market outlook is expected, supported by stronger demand from tier-1 customers and by the gradual easing of supply chain constraints, which will allow NOD to increase its delivery capacity and ultimately reach its long-awaited objective of \$1 billion in revenues. NOD’s liquidity position allows it to keep investing in its R&D to establish its presence in an industry with large growth potential. The creation of a full connectivity portfolio encompassing Bluetooth, Wi-Fi, Cellular IoT, Memory, and other technologies widens NOD’s focus and creates long-term growth prospects for the years to come.

After performing NOD’s intrinsic and relative valuations, one recommends investors to **Hold** NOD’s stocks. This recommendation is based on the DCF valuation, which looks at NOD’s underlying value, and yields a c. 6.7% expected return for FY 2023. In contrast, the relative valuations yield returns above 50%, which would imply a more positive recommendation (Figure 61). Since NOD’s outlook is that of a Bluetooth Low Energy leader facing difficulties in the post-pandemic era, the analysts feel most confident in **initiating NOD’s coverage at Hold**.

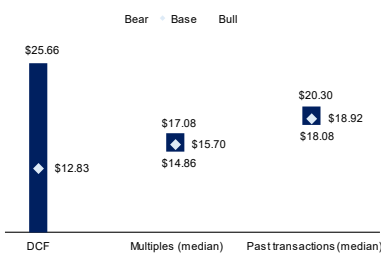


Figure 61: Box plot graph comparing the target prices obtained by each valuation method and for all created scenarios.

Appendix

Financial Statements

Forecasted income statement – Base Scenario

For the year ended December 31st
Amounts in USD 1,000

	Actual					Predicted (Growth period)			Predicted (Stable period)		
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2039	2040
Core Operations											
Total revenue	271,134	288,395	405,217	610,528	776,734	634,619	773,268	935,268	1,119,841	3,135,682	3,029,451
Revenues growth rate	-	6%	41%	51%	27%	-18%	22%	21%	20%	1%	-3%
Worldwide semiconductor revenues	468,778,000	412,307,000	440,389,000	555,892,000	574,100,000	556,000,000	602,000,000	655,134,408	712,958,625	2,089,181,533	2,250,000,000
NOD's market share	0.06%	0.07%	0.09%	0.11%	0.14%	0.11%	0.13%	0.14%	0.16%	0.15%	0.13%
Americas	102,997,000	78,619,000	95,366,000	121,481,000	121,347,152	117,521,366	127,244,357	138,475,343	150,697,611	441,588,972	475,581,069
NOD's market share	0.03%	0.04%	0.04%	0.05%	0.09%	0.08%	0.10%	0.12%	0.14%	0.14%	0.13%
Europe	42,957,000	39,816,000	37,520,000	47,757,000	51,570,387	49,944,496	54,076,595	58,849,565	64,043,812	187,667,481	202,113,519
NOD's market share	0.08%	0.07%	0.10%	0.11%	0.19%	0.17%	0.19%	0.20%	0.22%	0.15%	0.13%
Asia/Pacific	322,824,000	293,872,000	307,503,000	386,654,000	401,182,461	388,534,137	420,679,048	457,809,500	498,217,202	1,459,925,081	1,572,305,412
NOD's market share	0.06%	0.08%	0.11%	0.13%	0.14%	0.13%	0.14%	0.15%	0.15%	0.15%	0.14%
Cost of materials	-136,112	-141,641	-191,274	-283,887	-339,941	-277,121	-336,907	-406,572	-485,710	-1,320,062	-1,272,369
% of total revenues	50%	49%	47%	46%	44%	44%	43%	43%	43%	42%	42%
Gross Margin	49.8%	50.9%	52.8%	53.5%	56.2%	56.3%	56.4%	56.5%	56.6%	57.9%	58.0%
Net payroll expenses	-70,048	-80,281	-101,211	-149,824	-161,440	-212,906	-245,162	-277,592	-310,666	-676,407	-699,749
% of total revenues	26%	28%	25%	25%	21%	34%	32%	30%	28%	22%	23%
Salary and vacation pay	-57,604	-62,556	-72,522	-104,476	-115,380	-139,539	-160,679	-181,934	-203,611	-443,317	-458,616
Number of employees	685	767	977	1,197	1,435	1,635	1,835	2,035	2,235	3,735	3,785
Avg. Cost per employee	84	82	74	87	80	85	88	89	91	119	121
Compounded inflation rate	-	-	-	-	-	4.70%	7.42%	9.68%	11.76%	45.61%	48.65%
Other compensation	-11,364	-12,846	-18,553	-25,239	-28,335	-31,895	-36,727	-41,585	-46,540	-101,330	-104,827
Number of employees	685	767	977	1,197	1,435	1,635	1,835	2,035	2,235	3,735	3,785
Avg. Cost per employee	17	17	19	21	20	20	20	20	21	27	28
Compounded inflation rate	-	-	-	-	-	4.70%	7.42%	9.68%	11.76%	45.61%	48.65%
Capitalized development expenses (hourly costs)	9,774	7,776	5,747	4,121	4,453	-12,611	-14,522	-16,443	-18,402	-40,066	-41,449
Number of employees	685	767	977	1,197	1,435	1,635	1,835	2,035	2,235	3,735	3,785
Avg. Cost per employee	14	10	6	3	3	8	8	8	8	11	11
Compounded inflation rate	-	-	-	-	-	4.70%	7.42%	9.68%	11.76%	45.61%	48.65%
Payroll taxes	-5,422	-6,259	-8,985	-13,580	-11,280	-15,228	-17,535	-19,854	-22,220	-48,379	-50,049
Number of employees	685	767	977	1,197	1,435	1,635	1,835	2,035	2,235	3,735	3,785
Avg. Cost per employee	8	8	9	11	8	9	10	10	10	13	13
Compounded inflation rate	-	-	-	-	-	4.70%	7.42%	9.68%	11.76%	45.61%	48.65%
Defined contribution pension	-5,432	-6,396	-6,898	-10,650	-10,898	-13,633	-15,699	-17,776	-19,894	-43,314	-44,809
Number of employees	685	767	977	1,197	1,435	1,635	1,835	2,035	2,235	3,735	3,785
Avg. Cost per employee	8	8	7	9	8	8	9	9	9	12	12
Compounded inflation rate	-	-	-	-	-	4.70%	7.42%	9.68%	11.76%	45.61%	48.65%
Other operating expenses	-34,199	-33,665	-35,954	-52,098	-69,685	-64,305	-78,354	-94,769	-113,472	-317,733	-306,969
% of total revenues	13%	12%	9%	9%	9%	10%	10%	10%	10%	10%	10%
EBITDA Margin	11.4%	11.4%	18.9%	20.4%	26.5%	12.7%	14.6%	16.7%	18.8%	26.2%	24.8%
Depreciation and amortization	-16,727	-23,535	-31,063	-37,798	-44,067	-41,182	-50,929	-64,462	-82,519	-151,216	-141,834
Depreciation (fixed and right-of-use assets)	-7,976	-13,049	-17,168	-21,894	-25,575	-22,712	-25,423	-28,168	-30,372	-52,934	-53,664
as % of PP&E	45%	26%	32%	41%	45%	43%	43%	43%	43%	43%	43%
Amortization	-8,751	-10,486	-13,895	-15,904	-18,492	-18,470	-25,506	-36,294	-52,148	-98,282	-88,170
as % of intangible assets	20%	23%	24%	32%	46%	39%	39%	39%	39%	39%	39%
Net foreign exchange gains (losses)	-320	-375	-2,016	739	619	-692	-843	-1,019	-1,220	-3,417	-3,301
% of total revenues	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
EBIT Margin	5.1%	3.1%	10.8%	14.4%	20.9%	6.1%	7.9%	9.7%	11.3%	21.3%	20.0%
Core Result Before Taxes	13,728	8,898	43,699	87,660	162,220	38,414	61,073	90,854	126,253	666,847	605,228
Statutory taxes	-3,157	-1,958	-9,614	-19,285	-35,688	-8,451	-13,436	-19,988	-27,776	-146,706	-133,150
% of income tax rate	23%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%
Tax adjustments	-2,602	-399	2,462	-1,496	-8,561	-2,332	-2,842	-3,437	-4,116	-11,525	-11,134
% of total revenues	1%	0%	-1%	0%	1%	0%	0%	0%	0%	0%	0%
Other comprehensive income	-340	-162	623	-1,303	-532	-792	-965	-1,168	-1,398	-3,914	-3,782
% of total revenues	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Core Operations Result	7,629	6,359	37,170	65,576	117,439	26,838	43,830	66,261	92,964	504,702	457,162
Non-core Operations											
Financial income	1,782	1,910	642	730	6,202	4,480	5,459	6,603	7,906	22,138	21,388
% of operating cash	33%	33%	8%	6%	40%	35%	35%	35%	35%	35%	35%
Non-core Result Before Taxes	1,782	1,910	642	730	6,202	4,480	5,459	6,603	7,906	22,138	21,388
Statutory taxes	-410	-420	-141	-161	-1,364	-986	-1,201	-1,453	-1,739	-4,870	-4,705
% of income tax rate	23%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%
Tax adjustments	-153	155	2,447	4,605	518	1,805	2,199	2,660	3,185	8,919	8,617
% of total revenues	0%	0%	-1%	-1%	0%	0%	0%	0%	0%	0%	0%
Non-core Operations Result	1,219	1,645	2,948	5,174	5,356	5,300	6,458	7,810	9,352	26,186	25,299
Financing Operations											
Net financial expense	-428	-1,102	-1,416	-1,129	-1,267	-1,849	-1,964	-2,189	-2,593	-5,277	-5,162
Interest expense on lease liabilities	0	-834	-768	-822	-621	-1,158	-1,122	-1,172	-1,374	-1,864	-1,865
% of lease liabilities	0%	3%	3%	4%	3%	6%	5%	5%	6%	5%	5%
Other financial expense	-428	-268	-648	-307	-646	-691	-842	-1,018	-1,219	-3,413	-3,297
% of revenues	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Financing Result Before Taxes	-428	-1,102	-1,416	-1,129	-1,267	-1,849	-1,964	-2,189	-2,593	-5,277	-5,162
Statutory taxes	98	242	312	248	279	407	432	482	570	1161	1136
% of income tax rate	23%	22%	22%	22%	22%	22%	22%	22%	22%	22%	22%
Tax adjustments	0	0	0	0	0	0	0	0	0	0	0
Financing Operations Result	-330	-860	-1,104	-881	-988	-1,442	-1,532	-1,708	-2,023	-4,116	-4,027
Total Comprehensive Income	8,518	7,145	39,014	69,870	121,806	30,695	48,755	72,364	100,293	526,772	478,434

Forecasted balance sheet – Base Scenario

For the year ended December 31st
Amounts in USD 1,000

	Actual					Predicted (Growth period)			Predicted (Stable period)		
	2018	2019	2020	2021	2022	2023	2024	2025	2026	2039	2040
Core Operations											
Intangible assets	42,749	45,398	56,861	49,692	40,547	47,596	65,728	93,527	134,381	253,267	227,209
% of total revenues	16%	16%	14%	8%	5%	8%	9%	10%	12%	8%	8%
Right of use assets	0	23,934	25,092	18,935	21,416	19,231	22,093	24,612	27,313	51,405	52,232
Right of use assets turnover	0	12	16	32	36	33	35	38	41	61	58
Fixed assets	17,582	26,625	28,284	33,885	35,603	33,401	36,822	40,664	43,071	71,265	72,130
Fixed assets turnover	15	11	14	18	22	19	21	23	26	44	42
Inventory	42,679	53,067	61,955	54,943	102,091	90,794	110,133	132,605	158,057	416,885	400,884
Average holding period	114	136	118	71	110	120	119	119	119	115	115
Accounts receivable and other receivables	51,784	72,688	93,236	150,098	187,097	153,714	186,872	225,508	269,396	731,950	705,489
Average collection period	70	92	84	90	88	88	88	88	88	85	85
Operating cash	5,423	5,768	8,104	12,211	15,535	12,692	15,465	18,705	22,397	62,714	60,589
% of total revenues	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Accounts payable	-10,424	-19,738	-22,812	-28,392	-34,229	-31,761	-38,785	-47,013	-56,411	-162,074	-156,867
Average payable period	28	51	43	36	37	42	42	42	42	45	45
Payroll liabilities	-8,931	-10,329	-28,268	-34,251	-31,802	-50,025	-57,605	-65,224	-72,996	-158,932	-164,417
% of annual payroll	13%	13%	28%	23%	20%	23%	23%	23%	23%	23%	23%
Income taxes payable	-5,043	-3,136	-4,976	-17,427	-43,758	-16,073	-19,584	-23,687	-28,362	-79,416	-76,726
% of total revenues	2%	1%	1%	3%	6%	3%	3%	3%	3%	3%	3%
Other current liabilities	-21,215	-29,021	-30,441	-38,143	-61,768	-50,260	-61,241	-74,071	-88,689	-248,340	-239,926
Rebates	-11,393	-13,881	-24,699	-31,287	-54,076	-34,519	-42,061	-50,873	-60,913	-170,562	-164,784
% of total revenues	4%	5%	6%	5%	7%	5%	5%	5%	5%	5%	5%
Other current liabilities	-9,821	-15,141	-5,741	-6,854	-7,692	-15,741	-19,180	-23,198	-27,777	-77,777	-75,142
% of total revenues	4%	5%	1%	1%	1%	2%	2%	2%	2%	2%	2%
Deferred tax assets	1,335	2,813	3,668	6,331	4,554	3,871	3,290	2,797	2,377	287	244
Invested Capital Core Operations	115,939	168,069	190,703	207,882	235,286	213,179	263,188	328,423	410,534	939,011	880,840
Non-core operations											
Financial assets	7,155	3,190	4,170	3,601	5,829	7,761	9,456	11,437	13,694	38,346	37,046
% of total revenues	3%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Invested Capital Non-Core Operations	7,155	3,190	4,170	3,601	5,829	7,761	9,456	11,437	13,694	38,346	37,046
Financing Operations											
Invested Capital Financing Operations (Net Financial Assets)	98,453	60,947	207,617	246,725	342,428	261,770	291,819	324,370	359,385	568,011	569,084
Net debt	-98,453	-60,947	-207,617	-246,725	-342,428	-261,770	-291,819	-324,370	-359,385	-568,011	-569,084
Equity	221,547	232,206	402,490	458,208	583,543	482,710	564,463	664,230	783,613	1,545,368	1,486,970
Check	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
D/E	44%	26%	52%	54%	59%	54%	52%	49%	46%	37%	38%
E/A	83%	73%	78%	77%	75%	77%	76%	76%	76%	70%	70%

Valuation - Base Scenario

DCF Valuation						
	0	1	2	3	17	18
Debt changing with EV :	2023	2024	2025	2026	2040	2041
	actual	projected	projected	projected	projected	
Operating FCF		-6,180	1,027	10,852	515,334	516,457
@ WACC	11.16%	11.16%	11.16%	11.16%	11.16%	11.16%
Discounted operating FCF		-5,559	831	7,901	85,320	4,720,513
= Operating EV	2,180,647	2,430,159	2,700,306	2,990,774	4,720,513	
+ Operating EV	2,180,647	2,430,159	2,700,306	2,990,774	4,720,513	
+ Non-operating EV	7,761	9,456	11,437	13,694	37,046	
- Net Debt	-261,770	-291,819	-324,370	-359,385	-569,084	
= Equity	2,450,178	2,731,434	3,036,113	3,363,853	5,326,643	
Price per share	\$ 12.83					

$Terminal Value = \frac{FCF}{r - g} \approx \frac{Core Result * (1 + g)}{r - g}$

Valuation summary table (as of end 2023)				
Method	Expected equity value (weighted)	Price per share	Expected return	Recommendation
DCF	2,089,177	\$ 10.94	6.7%	Hold
Multiples (median)	2,960,323	\$ 15.50	51.3%	Buy
Past transactions (median)	3,575,273	\$ 18.72	82.7%	Buy

Share price as of May 12th 2023	10.25
Expected dividend payment	0
Dividend yield	0%

Sensitivity Analysis - Base Scenario

		<i>Price per share</i>							
Growth / WACC		10.86%	10.96%	11.06%	11.16%	11.26%	11.36%	11.46%	11.56%
0.07%		13.08	12.98	12.88	12.78	12.68	12.58	12.49	12.40
0.12%		13.10	13.00	12.89	12.79	12.70	12.60	12.51	12.42
0.17%		13.12	13.02	12.91	12.81	12.71	12.62	12.53	12.44
0.22%		13.14	13.04	12.93	12.83	12.73	12.64	12.54	12.45
0.27%		13.16	13.06	12.95	12.85	12.75	12.65	12.56	12.47
0.32%		13.19	13.08	12.97	12.87	12.77	12.67	12.58	12.49
0.37%		13.21	13.10	12.99	12.89	12.79	12.69	12.59	12.50
0.42%		13.23	13.12	13.01	12.91	12.81	12.71	12.61	12.52
0.47%		13.25	13.14	13.03	12.93	12.82	12.73	12.63	12.54
0.52%		13.27	13.16	13.05	12.95	12.84	12.74	12.65	12.55

		<i>Profitability per R&D employee</i>							
#employees / avg cost		155	165	175	185	195	205	215	225
2,862		237	229	221	214	206	198	190	182
<i>Incremental change</i>		3.40%	3.52%	3.65%		-3.65%	-3.79%	-3.94%	-4.10%

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Report Recommendations

Buy	Expected total return (including expected capital gains and expected dividend yield) of more than 10% over a 12-month period.
Hold	Expected total return (including expected capital gains and expected dividend yield) between 0% and 10% over a 12-month period.
Sell	Expected negative total return (including expected capital gains and expected dividend yield) over a 12-month period.

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