

ECO358 A1: Intel Corporation

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0 Introduction

Intel Corporation is a multinational semiconductor company that designs and manufactures advanced computer processors and related technologies. Its business model focuses on designing, manufacturing, and selling computing hardware such as CPUs (Central Processing Units) and FPGAs (Field Programmable Gate Arrays), as well as selling its licensed intellectual properties to other businesses / individuals [6].

Intel operates on a vertically integrated business model, where it controls the entire manufacturing process for its products, from design and development to fabrication and assembly [6]. This allows the company to monitor quality closely and minimize production costs. In recent years, Intel has begun to diversify its business model according to recent trends, investing in artificial intelligence, autonomous vehicles, and the Internet of Things (IoT) [6].

Currently, the semiconductor market in the US faces significant challenges. Decreases in consumer demand for semi-conductor related products such as laptops has drastically impacted the source of income of semiconductor companies. In addition, China being a large importer of semiconductor products, is in great tension with the US. As a result, the US banned exports of many semiconductor-related products to China, which further decreased the revenue stream.

In this report, I will analyze Intel in terms of the dividend discount method and discounted free cash flow method, as well as compare the firm to its competitors: AMD and Nvidia.

1 Dividend Discount Method (DDM)

In this section, we will calculate the equity cost of capital using APR, i.e. multiply the result by 4 to get the annual r_E because Intel pays dividends on a quarterly basis (paid on the 1st of every March, June, September, and December). This is based on the assumption that we don't reinvest the dividends given a year. If we want to reinvest dividends on each period, then we must convert r_E in terms of EAR to capture the effect of compounding. Below is a table for recent dividends and stock prices used in parts 1a, 1b, and 1c. The stock price is based on [1] and the dividend price is based on [2].

Date	2021-12-01	2022-03-01	2022-06-01	2022-09-01	2022-12-01
Dividend (\$)	0.3475	0.365	0.365	0.365	0.365
Stock Price (\$)	51.5	49.56	37.41	25.77	26.43

1.1 a

The calculation is shown in Equation 1. Given an infinitely long investment with no growth, we can use the perpetuity equation and re-arrange it to isolate r_E . Then, we can plug in the most recent dividend payment and its associated stock price, which is on 2022-12-01. Note that the result is multiplied by 4 to get the r_E in terms of APR due to Intel's quarterly dividend payment.

Note: since I'm not forecasting, I'll be using Div_0 instead of Div_1 here.

$$P_0 = 4\left(\frac{Div_0}{r_E}\right) \implies r_E = 4\left(\frac{Div_0}{P_0}\right) = 4\left(\frac{0.365}{26.43}\right) = 5.52\% \quad (1)$$

1.2 b

The calculation is shown in Equation 2. The most recent dividend payment is 2022-12-01, we will say that is period 1. The second-last dividend payment is on 2022-09-01, we will say that is period 0. To calculate the one-period cost of capital, we can use the formula for the total return of a stock, where we "buy" the stock in period 0 and "sell" the stock in period 1. Again r_E is represented using APR.

$$r_E = 4\left(\frac{Div_1 + P_1}{P_0} - 1\right) = 4\left(\frac{0.365 + 26.43}{25.77} - 1\right) = 15.91\% \quad (2)$$

1.3 c

The last time dividend payments changed was from 0.3475 on 2021-12-01, to 0.365 afterwards. Since Intel has a trend of changing its dividend once per year, I will use 2022-03-01 as period 1, and 2021-12-01 as period 0. This means the growth rate can be calculated using annual total dividends in 2021 and 2022: in 2021 total dividend is $0.3475 \times 4 = 1.39$, and in 2022 total dividend is $0.365 \times 4 = 1.46$.

In addition, we have to adjust the dividend price ratio by multiplying 4 to get the APR. Here we can use the perpetuity with growth rate formula and expand group rate g and isolate r_E to obtain the answer, shown in Equation 3.

$$r_E = 4\left(\frac{Div_1}{P_0}\right) + g = 4\left(\frac{Div_1}{P_0}\right) + \frac{Div_{2022} - Div_{2021}}{Div_{2021}} = 4\left(\frac{0.365}{51.5}\right) + \frac{1.46 - 1.39}{1.39} = 7.87\% \quad (3)$$

1.4 d

By definition of r_E , we know that higher r_E means a higher return, but this also comes with greater risks and volatility. We can see that r_E for Infinitely long investment with no growth < Infinitely long investment with growth < one-period investment. This makes sense because the infinitely long investment with no growth only relies on the proportion of dividend to stock price, while the infinitely long investment with growth incorporates the trend of the growing dividend, which leads to higher r_E . While dividend tends to increase by historical trends, it is not always guaranteed, therefore infinite growth has the assumption that the dividend will continue to grow, so there's an extra risk of the dividend not growing at the growth rate in the future.

When holding the stock for one period, there are more risks with high volatility. As stock prices are much more volatile than dividend payments, where stock prices fluctuate every day, dividend payments change every quarter and most of the time stay the same. We see the one period r_E being the highest simply because the stock price grew, but it r_E can easily be negative if the stock price fall during that quarter. Therefore, the one-period stock has the largest r_E with the most volatility. Another way to think about it is that the rewards of infinite stock holding are based on the company's long-term growth, which should be steady, while the rewards of one-period stock are based on short-term fluctuation due to market shocks and investor expectations, which is much more volatile and risky.

As a result, higher r_E often incorporates more assumptions, which means more doubts reflected by higher risks. It is important to consider the volatility, and not only the value of r_E .

2 Discounted Free Cash Flow Method (DFCFM)

In this section, we will analyze Intel's 10-k annual report for 2022, where all data points are reported as of 2022-12-31 [3], with the stock price of that day found in [1].

2.1 a

Item	Amount	Source
Stock Price (\$)	26.43	[1]
Weighted average shares of common stock outstanding - Diluted (\$ million)	4123	page 76 [3]
Net increase (decrease) in cash and cash equivalents (\$ million)	6317	page 46 [3]
Total Debt (\$ million)	42051	page 45 [3]

The computation can be done using the Discounted free cash-flow model shown in Equation 4. Here I used Diluted Weighted average shares of common stock outstanding because diluted shares also take into account "the potential dilution of outstanding shares due to the exercise of stock options, warrants, and other convertible securities", which gives a more holistic view of the firm's financial metrics [6]. Also, the basic metric has a value of 4108, which is not too far off from the diluted metric, and thus will not affect the result too much [3]. I used net cash instead of cash because it measures the net outflow of cash of the company, which takes into account inflow as well. Finally, I choose total debt to represent the debt so all debts are being considered.

$$P = \frac{V_0 + Cash - Debt}{Shares Outstanding} \implies V_0 = P \times Shares Outstanding + Debt - Cash \quad (4)$$

$$= 26.43 \times 4123 + 42051 - 6317 = \$144,704.89 \text{ million} \quad (5)$$

Therefore, the enterprise value V_0 is \$144,704.89 million, shown in Equation 5.

2.2 b

I choose the "weighted-average interest rate of the commercial paper", which was $r_{debt} = 4.39\%$ in the Debt section on page 100 [3]. Because Intel as a large company takes a lot of debt, its interest rate on debt typically fluctuates between 2% to 6%, therefore, it is crucial to get the weighted average interest rate in order to have an accurate analysis.

2.3 c

From textbook, we know that r_{wacc} is the weighted average of the firm's interest rate on debt and the equity cost of capital. Because in 2d we are calculating the infinite period of free cash flow and assume no growth, the equity cost of capital calculated in 1a in Equation 1 is the most suitable, where $r_E = 5.52\%$.

$$r_{wacc} = \frac{Debt \times r_{debt} + Equity \times r_E}{Debt + Equity} = \frac{Debt \times r_{debt} + Price \times Shares Outstanding \times r_E}{Debt + Price \times Shares Outstanding} \quad (6)$$

$$= \frac{42051 \times 4.39\% + 26.43 \times 4123 \times 5.52\%}{42051 + 26.43 \times 4123} = 5.21\% \quad (7)$$

Note: I used weights in terms of million as a unit, which does not change the proportion of the weights, so will yield the same result $r_{wacc} = 5.21\%$.

Here, we can see that since debts are generally less risky than equity, $r_{debt} = 4.39\% < r_E = 5.52\% \implies r_{wacc} = 5.21\% < r_E = 5.52\%$.

2.4 d

Assuming no growth in Cash Flow, we can use the perpetuity formula similar to Equation 1, inherently setting $g_{FCF} = 0$, where we replace r_E with r_{wacc} , replace Div with FCF , and replace P with V_0 . Then:

$$V_0 = \frac{FCF}{r_{wacc}} \implies FCF = V_0 \times r_{wacc} = 144704.89 \times 5.21\% = 7532.40948 \text{ million} \quad (8)$$

3 Comparable Firms

3.1 a

The two comparable firms I found are AMD (Advanced Micro Devices) and Nvidia. Both companies, similar to Intel, are giant companies that primarily focus on the development of semiconductor-related hardware. In the recent decade, these firms competed intensely in market shares for various semiconductor products. For instance, Intel takes over primarily the CPU market, while Nvidia takes over primarily the GPU market, and AMD takes over a big portion of both markets. While AMD and Nvidia are fabless, meaning they outsource the manufacturing process to other firms, Intel does in-house fabrication. This means they are prone to slightly different market risks, for example, Intel incurs much higher fixed costs on fabrication equipment but saves on variable costs. Nonetheless, their core business models are highly alike and rely on the designing of semiconductor-related hardware and technologies around them, therefore are highly correlated and are comparable firms. In addition, all three companies have their headquarters in Santa Clara, in the San Francisco Bay Area in California, which means they incur similar costs in terms of labor and equipment, and share similar customers.

3.2 b

Below are tables of relevant information and calculation based on the most recent 10-k annual report of Intel 3, AMD 4, and Nvidia 5.

3.2.1 i

	Intel	AMD	Nvidia	Source-Intel	Source-AMD	Source-Nvidia
Date	2022-12-31	2021-12-25	2022-01-30	[3]	[4]	[5]
Stock Price	26.43	146.14	228.4	[1]	[1]	[1]
Diluted EPS	1.94	2.57	3.85	page 5 [3]	page 48 [4]	page 47 [5]
P/E ratio	13.62	56.86	59.32	N/A	N/A	N/A

Note the P/E ratio is calculated based on the ratio of stock price to diluted EPS. Here I used diluted EPS similar to the reason for choosing diluted metric in 2a, which in my opinion gives a more accurate and conservative result.

3.2.2 ii

First, we need to calculate enterprise value for AMD and Nvidia using the method in 2a using equation Equation 4.

Enterprise Value Calculation for AMD

Item	Amount	Source
Stock Price (\$)	146.14	[1]
Shares used in per share calculation - Diluted (\$ million)	1229	page 48 [4]
Net increase in cash and cash equivalents, and restricted cash	940	page 52 [4]
Total Debt (\$ million)	313	page 61 [4]

Note: used diluted total shares, net cash, and total debt to keep information analogous to Intel

Enterprise Value Calculation for Nvidia

Item	Amount	Source
Stock Price (\$)	228.40	[1]
Weighted average shares - Diluted (\$ million)	2535	page 47 [5]
Change in cash and cash equivalents (\$ million)	1143	page 51 [5]
Total Debt (\$ million)	20930	page 65 [5]

Note: used diluted total shares, net cash, and total debt to keep information analogous to Intel

Using the two tables above, we can calculate the enterprise value for AMD and Nvidia, using the same procedure in question 2a for Intel.

V-EBITDA ratio calculation

	Intel	AMD	Nvidia	Source-Intel	Source-AMD	Source-Nvidia
Date	2022-12-31	2021-12-25	2022-01-30	[3]	[4]	[5]
Enterprise Value*	144704.89	178979.06	598781.00	Equation 5	table 3.2.2	table 3.2.2
EBITDA*	7768	3669	9941	page 39 [3]	page 48 [4]	page 47 [5]
V/EBITDA ratio	18.63	48.78	60.23	N/A	N/A	N/A

* Unit in millions

Note: I used Income before taxes to substitute for EBITDA

The V/EBITDA ratio is calculated based on the ratio of enterprise value to EBITDA. Enterprise Value is calculated based on Equation 4. The V_0 value is already calculated for Intel, we will use the same steps for AMD and Nvidia (Detailed calculation shown in excel submission). 3.2.2

3.3 c

With the P/E ratio and V/EBITDA ratio, we can now compare the firms using each of the ratios as the valuation multiple.

Say we have a set of n firms $\{1, 2, \dots, n\}$. If we want to calculate the value of firm i , for $i \in \{1, 2, \dots, n\}$ using comparable firms, we would first get the average valuation multiple of the comparable firms.

Then to value firm i , we can get the average valuation multiple by

$$\frac{1}{n-1} \sum_{j=1, j \neq i}^n ratio_j \quad (9)$$

where $ratio_j$ is the valuation multiple for a comparable firm, in this case, can be the P/E ratio or V/EBITDA ratio for AMD and Nvidia.

After we get the valuation multiple, we can multiply that by the EPS of firm i ,

To value Intel using P/E ratio, using Equation 9 we have

$$P = \frac{1}{2}(P/E_{AMD} + P/E_{Nvidia})(EPS_{Intel}) = \frac{1}{2}(56.86 + 59.32)(1.94) = \$112.70 \quad (10)$$

To value Intel using V/EBITDA ratio, using Equation 9 we have

$$V_0 = \frac{1}{2}(V/EBITDA_{AMD} + V/EBITDA_{Nvidia})(EBITDA_{Intel}) \quad (11)$$

$$= \frac{1}{2}(48.78 + 60.23)(18.63) = \$423,413.89 \text{ million} \quad (12)$$

Based on the comparable firms, it seems like Intel is currently undervalued by a lot. While its stock price is \$26.43, its stock price estimation using the average P/E ratio of comparable firms is \$112.70. While enterprise value is around \$144 billion, its enterprise value estimation using the average V/EBITDA ratio of comparable firms is \$423 billion. Therefore, the undervalued stock price and enterprise value may be a signal that the market currently is more optimistic about AMD and Nvidia than Intel.

Assuming Intel and comparable firms have similar business risk, financial risk, and growth prospects, the higher P/E ratio of comparable firms suggests that the market is more optimistic about their future growth, therefore willing to pay higher for their shares despite a lower proportion of earnings. Similarly,

the higher V/EBITDA ratio of comparable firms suggests investors are valuing them more despite having a lower proportion of income. Because the market is already optimistic about the comparable firms, this means AMD and Nvidia are likely to be overvalued and have a lower equity cost of capital compared to Intel.

To sum up, Intel's stock price is undervalued relative to the comparable firms, which suggests Intel has a higher equity cost of capital compared to AMD and Nvidia. Factors that contributed may include Intel not being fabless, which incurs more fixed costs due to costly fabrication equipment. Since global sales of semiconductors drastically decrease due to lower consumer demand and export restrictions posed by the US government, loss in revenue will hit Intel more than AMD and Nvidia due to higher operating expenditures with lower production and sales, which likely led to weaker expected financial performance and lower expected growth prospects in the eye of investors.

In my opinion, it is a good opportunity to buy Intel's stock now. With its stock price almost halved in the last 12 months due to decreasing consumer demand and export restrictions, and possibly investor pessimism, Intel's stock is currently greatly undervalued to comparable firms. With semiconductor-related computer hardware being a necessity in everyday life, the demand for computer chips will not vanish in the near future, it is very likely for Intel's stock to rise in the near future when consumer demand shifts back to the pre-pandemic level, which is a good opportunity to buy low and sell high for short-term investment. As for long-term investments, dividends of around 5% annually and a high likelihood of long-term growth are worth holding long.

4 ChatGPT 6

4.1

Prompt: explain the business model of Intel

ChatGPT:

Intel is a semiconductor company that designs, manufactures, and sells computer processors and other semiconductor products. The company's business model can be broken down into several key components:

- **Research and Development:** Intel invests heavily in research and development to create new products and improve its existing offerings. The company spends a significant portion of its revenue on RD each year, with the goal of staying at the forefront of technological innovation.
- **Manufacturing:** Intel has a vertically integrated business model, which means that the company designs and manufactures its own products. This allows Intel to have greater control over the production process and maintain high quality standards. The company operates several manufacturing facilities around the world.
- **Marketing and Sales:** Intel markets its products to a variety of customers, including computer manufacturers, retailers, and end-users. The company uses a multi-channel approach to distribute its products, including direct sales, distributors, and online sales.
- **Licensing and Partnerships:** Intel also licenses its technology to other companies and collaborates with partners to develop new products. The company has partnerships with a variety of technology companies and works closely with software developers to optimize its products for use in various applications.
- **Diversification:** While Intel is primarily known for its computer processors, the company has expanded into other areas in recent years. This includes products like memory and storage, programmable chips, and internet of things (IoT) technologies. By diversifying its product offerings, Intel can reduce its reliance on any one product or market.

Overall, Intel's business model is focused on creating and selling high-quality semiconductor products while investing in research and development to stay ahead of the competition. By controlling the entire production process and partnering with other companies, Intel is able to maintain a strong market position and expand its reach into new markets.

4.2

I asked ChatGPT to summarize the Intel's 4th quarter earning report in 2022.:

ChatGPT:

- The first section contains financial performance data for several different companies or business units, including information on revenue, gross margin, and operating income.
- There are declines in revenue and gross margin for some of the companies/business units, with the declines attributed to factors such as softening PC demand, competitive pressure, and inventory reductions.
- The second to last section provides financial information for a specific company or business unit, including GAAP and non-GAAP revenue and gross margin, as well as earnings per share.
- The final section provides detailed financial data for a three-month period, including GAAP and non-GAAP revenue, gross margin, and earnings per share.

4.3

Prompt: Please identify some risks if I were to invest in Intel

ChatGPT:

As with any investment, there are potential risks to investing in Intel. Here are some factors to consider:

- **Competition:** Intel faces intense competition in the semiconductor industry, with companies like AMD, NVIDIA, and Qualcomm competing for market share. The competition can drive down prices and reduce profit margins.
- **Technological change:** The semiconductor industry is constantly evolving, and Intel's products could become obsolete if the company fails to keep up with technological advancements. This could lead to declining demand for Intel's products.
- **Economic conditions:** The performance of the technology industry, and the semiconductor industry specifically, can be highly sensitive to broader economic conditions. A downturn in the economy could reduce demand for Intel's products and negatively impact the company's financial performance.
- **Dependency on a few key customers:** Intel's revenue is highly dependent on a few key customers, such as Apple and Dell. If these customers reduce their orders or shift to a competitor's products, it could have a significant impact on Intel's financial performance.
- **Intellectual property risks:** As a technology company, Intel's success is highly dependent on its ability to protect its intellectual property. If the company's patents and trademarks are challenged or invalidated, it could negatively impact the company's financial performance.
- **Environmental risks:** The manufacturing process for semiconductors can have negative environmental impacts. Intel has faced scrutiny in the past over its environmental practices, and increased regulation or public pressure to reduce its environmental footprint could increase the company's costs or negatively impact its reputation.

It's important to thoroughly research and consider these and other factors before making an investment in Intel or any other company.

5 References

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