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Valuation of an Indonesian Nickel Mine: Nico INA, A Case Study

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Abstract:- A private Indonesian nickel mine named Nico INA owned by Sangkuriang Mining has been observing their potential to become a player in the global nickel supply. Given a 47 million wet metric tons (wmt) of nickel ore and an additional 160.80 million wmt, Sangkuriang Mining is interested in selling its ownership of Nico INA. This study aims to determine Nico INA's intrinsic value to arrive at the most appropriate price tag for potential buyers. Internal data on Nico INA's financial statements, forecasts of global nickel price, total reserves amount, and production volume are used to forecast Nico INA's free cash flows to equity. The capital asset pricing model serves to determine the most appropriate cost of equity to discount Nico INA's free cash flows to equity in the discounted cash flow model. The analysis yields an intrinsic equity value range of $306.55 million to $552.81 million. The valuation range depicts that Nico INA's equity value as 30 to 54 times its book value of $10.30 million. The result of this valuation encourages Sangkuriang Mining to set Nico INA equity value as its price tag and move to sell the asset to obtain high gains on sale.

Keywords:- *nickel; nickel mining; forecast; risk; valuation; asset value; equity value; price tag.*

I. INTRODUCTION

A. Motivation

Nickel is a non-precious metal mineral obtained through a rigorous process of mining, smelting, and refining. Nickel seen on the market is known as refined nickel which can be classified further into two sub products: class 1 and class 2.Nickel obtained as a raw material from the nickel mine exists in the form of a nickel ore as opposed to refined nickel in class 1 and class 2 nickel. Nickel ores are heavily contaminated with dirt, mixture of other minerals, water droplets, and others. They are categorized into three forms depending on its geological and chemical characteristics: laterite, sulphide, and garnierite ores or commonly known as limonite, saprolite, and garnierite ores (Elias, 2013).

An important element to keep in mind when assessing nickel mines are their resource and reserve amounts. As with other mineral mines, there may be a very large volume of nickel present inside the mine but only a limited amount can be mined. In the mining industry, the total tonnage of mineral that exists inside the mine is referred to identified resources whereas the mineable quantity is known as reserves (Lusty and Gunn, 2014). In a mine's exploration and evaluation stage, the firm inject research capital expenditures to know more of how the mineral geologically lives inside the mine and ultimately arrive the number of reserves they can exploit for production.

There is an expected growing shortage of refined nickel in the market from 2020 to 2030 due a 3.44% gap of supply and demand in its 10-year forecasted CAGR. Supply is growing at a slower rate due to the time-consuming nature of studying the mine and its feasibility to generate profit in their exploration and evaluation period.Nickel demand is expected to grow by a 10-year CAGR of 6.19% to 4.3 million tons in 2030. This staggering growth is driven from increasing demand for electric vehicle (EV) batteries and stainless-steel alloys from Chinese manufacturers (Nickel Market - Growth, Trends, Covid-19 Impact, and Forecasts (2021-2026), 2021).

B. Nickel in Indonesia

Indonesia holds the title of highest nickel reserve and mining activity in the world at a total reserve of 21 million metric tons (McRae, 2021).Indonesia is home to five large nickel mines who in the past have highly contributed to the nation's large nickel ore export volume. They exist in a range of locations in central and eastern Indonesia: South Kalimantan, Southeast Sulawesi, South Sulawesi, and Western Papua, each owned and operated by different companies (Carmen, 2021). Historically, Indonesia pushed to produce and export nickel ore as opposed to processing ores domestically due to their limited capacity and resources. In 2019 alone, Indonesia fulfilled 40% of China's total nickel ore import demands (Durrant, 2019).Indonesia managed to increase their annual mined nickel ore volume from 6.51 million wet metric tons (wmt) in 2013 to 60.95 million wmt in 2019, resulting a 6-year CAGR of 45.18% (Nickel ore production in Indonesia from 2013 to 2019, 2021).

C. Objective of this case study

The nickel industry imposes various opportunities especially to new and existing Indonesian mining firms. With high inflows of foreign investment to nickel mining and processing, it is crucial for firms who own nickel mines to determine the most appropriate value given its current condition and projected future performance (Guberman, 2021). This will avoid unfairness in either one of the parties involved in a transaction negotiation and settlement. There are several elements that must be considered when determining the most appropriate price tag for a nickel mine. Understanding the firm's current financial health is important as it serves as a basis to predict how the firm will perform in the future. It is also important to consider external factors such as global nickel prices as it significantly affects the firm's performance.

D. Introducing Nico INA

Nico INA is a nickel mine owned by a private Indonesian state-owned company named Sangkuriang

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Mining that historically mined only saprolite ores. Nico INA's license to explore and evaluate was obtained by Sangkuriang Mining from the GOI in 1998. However, their license to operate and commercialize was only recently validated in 2017 taking a total of 19 years of exploration and evaluation.Their preliminary research suggests that Nico INA holds a total of 160 million wet metric tons (wmt) of saprolite ore and 154 million wmt of limonite ore resources, whereas reserves were recorded at 39 million wmt and 8 million wmt for saprolite and limonite ores respectively. This information was attained through an accumulated exploration and evaluation expense valued at $5.15 million.Nico INA is interested to increase the number of reserves that exist inside their mine. Doing so requires additional capital expenditure expected to be incurred from 2019 to 2034 for additional exploration conduct another exploration and evaluation. They estimate that it will cost $29 million which will allow Nico INA to increase their total reserves by 160.8 million wet metric tons of nickel ore to a total of 208.6 million wet metric tons of nickel ore reserves.

Nico INA began its initial production in 2018 with a total ore mined volume of 0.91 million wet metric tons (wmt). They successfully sold 87.69% of their total production in the same year, recording a total revenue of $26.2 million, with the remaining unsold goods recorded as inventory. Their high sales rate on only their first year of production is due to Sangkuriang Mining's ability to secure deals with customers prior to 2018. Nico INA's income statement for the year 2018 is presented in table 1.

Nico INA income statement for fiscal year 2018 (in US$ millions)	
Revenue	26.20
Direct costs	-10.10
SG&A costs	-1.10
Selling cost	-7.40
Amortization expense	-0.20
Operating income	7.60
Interest income/expense	6.00
Income before taxes	7.80
Tax expense	-1.90
Royalty fee	-1.38
Net income	**4.32**

Table 1: Nico INA's income statement for Fiscal Year 2018 in US$ millions

(Source: Final Report: Valuation and Transaction Structure, n.d.)

Furthermore, after deducting their revenue with all expenses incurred throughout the period, Nico INA recorded a net income of $4.32 million. Direct costs incurred is the highest among other costs throughout the period, proportional to 38.55% of revenue. In the mining industry, direct costs are comprised of four items: mining services costs, employee costs, maintenance costs, and other costs. Sangkuriang Mining recorded that of the four items, 69% are mining services costs, 18% are employee costs, and 12% are maintenance costs (Final Report: Valuation and Transaction Structure, n.d.). Nico INA has a net profit margin of 16.49% in 2018 as compared to an operating profit margin of 29.01% for the same year. This indicates that Nico INA's costs are heavy on their operating expenses as compared to interest and tax expenses.

In addition to their income statement, Nico INA provided their information on current assets, current liabilities, and total equity amounts for the year ending on December 31, 2018. Nico INA has a total of $6.50 million current assets comprised of $0.60 million cash, $4.80 million in accounts receivable, $0.90 million in inventory, $0.20 million of other current assets. Nico INA also records total current liabilities at $5.40 million resulted from the summation of $3.80 million in accounts payable, $0.90 million in accrued expenses, and $0.70 million in other current liabilities. Aside from their current assets and current liabilities, Nico INA records a total of $10.30 million in equity in 2018.

Nico INA's additional exploration and evaluation expenditure from 2019 to 2034 allows them to stretch the mine's useful lifetime and optimize their annual production capacity seen in their three alternative plans on their production timeline: worst, base, and best case. In 2018, Nico INA produced saprolite ores containing 1.8% nickel. In both base and worst case, the firm expects to only mine 1.8% nickel grade saprolite ores whereas the best case mines an additional 1.2% nickel grade limonite ore. The base case expects to mine a maximum capacity of 3.7 million wet metric tons per annum (wmtpa) of saprolite ores, low case expects 3.1 million wmtpa of saprolite ores, and best case expects 3.7 million wmtpa of saprolite ores and an additional 1.3 million wmtpa of limonite ores. Nico INA expects a total production of 85 million wmt, 103 million wmt, and 171 million wmt throughout its lifetime for the worst, base, and best cases respectively.The base and low case expects to conduct mining activities from 2018 until 2047, whereas the best case expects production to last until 2067.Table 2 illustrates Nico INA's expected production schedule throughout its useful lifetime.

Year/Case	2018 (Base Year)	2019	2020	2021	2022	2023	2024	2047	2048	2067	2068
Worst Case	0.91	2.00	3.00	3.10	3.10	3.10	3.10	3.10	0.00	0.00	0.00
Base Case	0.91	2.00	3.00	3.00	3.10	3.70	3.70	3.70	0.00	0.00	0.00
Best Case	0.91	2.00	3.00	3.00	4.20	5.00	5.00	5.00	5.00	1.30	0.00

Table 2: Nico INA's production schedule for each alternative case in million wmtpa

(Source: Final Report: Valuation and Transaction Structure, n.d.)

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E. Nico INA's financial expectations

In addition to the different volumes present in each alternative case, Nico INA expects different global nickel prices and operating expenses for each of the three alternative cases. The worst case expects no deviation from the global nickel price forecast whereas the base case and best case expects global nickel prices to be 3% and 6% higher than the initial forecast respectively. Whereas operating costs are expected to be 7% lower for the worst case, 5% higher for the base case, and 2% higher for the best case. Sangkuriang Mining's CEO briefly discussed that nickel prices are very volatile making it hard to predict. With the increase in price due to external factors, it is safe to assume that expenses will increase accordingly. These assumptions are derived from Sangkuriang Mining's experience in forecasting income statements. Their CEO advised this study to use their assumptions accordingly when dealing with forecasting Nico INA's income statements.

As of 2018, Nico INA is in good financial health indicated by a net profit margin of 16.45% and operating margin of 29.01%. With the positive sentiment on nickel prices due to an expected increasing shortage until 2030, Nico INA can expect to enjoy increasing dollar value in sales. The expected positive future performance may allow Nico INA to potentially attract new investors. Given Nico INA's current and expected performance, Sangkuriang Mining wants to know the feasibility of selling Nico INA in part or whole to a potential buyer.

F. Research questions

Sangkuriang Mining wants to sell Nico INA given the positive prospects from both EV battery and stainless-steel industries. The board of directors want to know the most appropriate price tag to put on Nico INA. It is crucial to determine Nico INA's value prior to entering a transaction negotiation with a potential buyer to avoid settling at a disadvantageous price. The board of directors wants to know what is Nico INA's value given the global nickel prices, expected annual production capacity, and expenses incurred. Hence, this study aims to answer the research questions of:

- What is Nico INA's intrinsic equity value?
- Should Sangkuriang Mining sell Nico INA at its intrinsic equity value?
- How much can Sangkuriang Mining expect to receive if they sell 49% of Nico INA's ownership?

G. Scope of research

The aim of this study is to analyse and determine Nico INA's intrinsic equity value. Internal data from Nico INA is obtained along with public data regarding annual market returns, annual risk-free rates, and returns from comparable publicly listed stocks are utilizes. To maintain reliability, this study will apply a 10-year average when computing annual returns. This case study will conduct a valuation analysis for Nico INA in three different alternative cases: worst case, base case, and best case. The worst and base case has a timeline of 30 years from 2019 to 2048, whereas the best case has a 50-year timeline from 2019 to 2068. This study designates the year 2018 to be the base year as reference when forecasting values for future periods.

The discounted cash flow (DCF) model is used to arrive at Nico INA's intrinsic equity value. In DCF, it is a custom to account for growth rates when forecasting free cash flows to firm or equity. However, the growth in free cash flows to equity (FCFE) forecasts in this study is dependent on the growth in nickel prices. Hence, FCFE growth is only dependent on the growth of nickel ore price, deviations in operating expenses, and production capacity. With zero debt, the irrelevance of accounting for their proportion of debt and cost of debt concludes for the use of cost of equity in discounting forecasted FCFE. Arriving at Nico INA's annual free cash flows to equity requires forecasting annual income statement. This study models Nico INA's forecasted operating expenses in its income statement to have zero-growth over the forecasted period. Instead, it will use the percentage of revenue as the forecasting method. This study utilizes the Capital Asset Pricing Model (CAPM) is used as the cost of equity. It is important to note that this study will treat Nico INA as an asset as opposed to an entity or firm as it affects the decision to rename Nico INA's enterprise value to asset value.

II. METHODS

A. Forecasting net income

To protect nickel ore miners, the government of Indonesia (GOI) imposed a price floor as a form of government intervention. This rule is enforced through Indonesia's Ministry of Energy and Natural Resources' mandate in *Peraturan Menteri (PerMen) ESDM Nomor 11 Tahun 2020* stating that the price floor is dependent upon three elements: nickel ore grade, its corresponding correction factor, and nickel price per ton consensus tonne as highlighted in equation (1) (Menteri Energi dan SumberDaya Mineral Republik Indonesia, 2020:7).

$$Price\ Floor = \%Ni \times Correction\ Factor \times Consensus\ Price \quad (1)$$

Nickel grade is the proportion of nickel that can be found for every 1 ton of nickel ore. It usually lies within the range of 0-2%. Saprolite Ores often contain more than 1.7% of nickel whereas limonite ores contain 1-1.6% (Gultom and Sianipar, 2020). The correction factor is essentially a premium to manage the intense fluctuations on nickel consensus prices to protect nickel ore suppliers from experiencing high losses during extreme drops in price. It is set by the Ministry to be dependent upon each nickel grade where it fluctuates within a $\pm 1\%$ for every 0.1% increase or decrease in nickel grade as seen in figure 1. Whereas the global nickel price per ton consensus is determined by the ministry of Energy and Natural Resources according to London Metal Exchange (LME) or others.

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	HPM						HPM					
	%Ni						%Ni					
Kadar	1,10%	1,20%	1,30%	1,40%	1,50%	1,60%	1,70%	1,80%	1,90%	2,00%	2,10%	2,20%
CF	12%	13%	14%	15%	16%	17%	18%	19%	20%	21%	21%	22%

Fig. 1: Indonesia's correction factor for every nickel ore grade in computing for its domestic price floor(Source: DirektoratJendral Mineral dan Batubara, 2020:11)

The historical 10-year nickel per ton price posted by the LME from 2008 to 2018 has a 10-year compounded annual growth rate (CAGR) of -4.99%. Table 3 illustrates the annual average prices of nickel posted by the LME. Nickel records its highest price at $52,180 on May 2007, where it dropped by 73.03% in just 19 months to $9,690 on December 2008. Drastic price movements in 2007, 2008, and 2015 as seen in Table 3 and other regular fluctuations are the result of significant changes in surplus and shortages of nickel (Desai, 2021).

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Price	20648	14949	22287	23053	17435	14863	16780	11583	9594	10566	13037

Table 3: Nickel price per ton from 2008 to 2018 in US$

Brooks (2019) demonstrates that the annual revenue formula follows the quantities sold multiplied to the price of which it was sold as seen in equation (2). Following the price floor formula presented in equation (1) as the input to *price* in equation (2) and annual selling quantities following 87.69% of total produced nickel ores added with inventory from the previous period will yield its annual revenue.

$$Annual\ revenue = Price \times Annual\ selling\ quantity \quad (2)$$

As previously mentioned in Chapter 1, Nico INA's most significant direct cost account is their mining services costs. Syafrizal (2021) illustrates that a mining company's direct expenses include mining cost, ore getting cost, all transportation costs from pit to ship, safety and environment cost, reclamation cost, mine closure cost, and infill drilling costs. Transportation costs are comprised of five stage costs: pit to top-soil dump, pit-to-waste dump, pit-to-exportable transit ore (ETO), ETO to exportable final ore (EFO), EFO to barge or ship. For most mining businesses, transportation costs come to a halt at the port where shipping or freight is paid by the customer, known as the freight on board (FOB). In cases where the contract with the buyer specifies shipping to be under the hands of the seller, cost, insurance, and freight (CIF) will be used (Sangkuriang Mining CEO, personal interview, 2021). Reclamation, mine closure, and infill drilling costs are accounted as direct costs due to responsible mining practices.

Expenses as operating expense can be forecasted as a percentage of revenue method to obtain a pro-forma income statement for each forecasted year (HBS Online, 2021). Nico INA's 2018 income statement information in table 1 is used to build ratios for each expense account to arrive as a reference when forecasting future periods as seen in table 4.

Profit and Loss Accounts	Year	Percentage of Revenue
	2018	
Revenue	$ 26,200,000.00	
Direct expense	$-10,100,000.00	38.55%
G&A expense	$ -1,100,000.00	4.20%
Selling expense	$ -7,400,000.00	28.24%

Table 4: Percentage of revenue table for income statement accounts

$$Direct\ expense_n = 38.55\% \times Revenue_n \quad (3)$$
$$G\&A\ expense_n = 4.20\% \times Revenue_n \quad (4)$$
$$Selling\ expense_n = 28.24\% \times Revenue_n \quad (5)$$

Equations (3), (4), and (5) shows forecasting direct expense, general and administrative expense, and selling expense as a percentage of revenue for each forecasted year.

According to the International Accounting Standard (IAS) 38, Nico INA's exploration and evaluation costs incurred prior to Nico INA's operation commencement is recognized as an intangible asset, hence subject to amortization. In the mining industry, intangible assets are amortized commonly by the units of production (UoP) as opposed to the straight-line method. Burkitt et al. (2012) discussed that mining companies often use this method of amortizing their intangible assets as it recognizes the different production volumes the asset generates over its useful lifetime. Computing for Nico INA's annual amortization expense for their intangible asset is done in two steps. Firstly, the amortization expense per unit must be determined. Then this cost per unit is multiplied to each year's total production to give the year's amortization expense. The amortization expense per unit is computed by subtracting the salvage value from the asset's total cost, then divided by the total estimated produced units throughout the asset's lifetime. For a nickel

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mine, its total cost would be the accumulated exploration and evaluation that is recognized an intangible asset. It has a salvage value of zero because the mine is expected to be fully depleted after its useful lifetime. The net cost will be divided by the total expected tonnage of production as illustrated in equation (6) to determine the amortization per ton (Singh, n.d.).

$$Amortization\ per\ unit = \frac{Cost - Salvage\ value}{Total\ estimated\ production\ units} \quad (6)$$

The income statement records amortization expense as opposed to amortization per unit. Throughout the fiscal year, Nico INA will record how much minerals they mined. Combining their annual production output and the amortization cost per ton from equation (6) into equation (7) will give the mine's annual amortization expense for their intangible asset (Singh, n.d.).

$$Amortization\ expense_n = Amortization\ per\ unit \times annual\ production_n \quad (7)$$

Nico INA is only able to commence their exploration, evaluation, production, and commercialization because they attained a license from the GOI to conduct such activities. Extracting minerals that exists inside Indonesia's sovereign land demands a compensation to the GOI in the form of royalty fees for every tonnage mined (Kencono et al., 2017).Mining firms such as Nico INA often experience double taxation: production (royalty fees) and income tax.The amount of royalty fees mining firms must pay to the GOI is determined based on the license owned by the company. Indonesia issues five types of mining licenses: *Izin Usaha Pertambangan (IUP), Izin Usaha PertambanganKhusus (IUPK), IzinPertambangan Rakyat (IPR), KontrakKerja (KK), and PerjanjianKaryaPengusahaanPertambangan Batubara (PKP2B).* Each license has different scopes of activities allowed accounting for different production royalty calculations. Nico INA's license to mine is under IUPK, which according to Kencono et al. (2017) computes its annual royalty fees using equation (8).

$$Annual\ royalty\ fees = Volume \times Selling\ price \times Tariff \quad (8)$$

To satisfy the requirements of equation (5), production volume can follow Nico INA's production timeline whereas selling price will utilize the domestic nickel ore price computation using equation (1) based on the specific nickel grade and its correction factor. Tariffs however are determined by the GOI in *PeraturanPemerintahRepublik Indonesia Nomor 7 Tahun 2012* (PP No. 7/2012) in article 4 stating that royalty fee tariffs for IUPK holders are at 4% (PeraturanPemerintahRepublik Indonesia Nomor 9 Tahun 2012).

Based on Nico INA's 2018 income statement, their tax rate is 25% of their earnings before taxes. For simplicity, this study assumes that Nico INA will be liable for 25% corporate income tax annually. For future years, Nico INA's corporate income tax expense will follow equation (9) in line with Brooks (2019).

$$Income\ tax\ expense_n = 25\% \times Earnings\ before\ taxes_n \quad (9)$$

Arriving at the net income is useful for various reasons. Investors and management can derive profitability ratios from the net income to aid their decision-making processes. A firm's net income is defined by Brooks (2019) as the amount a firm earns within a fiscal year after meeting all their operating expenses, depreciation and amortization expenses, interest and tax obligations as formulated in equation (10).

$$Net\ Income_n = Revenue_n - Operating\ expenses_n - Depreciation\ \&\ amortization\ expenses_n - Interest\ expenses_n - Tax\ expenses_n \quad (10)$$

B. Forecasting non-cash net working capital

To arrive at the annual net working capital, forecasting annual non-cash current assets and current liabilities must be done accordingly. Forecasting by the percentage of revenue as seen in table 4 can be replicated to current asset and current liabilities accounts as seen in table 5. However, it excludes the inventory account as it depends on the unsold quantities from the previous operating year.

Balance Sheet Accounts	2018 (in US$ millions)	As a percentage of 2018 revenue
Accounts Receivables	4.80	18.32%
Other Current Assets	0.20	0.76%
Accounts Payable	0.38	14.50%
Accrued Expenses	0.90	3.44%
Other Current Liabilities	0.70	2.67%

Table 5: Non-cash and inventory current asset and current liabilities as a percentage of revenue

$$Total\ non-cash\ and\ inventory\ current\ assets_n = Revenue_n(18.32\% + 0.76\%) \quad (11)$$

$$Total\ current\ liabilities_n = Revenue_n(14.50\% + 3.44\% + 2.67\%) \quad (12)$$

Arriving at the net working capital requires total non-cash current assets and total current liabilities for every given forecasted year. Equation (11) shows the combination of accounts receivables and other current assets. The total current liabilities annual forecast can combine accounts payable,

accrued expenses, and other current liabilities as seen in equation (12).

C. Free cash flows to Equity (FCFE)

This case study utilizes the free cash flows to equity as one of two inputs to the discounted cash flow model. Damodaran (2011) defines FCFEs as the estimated returns management can return to investors. This type of free cash flow is chosen as opposed to free cash flows to firm (FCFF) because Nico INA's independence from debt as a source of financing. With 100% equity, the nominal value of their FCFEs and FCFFS are virtually equivalent. Damodaran (2011) outlines that obtaining FCFEs can be done under four adjustments to the annual net income as seen in equation (13).

$$\begin{aligned} FCFE = {} & Net\ income \\ & + Depreciation\ \&\ amortization \\ & - Capital\ expenditure \\ & - \Delta Non\ cash\ net\ working\ capital \\ & - Net\ debt \end{aligned} \tag{13}$$

As featured in equation (13), arriving at Nico INA's free cash flow to equity requires several adjustments to its annual net income: add back non-cash expense such as amortization, subtract with capital expenditure, subtract with the change in non-cash net working capital, and subtract with net debt incurred in the same year. However, since Nico INA has zero debt and its unlikeliness to change, net debt can be set to zero and ignored. The remaining three adjustments are analytically computed from all information presented.

Annual capital expenditures are assumed to be the average of their 15-year investment on additional exploration and evaluation at an amount of $29 million expected to be incurred from 2019 to 2034. It will follow equation (14), while the changes in non-cash net working capital will subtract non-cash net working capital in year n with non-cash net working capital in year n-1 as illustrated in equation (15).

$$Annual\ Capital\ Expenditure = \frac{Total\ capital\ expenditure}{No.of\ years\ incurred} \tag{14}$$

$$\begin{aligned} \Delta Net\ working\ capital = {} & Net\ working\ capital_n \\ & - Net\ working\ capital_{n-1} \end{aligned} \tag{16}$$

All four adjustments in equation (13) will result to computing for annual free cash flows to equity. These values will be useful when computing for Nico INA's intrinsic asset value as an effort to search for its most appropriate price tag.

D. Cost of Equity

Brooks (2019) highlighted that the theory of time value of money dictates future streams of cash such as future free cash flows that must be discounted to the present value using an appropriate discount rate due to the increasing levels uncertainty in attaining those free cash flows.The discount rate captures the risk financiers take by expecting the promised future cash flows from their capital injection, hence the cost of capital. When looking at the risk attached to free cash flows to equity, Damodaran (2011:34) describes *"when valuing equity, you look at the risk in the equity investment in the business"*. The risk or cost of equity is estimated by the capital asset pricing model (CAPM).

The capital asset pricing model (CAPM) essentially estimates the expected return from an investment given the risks present in the investment. It captures three inputs: the risk-free rate, the investment's beta, and the market risk premium. Since Nico INA is an investment that lives outside of the United States, an additional element of risk known as the country risk premium (CRP) is added to the equation (Damodaran, 2018). Equation (17) shows Damodaran's adjustment to the CAPM equation based on Finnerty (2013) and Julio (2021) that will be used in this study's analysis where $E(R_i)$ describes the cost of equity to the investment *i*.

$$E(R_i) = r_f + \beta_i\big(E(R_m) - r_f\big) + CRP \tag{17}$$

Analysts generally use a 10-year U.S. Treasury Bill (T-Bills) yield for the risk-free rate, r_f, whereas the market return, R_m, commonly refer to the index returns. A global market index such as the MSCI ACWI is utilized to represent the market returns. Annual eturns are computed by equation (18). The investment's beta is a measure of its volatility compared to the overall market (Julio, 2021:38). For private entities such as Nico INA, their beta is estimated by the average of publicly listed stocks betas under the same industry. Lastly, Damodaran (2018; 2021) quotes Indonesia's country risk premium at 2.54% signaling to investors that investors the additional risk they must absorb when investing in Indonesia as opposed to the United States of America is 2.54%.

$$E(R) = \frac{End\ of\ year\ price - beginning\ of\ year\ price}{beginning\ of\ year\ price} \tag{18}$$

An investment's beta describes how sensitive its annual returns are compared to the market's risks. It illustrates how the stock's expected return changes given a change in the market portfolio's movement. Often, betas of publicly listed companies are levered betas since their capital structure combines both debt and equity. Julio (2021) explains that computing for a particular investment's beta requires the covariance between the stock's return and the market return along with the variance of the market return as seen in equation (19).

$$\beta_i = \frac{Cov(E(R_i), E(R_{market}))}{Var(E(R_{market}))} \tag{19}$$

It is common for different companies within the same industry to have different proportions of debt and equity in their capital structure. Kruschwitz and Loeffler (2006) described that debt has an influence over a firm's cost of capital making it incomparable with firms such as Nico INA that are funded entirely by equity. To reliably determine Nico INA's beta by its comparable, an un-levering adjustment must be made to the levered betas of comparable stocks. Equation (20) presents the formula used when un-levering betas (Fernandez, 2003).

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$$Unlevered\ Beta\ stock_i = \frac{Levered\ beta\ stock_i}{\left(1 + \left((1 - tax\ rate) \times \frac{Total\ Debt}{Total\ Equity}\right)\right.} \quad (20)$$

After assuring that the industry beta is comparable in terms of its level of leverage, Kruschwitz and Loeffler (2006) suggests that the industry average beta is now ready to be relevered according to Nico INA's capital structure using equation (21). Fernandez (2003) demonstrated that the unlevered beta formula in equation (20) can be rearranged to relever each stock's beta as seen in equation (22).

$$Relevered\ Beta\ stock_i = Unlevered\ Beta_i \times \left(1 + \left((1 - tax\ rate) \times \frac{Total\ Debt}{Total\ Equity}\right)\right. \quad (21)$$

E. Intrinsic value

Computing for Nico INA's intrinsic value, or more specifically its intrinsic equity value is done by using the discounted cash flow (DCF) analysis. It considers of the asset's forecasted free cash flows, in this case FCFEs, and discounts it to the present value using the cost of equity. Finnerty (2013) illustrated the summation of present values for all future cash flows for FCFFs and the weighted average cost of capital. However, the equation can exchange FCFF with FCFE and weighted average cost of capital with the cost of equity. Prior to the summation, Brooks (2019) illustrates the method of attaining the present value for each forecasted FCFE in equation (23). In its essence it divides the free cash flow to equity of a particular year in the future by the present value interest factor (Brooks, 2019; Finnerty, 2013).

$$Discounted\ FCFE_n = \frac{Future\ Value}{(1 + discount\ rate)^n} = \frac{FCFE_n}{(1 + cost\ of\ equity)^n} \quad (23)$$

The purpose of conducting the discounted cash flow analysis is to determine a stock's equity value from their enterprise value. However, Nico INA is an asset owned by Sangkuriang Mining as opposed to being a stand-alone entity, hence calculating for its asset value instead of enterprise value. When equation (23) is replicated to all years forecasted, it gives the reader a picture of how Nico INA's annual forecasted FCFE is equivalent to today's dollar value. The summation of all discounted FCFEs as highlighted in equation (24) produce an enterprise value, or for this case, Nico INA's asset value since. This equation is adopted from Finnerty (2013).

$$Asset\ Value = \sum_{t=0}^{n} \frac{FCFE_n}{(1 + cost\ of\ equity)^n} \quad (24)$$

Lastly, obtaining the equity value from the asset value is done by adding excess cash and subtract net debt at the base year (n=0) as seen in equation (25) (Enterprise Value vs Equity Value, n.d.).

$$Equity\ Value_0 = Asset\ Value + Total\ cash_0 - Total\ debt_0 \quad (25)$$

Nico INA's intrinsic equity value estimated by the discounted cash flow model will then be compared to Nico INA's book value to as a measure of whether Nico INA is over, under, or par valued. As a privately owned asset, Nico INA's book value is their total equity as of the year ending on December 31, 2018.

III. RESULTS

A. Estimating net income

Given the importance of all theories mentioned in section 2, computing for Nico INA's value from 2019 to 2048 for base and worst case; and 2019 to 2068 for best case can be done to determine the most appropriate price tag based on its intrinsic equity value. The timeline set for this valuation analysis covers the entire lifetime of Nico INA assuming that it will be dissolved once the mine has zero economic value. Hence the base and worst case will be valued for 30 years whereas the best case is valued for 50 years.

Forecasting Nico INA's annual revenue will follow equation (2) where the price will be determined based on equation (1) and its annual selling quantity will refer to table 6 based on table 2. Following a total of 87.69% of nickel ore sold in 2018 compared to the total amount mined in the same year, this ratio is assumed to be true for all forecasted years.

Year/Case	2018 (Base Year)	2019	2020	2021	2022	2023	2024	2047	2048	2067	2068
Worst Case	0.91	1.87	2.24	2.88	2.94	2.88	2.94	2.88	0.22	0.00	0.00
Base Case	0.91	1.87	2.76	2.87	2.85	3.49	3.45	33.49	0.21	0.00	0.00
Best Case	0.91	1.87	2.76	2.87	3.62	4.74	4.64	4.74	4.64	1.25	0.05

Sangkuriang Mining's internal analysis presents a 10-year nickel price forecast from 2021 to 2029. Due to limited information about how the supply and demand equilibrium after 2029, this study will assume that nickel prices beyond 2029 will be the 20-year average from 2008 to 2029. Taking the average of nickel prices from 2008-2018 found in table 3 and the 10-year nickel price forecast from 2019 to 2029 in table 7, the 20-year average is computed at $16,015. This price is assumed to be true from 2030 onwards.

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Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Price	12312	12968	13552	14121	14760	14970	15459	17650	20689	21206	19842

Table 7: Forecasted nickel price per ton according to Sangkuriang Mining from 2019 to 2029 in US$

As mentioned in the introduction, Nico INA mines 1.8% saprolite ore and 1.2% limonite ores. Using equation (1) yields the annual forecasted nickel ore prices, whereas equation (2) results in the annual revenues Nico INA can expect to achieve by selling ores at those prices and quantities mentioned in table 6. As an example, computing for a 1.8% nickel grade ore price in 2023 will follow a 19% correction factor and a nickel price per ton of $14,760 to yield a price floor of $50.48.

$$2023\ Forecasted\ Price\ for\ 1.8\%\ grade\ nickel = 1.8\% \times 19\% \times \$14760 = \$50.48$$

The 1.8% grade saprolite ore price forecasted at $50.48 is yet to be multiplied with the deviations mentioned in section 1. The low case expects +0% deviation whereas the base case and best case expects a +3% and +6% from the price forecasts set by Sangkuriang Mining respectively. This means that the saprolite ore price for the year 2023 in the base case is 3% higher than $50.48 as well as price at 5% higher than $50.48 for the best case, and the worst case has the same forecast price as provided by Sangkuriang Mining. The following are the calculations for the base and best case's expectation for nickel prices in 2023. Forecasted nickel prices are hence found in table 8.

$$2023\ Forecasted\ price\ for\ 1.8\%\ grade\ nickel_{Base\ case} = \$50.48 \times (1 + 3\%) = \$51.99$$
$$2023\ Forecasted\ price\ for\ 1.8\%\ grade\ nickel_{Best\ case} = \$50.48 \times (1 + 6\%) = \$53.51$$

Year/Grade	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Worst case saprolite	42.11	44.35	46.35	48.29	50.48	51.20	52.87	60.36	70.76	72.52	67.86	54.77
Base case saprolite (+3%)	43.37	45.68	47.74	49.74	51.99	52.73	54.46	62.17	72.88	74.70	69.90	56.41
Best case saprolite (+6%)	44.63	47.01	49.13	51.19	53.51	54.27	56.04	63.98	75.00	76.88	71.93	58.06
Worst case limonite	19.21	20.23	21.14	22.03	23.03	23.35	24.12	27.53	32.27	33.08	30.95	24.98
Best case limonite (+6%)	20.36	21.44	22.41	23.35	24.41	24.75	25.56	29.19	34.21	35.07	32.81	26.48

Table 8: Forecasted nickel prices for all alternative cases given their deviations from 2019 to 2030 in US$

Prices from table 8 will be multiplied to each corresponding year's selling quantities as found in table 6. Table 9 illustrates annual revenues Nico INA can expect to receive over the coming years.

Year	2019	2020	2021	2022	2023	2024	2047	2048	2067	2068
Worst case	26.20	78.58	99.27	133.48	141.91	145.38	157.74	12.05	0.00	0.00
Base case	80.94	126.29	136.83	141.88	181.58	182.05	197.02	11.72	0.00	0.00
Best case	26.20	83.29	129.96	140.81	164.03	217.33	235.81	231.98	33.06	1.37

Table 9: Annual revenues for each alternative case in US$ millions

Annual operating expenses follows equation (3), (4), and (5) and utilizes annual revenues from table 9 as inputs. A sample calculation of the base case's total operating expenses for the forecasted year 2023 are as follows:

$$Direct\ expense_{2023} = 38.55\% \times \$181.58\ million = \$67.00 million$$
$$G\&A\ expense_{2023} = 3.44\% \times \$181.58\ million = \$6.25\ million$$
$$Selling\ expense_{2023} = 28.24\% \times \$181.58\ million = \$51.28\ million$$

The computations above result a total operating expenditure of $127.52 million in 2023. Each case has different operating expense for the same year due to different revenues because of different selling quantities. Additionally, section 1 mentions that each alternative case adds a deviation to operating expenses at 7%, 5%, and 2% higher than the pro-forma operating expenses for the worst, base, and best cases respectively. This means that for each operating expense forecasted as seen in the example above, an additional percentage increase is incorporated to further differentiate each alternative case. These percentages are multiplied to the forecasted year's operating expense as seen in the following example. Table 10 shows total operating expense for the worst (+7% deviation), base (+5% deviation), and best (+2%) deviation cases.

$$Operating\ expense_{Base\ case\ 2023} = \$127.52 \times (1 + 5\%) = \$133.90\ million$$

Year	2019	2020	2021	2022	2023	2024	2047	2048	2067	2068
Worst case	59.05	74.60	100.31	106.64	109.25	113.05	118.53	9.05	0.00	0.00
Base case	59.68	93.12	100.90	104.62	133.90	134.24	51.74	3.08	0.00	0.00
Best case	59.67	93.10	100.87	117.50	155.68	155.34	66.89	65.81	23.68	0.98

Table 10: Forecasted annual operating expenses for all alternative cases in US$ millions

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As of 2017, Nico INA has accumulated a total exploration and evaluation expenditure of $5.15 million. Nico INA expects an additional exploration and evaluation expenditure of $29 million from 2019 to 2035. Since IAS 38 allows for exploration and evaluation to be capitalized as intangible assets, it must be amortized accordingly. Equation (6) and equation (7) highlights the formulae to arrive at the annual amortization ratio using the UoP method expected to be incurred by Nico INA.

It is unclear to determine the exact tonnage of nickel ore that each of the two capital expenditures generate. This problem is addressed by estimating proportional weights through information about Nico INA's reserve amounts and the proportion of reserve contributed by each capital expenditure. With the additional $29 million capital expenditure, Nico INA expects to increase nickel reserves by 160.8 million wet metric tons (wmt) to a total of 208.6 million wmt. With that, it can be deduced that the initial $5.15 million capital expenditure yields a total of 47.8 million wmt of reserves. The 47.8 million wmt of nickel reserves determined from the $5.15 million exploration and evaluation cost is proportional to 22.91% of the total reserves in Nico INA, whereas the 160.8 million wmt of nickel ore obtained from the additional $29 million is proportional to 77.09% of total reserves. Each case has different expected production capacities: low case at 85 million wmt, base case at 103 million wmt, and best case at 171 million wmt. The weights are assigned to each expected production capacities to arrive at the amortization per unit cost for each case using equation (3). The following are the calculations for the base case.

$$Amortization\ per\ unit_{Base\ case\ \$5.15\ million\ capex} = \frac{\$5.15\ million - 0}{22.91\% \times 103\ million\ wmt} = \$0.22\ million\ per\ million\ wmt$$

$$Amortization\ per\ unit_{Base\ case\ \$29\ million\ capex} = \frac{\$29\ million - 0}{77.09\% \times 103\ million\ wmt} = \$0.37\ million\ per\ million\ wmt$$

$$Total\ amortization\ per\ unit_{Base\ case} = \$0.22 + \$0.37 = \$0.58\ million\ per\ million\ wmt$$

Cases	Worst	Base	Best
Amortization expense per ton	0.71	0.58	0.35

Table 11: Amortization expense per ton for all alternative cases

Equation (7) is utilized to arrive at the annual amortization expense by using the amortization expense per ton values in table 11 and the annual production quantities in table 2. Table 12 highlights the annual amortization expense in US$ million for all alternative cases

Year	2019	2020	2021	2022	2023	2024	2047	2048	2067	2068
Worst	1.41	2.12	2.19	2.19	2.19	2.19	2.19	0.00	0.00	0.00
Base	1.17	1.75	1.75	1.81	2.16	2.16	2.16	0.00	0.00	0.00
Best	0.70	1.05	1.05	1.48	1.76	1.76	1.76	1.76	0.46	0.00

Table 12: Forecasted annual amortization expense for each alternative case in US$ millions

Nico INA is obligated to pay annual royalty fees for mining minerals out of Indonesia's land. Equation (8) illustrates royalty fees Nico INA is subject to for all producing years. For the base and worst case, Nico INA expects to commence production until 2047 for a total of 29 years, whereas the best case expects a total of 49 years with its end in 2067. Using the production timeline in table 2, nickel ore sales prices in table 8 and the 4% tariff as mentioned in section two, Nico INA's expected future annual royalty fees are determined in table 13. A sample calculation for the base case's 2023 royalty fee results at $3.74 million.

$$Royalty\ Fee_{Base\ 2023} = 3.70\ million \times \$51.99 \times 4\% = \$7.70\ million$$

Year	2019	2020	2021	2022	2023	2024	2047	2048	2067	2068
Worst	3.74	5.32	5.75	5.99	6.26	6.35	8.41	0.00	0.00	0.00
Base	3.47	5.48	5.73	6.17	7.70	7.80	8.35	0.00	0.00	0.00
Best	3.57	5.64	5.90	7.38	9.19	9.32	9.97	9.97	1.38	0.00

Table 13: Forecasted annual royalty fees for all alternative cases in US$ millions

In addition to their royalty fees, Nico INA is subject to corporate income taxes. As mentioned in Chapter 2, the income tax that is considered in this case is 25% of Nico INA's earnings before taxes. Hence, following equation (6) generates an annual income tax as highlighted in table 3.11. A sample income tax calculation for the year 2023 for the base case is found below. To view the complete table, refer to appendix 3.

$$Income\ tax\ expense_{Base\ case\ 2023} = (\$181.58\ million - \$133.90\ million - \$2.16\ million) \times 25\% = \$11.38\ million$$

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Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	…
Worst	4.53	7.09	7.96	8.05	8.72	8.56	9.16	10.20	12.44	12.36	11.91	…
Base	5.02	7.85	8.54	8.86	11.38	11.41	11.95	13.55	16.17	16.39	15.48	…
Best	5.73	8.95	9.72	11.58	15.02	14.89	15.75	17.64	21.23	21.28	20.34	…

Table 14: Forecasted annual income taxfor all alternative cases in US$ millions

The forecasted annual net income can be calculated using equation (10) and all the previous information as its inputs. Table 15 shows the net income forecasts for all alternative cases. An example for the computation of net income for the year 2023 is found as follows.

$$Net\ income_{Base\ case\ 2023} = \$181.58\ million - \$133.90\ million - \$2.16\ million - \$7.70\ million - \$11.38\ million = \$26.42\ million$$

Year	2019	2020	2021	2022	2023	2024	2047	2048	2067	2068
Worst case	9.84	12.98	17.49	18.82	19.20	20.05	19.35	2.25	0.00	0.00
Base case	11.60	18.08	19.91	20.42	26.45	26.43	28.83	2.31	0.00	0.00
Best case	13.62	21.22	23.27	26.68	35.73	35.50	38.88	38.07	5.31	0.29

Table 15: Forecasted annual net income for all alternative cases in US$ millions

A. Approximating free cash flows to equity

The annual net income from table 15 is used as the base line when approximating for each forecasted year's free cash flows to equity. As highlighted in equation (13), amortization expense is added back, capital expenditures are subtracted, changes in non-cash net working capital is subtracted, and net debt is also subtracted from net income. Amortization expense is computed for as seen in table 12. The next adjustment is the annual capital expenditures. Following equation (14), and information about Nico INA's planned $29 million capital expenditure over 15 years from 2019 2034, an annual average capital expenditure of $1.93 million is computed. Years following 2034 will have a capital expenditure of zero.

Changes in non-cash net working capital requires equation (15) and (16). Arriving at equation (15) requires inputs from equation (11) and (12). Total non-cash current assets is a summation of equation (11) with the dollar value of annual inventories, whereas total current liabilities follow equation (12). The dollar value of annual inventory is obtained by multiplying annual inventory, calculated from the difference between each year's producing units with sold units, with the respective year's forecasted annual nickel ore prices in table 5. Computing for Nico INA's net working capital follows equation (15) by subtracting total current liabilities from non-cash current assets. An example for Nico INA's non-cash net current assets, current liabilities, and net working capital for the base case for the year 2023 are as follows.

$$Total\ non-cash\ current\ assets_{Base\ case\ 2023} = \big(\$181.58\ million \times (18.32\% + 0.76\%)\big) + (0.21 \times \$51.99) = \$45.46\ million$$

$$Total\ current\ liabilities_{Base\ case\ 2023} = \$181.58\ million \times (14.50\% + 3.44\% + 2.67\%) = \$37.42\ million$$

$$Non-cash\ net\ working\ capital_{Base\ case\ 2023} = \$45.46\ million - \$37.42\ million = \$8.03\ million$$

The next step is to compute for Nico INA's annual change in net working capital which utilizes equation (16). It subtracts the non-cash net working capital in year n with the non-cash net working capital in year n-1. If the non-cash net working capital for year 2022 is $10.16 million, whereas the previous calculation shows that 2023 non-cash net working capital is $8.03 million. Equation (16) gives the change in non-cash net-working capital ($\Delta Non-cash\ NWC$) for 2023 to be -$2.13 million as briefly presented below. Table 16 briefly illustrates the changes in non-cash net working capital for each alternative case. The last adjustment that must be made to the net income is new debt issued. Since Nico INA claims that they remain firm in funding their activities solely by equity, new debt issued will be zero.

$$\Delta Non-cash\ NWC_{base\ 2023} = \$8.03\ million - \$10.16\ million = -\$2.13\ million$$

Year	2019	2020	2021	2022	2023	2024	2047	2048	2067	2068
Worst case	3.96	0.59	2.51	-2.52	3.25	-2.91	4.01	-27.63	0.00	0.00
Base case	3.47	4.26	-4.53	5.86	-2.13	2.26	-2.30	-20.60	0.00	0.00
Best case	3.89	3.47	-4.41	5.41	0.20	0.92	-1.03	1.03	1.73	-1.27

Table 16: Changes in non-cash net working capital for all alternative cases in US$ millions

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Nico INA's annual free cash flows to equity can now be estimated by utilizing all adjustments listed above. Equation (13) aids this process of adjusting Nico INA's forecasted annual net income into FCFE. Forecasting FCFE will strictly be done for the years 2019-2048 for the base and worst cases, and 2019-2068 for the best case. Computing for the free cash flows to equity typically does not include its base year of 2018 as it only serves as a reference to compute for the forecasted years. This study extends the FCFE calculation to 2048 and 2068 as opposed to following Nico INA's useful lifetime that ends in 2047 and 2067 because there is inventory from 2047 and 2067 that is expected to sell the following year. Table 17 presents the free cash flows to equity for all alternative cases in US$ millions.

Year	2019	2020	2021	2022	2023	2024	2047	2048	2067	2068
Worst case	5.36	12.15	15.24	21.60	16.21	23.22	17.53	29.88	0.00	0.00
Base case	7.36	13.63	24.25	14.43	28.81	24.39	33.29	22.91	0.00	0.00
Best case	8.50	16.87	26.80	20.73	35.36	34.40	41.67	38.80	4.04	1.56

Table 17 Forecasted FCFE for all alternative cases in US$ millions

According to CAPM, analysts can estimate the expected return of an investment when it considers the risk-free rate, the investment's beta, market risk premium, and the country risk premium. As mentioned in Chapter 2, the 10-year U.S. treasury bills (T-Bills) is be used as the risk-free rate. Table 18 exhibits annual returns for a 10-year U.S. T-Bills from 2008 to 2018. Table 18 utilizes annual returns for 10 years prior to the base year to take its average as the input to the risk-free rate in the CAPM equation. An average yield is found at 2.58%. This value will be used as the input to the risk-free rate in computing for Nico INA's cost of equity by the capital asset pricing model.

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Yields	2.46	3.85	3.30	1.89	1.93	3.01	2.12	2.27	2.44	2.41	2.67

Table 18: 10-year historical returns for the U.S. T-Bills in %

(Source: 10 Year Treasury Rate – 54 Year Historical Chart, n.d.)

The market returns utilized in this analysis is represented by the MSCI ACWI index. The 10-year historical annual returns are obtained through a published document by MSCI (2021). By the catch of the eye, the market return is significantly different from the risk-free returns which is in line with the concept of higher risk, higher return. Table 19 presents MSCI ACWI index's annual returns.Table 19 gives the average market return of 5.54% which will be the second input in equation (17). Table 20 shows the annual market risk premium, giving a 10-year average of 2.96%.

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Return	-42.19	34.63	12.67	-7.35	16.12	22.80	4.16	-2.36	7.86	23.97	-9.41

Table 1910-year historical market returns in %

(Source: MSCI ACWI (2021))

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Return	-44.65	30.79	9.37	-9.24	14.20	19.79	2.04	-4.63	5.42	21.56	-12.08

Table 20: Market risk premium in %

With both the risk-free rate and the market risk premium, the only thing remaining to fulfil the requirements of CAPM in equation (17) is Nico INA's beta. The next section will estimate Nico INA's beta to complete the calculation of Nico INA's cost of equity through CAPM.

Six publicly listed companies are used to estimate Nico INA's beta: Haynes International Inc. (NDAQ:HAYN), Polymet Mining Corporation (NYSE:PLM), Nickel Asia Corporation (PSE:NIKL), Global Ferronickel Holdings Inc. (PSE:FNI), Marcventures Holdings Inc. (PSE:MARC), and Sama Resources Inc. (TSXV:SME). All six companies work primarily in nickel mining. The complete calculation of each beta is found in appendix 6 but a sample for Polymet Mining Corporation is presented in the following.

Computing for Polymet Mining Corporation's (PLM) beta begins with its annual return in % as found in table 21, which is calculated using equation (20). It uses the assumption that an investor purchases PLM shares at the beginning of the year and sells it at the end of the year. Hence the difference of prices at the end and the beginning of the year is divided by the price at the beginning of the year. Data regarding Polymet's prices at the beginning of the year and at the end of the year were obtained from *Market Watch*.

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Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Beginning Price	26.17	7.81	27.11	19.16	14.02	10.56	10.1	9.81	7.09	8.23	12.34
Ending Price	6.26	28.6	22.34	9.72	8.6	8.48	9.81	7.38	6.94	8.04	7.54
Return in %	-76.1	266.2	-17.6	-49.3	-38.7	-19.7	-2.87	-24.8	-2.1	-2.3	-38.6

Table 21: Polymet Mining Corp (PLM) beginning and end of the year prices in Canadian dollars (CAD) and its annual returns in %

(Source: Polymet Mining Corp. Price Data, 2018)

In addition to the annual return in percentage for Polymet Mining Corp, the annual market returns proxied with MSCI ACWI's annual returns as tabulated in table 19 is needed to compute for the covariance and variance of market returns. By entering the covariance and variance formulas in Microsoft Excel, the covariance of Polymet Mining Corporation with the MSCI ACWI's annual returns is found at 0.12 whereas the variance of the market return is at 0.04. Following equation (19), Polymet Mining Corporation's levered beta is found as 2.71 as illustrated below.

$$\beta_{PLM} = \frac{cov(PLM, MSCI\ ACWI)}{var(MSCI\ ACWI)} = \frac{0.12}{0.04} = 2.71$$

Table 22 summarizes the levered betas for each stock. Each stock's average annual returns for the years 2008-2018 that are obtained from *Yahoo Finance* and *Market Watch*. Results in table 22 indicates a large spread between the lowest and highest levered beta among comparable firms. Marcventures Holdings Inc. (MARC) holds the lowest beta at 0.91 whereas Global Ferronickel Holdings Inc. (FNI) has the highest levered beta. The higher the value the greater its effect given a slight change in the market portfolio's returns. Hence, FNI's returns are more volatile as compared to returns from investing in MARC.

Ticker	HAYN	PLM	NIKL	FNI	MARC	SME
Levered Beta	1.07	2.71	0.43	2.33	0.91	3.91

Table 22: Comparable stocks' levered beta

As mentioned in section 2, it is incomparable to use levered betas of the industry as a direct comparison to Nico INA's beta due to the different debt-to-equity ratios for each stock. Adjusting for this difference must be done according to equation (20) for all six comparable stocks. As with the source for each stock's annual returns, their debt-to-equity ratios and tax rates in 2018 are retrieved from *Yahoo Finance* and *Market Watch*. Table 23 summarizes all comparable information needed to unlever each stock's beta.

Ticker	HAYN	PLM	NIKL	FNI	MARC	SME
D/E ratio	3.04	11.94	9.98	6.11	14.49	0
Tax rate	14%	27%	32%	35%	63%	20%

Table 23: Comparable stocks' debt-to-equity ratios and tax rates

(Source: Yahoo Finance and Market Watch)

Un-levering levered betas found in table 3.20 according to each corresponding stock's debt-to-equity ratio and tax rate from table 23 will follow equation (21). The following computations illustrate the unlevering process of each stock's levered beta to achieve an even ground.

$$Unlevered\ beta_{PLM} = \frac{2.71}{\left(1 + \left((1 - 27\%) \times 11.94\right)\right)} = 0.28$$

$$Unlevered\ beta_{HAYN} = \frac{1.07}{\left(1 + \left((1 - 14\%) \times 3.04\right)\right)} = 0.29$$

$$Unlevered\ beta_{NIKL} = \frac{0.43}{\left(1 + \left((1 - 32\%) \times 9.98\right)\right)} = 0.06$$

$$Unlevered\ beta_{FNI} = \frac{2.71}{\left(1 + \left((1 - 35\%) \times 6.11\right)\right)} = 0.47$$

$$Unlevered\ beta_{MARC} = \frac{0.91}{\left(1 + \left((1 - 63\%) \times 14.49\right)\right)} = 0.14$$

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$$Unlevered\ beta_{SME} = \frac{3.91}{\Big(1 + \big((1 - 20\%) \times 0\big)\Big)} = 3.91$$

With the calculations above, table 24 summarizes the unlevered beta for all the six publicly listed stocks considered as Nico INA's comparable stocks. These numbers can now be used as estimates for Nico INA's unlevered beta.

Ticker	HAYN	PLM	NIKL	FNI	MARC	SME
Unlevered Beta	0.29	0.28	0.06	0.47	0.14	3.91

Table 24: Unlevered beta for comparable stocks

With the industry beta presented through the six nickel mining stocks as presented in table 24, Nico INA's unlevered beta is estimated by taking the industry average. A simple average equation by taking the summation of all values in table 24 divided by the number of firms yields Nico INA's estimated unlevered beta as 0.86.

$$Nico\ INA's\ unlevered\ beta = \frac{0.29 + 0.28 + 0.06 + 0.47 + 0.14 + 3.91}{6} = 0.86$$

As mentioned in section 2, betas must be relevered according to their proportion of debt in their capital structure. To do so, equation (21) is utilized to adjust Nico INA's unlevered beta of 0.86. However, since Nico INA equips a capital structure of 100% equity, following equation (22) will yield the exact same value of 0.86.

$$Relevered\ beta_{Nico\ INA} = 0.86 \times \Big(1 + \big((1 - 25\%) \times 0\big)\Big) = 0.86$$

With Nico INA's relevered beta, the elements to compute for Nico INA's expected return by the capital asset pricing model is now complete. Using the 10-year average of 10-year T-Bills of 2.58% as the risk-free rate, the average MSCI ACWI return of 5.54% as the market return, levered beta of 0.86, and Indonesia's country risk premium at 2.54% will yield an expected return or cost of equity of 5.09%.

$$Cost\ of\ equity = CAPM = 2.58\% + 0.86 \times (5.54\% - 2.58\%) + 2.54\% = 5.09\%$$

B. Discounting FCFEs with the cost of equity

The cost of equity tells Nico INA that the expected return for 100% equity investment in the firm is 5.09%. The CAPM computed tells Nico INA the cost associated with funding their operations through equity. As mentioned in section 2, Nico INA and investors must quantify the risk of attaining the projected FCFEs. Equation (23) is used to discount each forecasted FCFE from 2019 onwards into today's dollar value. A sample calculation using equation (23) for the base case's fifth year, or year 2023 is found by utilizing the FCFEs in table 17 and the cost of equity of 5.09%.

$$Discounted\ \ FCFE_{Base\ case\ year\ 5\ (2023)} = \frac{\$28.81\ million}{(1 + 5.09\%)^5} = \$22.47\ million$$

The tabulation of all discounted free cash flows to equity for the base case is presented in table 3.23. It is important to acknowledge that the cost of equity does not change over time or cross-alternative cases. The table begins with the FCFE values as seen in table 3.15 to introduce how the discounting process begins.

Year	2019	2020	2021	2022	2023	2024	2047	2048	2067	2068
n	1	2	3	4	5	6	29	30	49	50
Worst case	5.10	11.00	13.13	17.71	12.65	17.24	4.15	6.74	0.00	0.00
Base case	7.00	12.35	20.90	11.83	22.47	18.11	7.89	5.17	0.00	0.00
Best case	8.09	15.28	23.09	17.00	27.59	25.54	9.87	8.75	0.35	0.13

Table 25: Discounted FFCFEs using the cost of equity for all alternative cases in US$ millions

The discounted FCFE values obtained and presented in table 25 are now comparable. Furthermore, investors and managers are interested in how all the discounted free cash flows to equity looks like today as one value. That objective is met by the summation of all FCFEs throughout Nico INA's useful lifetime as conceptualized in equation (24). This summation yields Nico INA's intrinsic asset value.

$$Asset\ value_{Base\ case} = \$7.00\ million + \$12.35\ million + \cdots + \$7.89\ million + \$5.17 = \$409.81\ million$$

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The analysis according to equation (24) yields Nico INA's base case intrinsic asset value at $383.75 million. Nico INA's intrinsic asset value range is summarized in table 26. Valuation always comes as a range due to varying assumptions and concerns. Given Nico INA's strength, weakness, opportunities, and threats, they can expect an asset value at a range of $305.95 million to $552.21 million.

Case	Worst	Base	Best
Asset value	305.95	409.81	552.21

Table 26: Nico INA's intrinsic asset value for worst, base, and best cases in US$ millions

An equity investor or potential equity investor to Nico INA however is more interested in its equity value. Equation (25) adjusts Nico INA's intrinsic asset value in table 26 to intrinsic equity value by adding back cash and subtracting debt from its base year of 2018. As highlighted in section 1, Nico INA owns $0.60 million cash and $0 debt in 2018. These values are inputted to equation (25) to give the following results. Table 27 summarizes Nico INA's equity values given a $0.60 million in cash and $0 debt in its base year of 2018, giving an equity value range of $306.55 million in its worst case to $504.04 million in its best case.

$$Equity\ value_{worst} = \$305.95\ million + \$0.60\ million - \$0 = \$306.55\ million$$
$$Equity\ value_{base} = \$409.81\ million + \$0.60\ million - \$0 = \$410.41\ million$$
$$Equity\ value_{best} = \$552.21\ million + \$0.60\ million - \$0 = \$552.81\ million$$

Case	Worst	Base	Best
Equity Value	306.55	410.41	552.81

Table 27: Nico INA's intrinsic equity values for worst, base, and best cases in US$ millions

IV. DISCUSSION AND CONCLUSION

A. *Implication of valuation*

Nico INA conducts a valuation analysis to determine its value given its capital structure of 100% equity. Current equity holders may choose to sell their ownership to potential buyers. Naturally, sellers are interested to gain profits when making a sale. The ultimate price tag for 100% ownership depends on Nico INA's intrinsic value and whether current owners are willing to sell at that price.

Intrinsic values obtained from the discounted cash flow analysis by free cash flows to equity discounted by the cost of equity in Chapter 3 provides a useful insight to management, investors, and potential investors. Based on the data and assumptions, Nico INA has an equity value at a range of $306.55 million (worst case) to $552.81 million (best case). Since Nico INA is a private company without publicly tradeable shares, measuring whether Nico INA is under, over, or par-valued is done by comparing it with their book value, as seen in their balance sheet's total equity.

Nico INA has a total of $10.30 million in equity in the year ending 2018 as highlighted in Chapter 1. In the case of a private asset, their total equity is their book value. Dividing Nico INA's equity value in each alternative case with its book value in 2018 yields an equity value multiple. Furthermore, this multiple tells investors how many times Nico INA's equity will be worth in the future given an amount of equity invested today. Nico INA's equity value is 30 times (worst case) to 54 times (best case) its book value. Its base case alternative is listed at 40 times its book value. With these positive multiples, Sangkuriang Mining would like to sell 100% of Nico INA's ownership at a range of 30 to 54 times its book value, with a reasonable target of a price tag 40 times its book value. Price tag values are presented in a range since valuation provides a guideline to parties to arrive at a settlement price in their transaction negotiation.

V. CONCLUSION

This case study analytically determined Nico INA's equity value at a range of $306.55 million to $552.81 million or 30 to 54 times its book value of $10.30 million. They will use this value as Nico INA's price tag. This range is obtained through forecasting Nico INA's financial statements, computing for its free cash flows to equity, and applying the most appropriate discount rate to its free cash flows to equity. With its current capital structure of 100% equity and its unlikeliness to change, potential equity investors can expect deviations to Nico INA's value to be at a minimum. However, with their concerns on fluctuating global nickel prices and a possibility that the expected production capacity could not be met, Nico INA could potentially arrive at a larger spread in its valuation range from $239.45 million to $611.34 million or 23 to 60 times its book value of $10.30 million.

There is no difference to utilizing free cash flows to equity or free cash flows to the firm because Nico INA does not incur any debt. In this case, the discount rate for FCFF and FCFEs would be nominally equivalent. Since there is zero debt, computing for the weighted average cost of capital will yield the same value as the cost of capital. Computing for the cost of capital utilizes the capital asset pricing model which has four inputs and an additional element: risk-free returns, beta, market risk premium, and country risk premium. Beta is estimated through publicly listed comparable firm's betas which needs to be unlevered first to account for their different debt-to-equity ratios then relevered according to Nico INA's capital structure. When combined it generates the cost of equity which is used to discount annual free cash flows to equity using the theory of time value of money to give present values then summed together at the year 2018 to arrive at the intrinsic asset value. Cash Nico INA has in 2018 is added to and total debt is deducted from its intrinsic asset value to arrive at their intrinsic equity value.

As mentioned in Chapter 1, Sangkuriang Mining may choose to sell 100% of Nico INA's ownership to another or several equity investors or sell only part of the ownership. The equity value range of $306.55 million to $552.81 million becomes a basis to compute for the exact percentage that Nico INA will sell. If Sangkuriang Mining decides to sell 49% of Nico INA's shares given a 30 to 54 times equity value compared to its book value, Nico INA can expect to receive $150.21 million to $270.88 million from the sale proceeds. This is a very advantageous deal for Sangkuriang Mining to sell 49% of Nico INA's shares at a price 30 to 49 times higher than its book equity value. With that in mind, Sangkuriang Mining should sell 49% of their ownership of Nico INA to a third party with an exchange of capital at the ownership price, and other relevant resources such as technologies, knowledge, and experience.

Sangkuriang Mining may experience additional benefits by selling a percentage of Nico INA's ownership to a third party such as decreasing risk, decreasing costs, and a share of resources and capital. These advantages will be useful for Nico INA's long-term survival and participation in the global nickel supply chain. Aside from that, the sale of Nico INA's ownership itself brings cash to Sangkuriang Mining which they can use to further fund for Nico INA's capital expenditure and operating expenditure needs in the forecasted years. With that, Sangkuriang Mining will be able to continue operating Nico INA at lower net cash flows.

VI. RECOMMENDATION

Aside from the financial intrinsic elements considered in this analysis, there are external details that may influence Nico INA's price tag. Sangkuriang Mining's CEO notes three elements often observed in detail: geological characteristic and quality of the mineral being extracted, location of the mine and ergonomics to enter and exit the mine and carrying cost from extracting the ore to shipment (Sangkuriang Mining CEO, personal interview, 2021). Depending upon the type of mineral being extracted, the level of contamination per metric ton of ore can significantly impact the mine's value. Sangkuriang Mining's CEO mentioned that ore contamination is more prevalent for gold mining as compared to nickel mining (Sangkuriang Mining CEO, personal interview, 2021).

As mentioned earlier in this study, operating costs significantly impacts the net profit after tax. However, operating costs was not discussed in detail in this paper. Aside from direct costs, general and administrative costs, and selling costs, characteristics of the mine itself could drive down or increase operating costs and impacts the mine's overall valuation. Nickel mines located closer to centre land typically requires higher transportation cost to haul mines ores from the pit to the ship. Sangkuriang Mining's CEO notes that the cheapest form of transportation is by water (Sangkuriang Mining CEO, personal interview, 2021). With that, mines located in proximity with rivers or near the seaport offer a valuable selling point as opposed to mines located far from waters. A recommendation to further research may include a more detailed view on the mine's physical characteristics that may influence its value and ultimately its price tag.

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