



FELLOWSHIP PROGRAM ASSIGNMENT COVER SHEET

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CANDIDATE NUMBER: 222XXX	COURSE: Investment
DATE DUE: Monday, 15 August 2022 at 12:00pm (AEST)	

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1. Introduction

The Equity Analyst team ('we') at Pragmatic Investment ('PI') have been engaged by the Portfolio Management team to prepare a valuation report on ordinary shares issued by BHP Group Limited ('BHP') as at 30 June 2022. This report will form part of the assessment of BHP shares for inclusion in PI's portfolios with the intention of holding them for at least five years.

2. Methodology (Q1&Q2)

Free Cash Flow ('FCF') model has been selected for our valuation exercise for the following reasons:

- To comply with PI's policy of not using Gordon Growth Model so as to meet PI's investors' expectations.
- The team is new to BHP and FCF model encourages rigorous consideration of the factors that influence the cash flows, and hence the value of BHP.
- Recent events such as Russia-Ukraine war might have very different impact on short and long-term cash flows and FCF model can accommodate this.
- BHP's past dividend payout ratio has been volatile (92% for the final dividend in FY21 compared to 72% in FY20¹) which makes dividend projection challenging.
- BHP being a producer of essential commodities might vary its portfolio mix (e.g. the recent divestment in its Petroleum business) in response to the environment and FCF model can handle this.

Generally, FCF model can be used to calculate the value of a single BHP share today using the formula below:

$$V_0 = \left(\sum_{t=1}^{\infty} \frac{FCFF_t}{(1 + WACC)^t} - D_0 \right) / S_0$$

where:

- FCFF, free cash flow to the firm = Earnings before interest and tax * (1 – Corporate tax rate) + Depreciation – Capital expenditure - Increase in net working capital
- WACC, weighted average cost of capital = (1 – Corporate tax rate) * Cost of debt * Debt to asset ratio + Cost of equity * Equity to asset ratio
- D_0 = Current net debt
- S_0 = Current number of shares on issue

¹ BHP results announcement for FY 30 Jun 2021.pdf pg. 13



Given BHP is a producer of commodities, we have further broken down earnings before interest and tax ('EBIT') into:

$$\text{Revenue} * \text{EBIT margin}$$

where:

- Revenue = Sum of production volume * unit price over all commodities produced by BHP
- EBIT margin = EBIT/revenue

Note that production volumes have been used as BHP's sales and production volumes have historically been similar. By breaking down EBIT this way, recent events which affect the production levels and unit prices of various commodities, as well as changes in BHP's commodity mix can be accommodated.

FCFF has been projected in detail over the first five years, which corresponds with PI's minimum holding period, and assumed to be growing at a constant terminal growth rate (TGR) from year 6 onwards:

$$PV \text{ of FCFF from year 6} = \frac{FCFF_5(1 + TGR)}{(Terminal \text{ Discount Rate} - TGR)}(1 + WACC)^{-5}$$

Due to the volatile nature of the market in which BHP operates in, where there are limited suppliers and consumers and hence each is influential, it is believed that more granular projection for the longer-term might not be value-adding.

3. Assumptions

3.1. Data

The data provided includes commodity data (production volumes and unit prices for each of the main commodities) between FY17 and H1FY22 (5.5 years), and financial data between FY21 and H1FY22 (1.5 years).

For simplicity, the first projection is assumed to be 1.5 years from the data cut-off date, and the projection thereafter is assumed to be annual.

3.2. Assumptions on FCFF (Q3)

The table below summarises the main assumptions underpinning the FCFF used in our valuation and the justifications behind these assumptions.

Item	Assumption	Justification
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Copper production level	Increases at a rate of 2.3% p.a., as observed between FY17 and H1FY22.	BHP intends to expand its copper production in response to the decarbonisation trend ² .
Iron ore production level	Increases at a rate of 2.3% p.a., as observed between FY17 and H1FY22.	Historical production movement has been stable.
Coal production level	Decreases at a rate of 2.3% (metallurgical) and 13.1% (energy) p.a., as observed between FY17 and H1FY22.	Historical production level has been reducing since FY17. A move towards decarbonisation can see coal being phased out ³ .
Nickel production level	Increases at a rate of 2% p.a..	Historical production movement fluctuated at around 0%. However, nickel plays a key role in the electrification boom ⁴ and hence production level is assumed to increase.
Potash production level	4.35 million tonnes produced in CY27.	Potash mine is still under construction and hence its production level is assumed to follow BHP's strategic plan ⁵ .
Copper price	Decreases at a rate of 2% p.a..	Although copper price has seen a strong increase since FY21, it has started to plummet in H2FY22 due to poor economy outlook ⁶ . It is hence assumed to decrease over the short to medium term.

² BHP results announcement for FY 30 Jun 2021.pdf pg. 1

³ Accessed <https://theconversation.com/albanese-says-we-cant-replace-steelmaking-coal-but-we-already-have-green-alternatives-126599> on 6/8/2022

⁴ Accessed <https://www.spglobal.com/commodityinsights/en/market-insights/blogs/metals/123121-nickel-supply-electric-vehicle-demand> on 7/8/2022

⁵ BHP Operational Review Half Year ended 31 December 2021.pdf pg. 8

⁶ Accessed <https://www.theguardian.com/business/2022/jul/15/copper-price-at-lowest-level-since-2020-as-fears-over-global-economy-grow-inflation> on 7/8/2022



Iron ore price	Decreases at a rate of 15.2% p.a. over the first three years and stays constant thereafter.	Iron ore price spiked in FY21 and reduced in H1FY22. It is assumed to return to pre-spike level over the first three years.
Coal price	Stays constant over the first 2 years followed by a decrease of 16.4% (metallurgical) and 19.8% (energy) p.a. in the next 3 years.	Coal price has surged following the Russia-Ukraine war due to sanctions imposed on Russia, a major supplier, which led to supply disruption ⁷ . In the medium term, we have assumed that price will fall back to pre-war level, either because of sanctions getting lifted (Russia's supply capacity remains intact) or other suppliers catching up with the demand.
Nickel price	Increases at a rate of 3% p.a..	Nickel price has nearly doubled over FY17-H1FY22. Although price will likely continue to rise due to strong demand from electrification trend, the high growth rate is unlikely sustainable and hence we have assumed a moderate growth rate.

⁷ BHP_2022-03-10_RR.pdf pg. 1 & 2



Potash price	US\$562.5 per tonne in CY27.	Potash price has skyrocketed earlier this year due to sanctions imposed on Russia which disrupted the already tight supply ⁸ . Price is assumed to maintain in the medium to long term as climate change and increase in population ⁹ cause demand to continue overpowering supply.
EBIT margin	Increases at a rate of 1% p.a. from 48.6% observed in H1FY22 for the first 2 years and stays at 49.9% from year 3 onwards.	Historical EBIT margin has been lower due to increased operating expense associated with COVID ¹⁰ (e.g. border restrictions might have led to increased freight costs). This is believed to ease over the coming years as COVID becomes the new norm.
Corporate tax rate, Depreciation, Capital expenditure, Increase in net working capital	Based on averages over H1FY22 and FY21, inflation adjusted.	These values are highly subjective (driven by BHP's management decisions) and hence can evolve very quickly. On average, figures will likely mimic those of the past assuming BHP continues to follow the same operational framework.

⁸ Accessed <https://www.reuters.com/business/nutrien-may-raise-potash-output-sanctions-curb-russia-supply-2022-05-03/> on 7/8/2022

⁹ Accessed <https://investingnews.com/potash-outlook-2022/> on 7/8/2022

¹⁰ BHP results announcement for FY 30 Jun 2021.pdf pg. 10



Terminal growth rate	2.7% p.a. based on 2.5% inflation rate implied by US government bonds and a 0.25% margin.	Both moving towards unified structure (can react more quickly to the changing environment) and targeting a forward-looking portfolio mix ¹¹ suggest that BHP will likely outperform inflation. However, modest margin has been allowed for as demand from China (BHP's largest customer) will likely soften with the end of China boom ¹² .
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3.2.1. Uncertainty in FCFF (Q4)

There is high uncertainty around the FCFF modelled. The sources of uncertainty may include:

- Portfolio mix – Similar to the recent divestment in Petroleum, BHP may exit a current or enter a new commodity business. These prospective shifts are difficult to forecast.
- Commodity prices – As can be seen in iron ore, coal, and potash, unit prices can change tremendously over a short period which makes projection challenging.
- Terminal growth rate – This applies further into the future and hence the level of uncertainty is inherently high.

To deal with uncertainty, we have incorporated a buy price safety margin on our best estimate value (see Section 4.3) such that price needs to be sufficiently low before purchase is recommended. The margin serves as a buffer for value overestimation and reduces the chance of buying above the true value.

3.3. Assumptions on WACC (Q5)

The table below summarises the main assumptions underlying the WACC used in our valuation and the justifications behind these assumptions.

Item	Assumption	Justification
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¹¹ BHP results announcement for FY 30 Jun 2021.pdf pg. 20 & 22

¹² BHP_2022-03-10_RR.pdf pg. 4



Debt to asset ratio	29.4% based on average over H1FY22 and FY21.	Given the high operating leverage inherent in the mining business, it is unlikely that financial leverage will increase significantly. Future leverage ratio is hence assumed to follow that of the past.
Cost of debt	Based on 3.5% historical credit spread and US government bond yields (risk-free plus inflation).	BHP's S&P credit rating has never fallen into the "BBB" territory ¹³ which suggests that its credit spread has been and hence will likely remain stable. There are also no signs indicating a deterioration in management quality.
Cost of equity	11.6% p.a. based on 8.6% historical earnings yield and a 3% margin.	Central banks around the world have been raising their cash rates to tame inflation. Specifically, US fund rate has already risen by 2% in 2022 ¹⁴ . Cost of equity will likely need to catch up to secure funding.
Terminal WACC	Same calculation as those in the first 5 years except for a lower cost of equity margin (1.5%).	In the long term, as global monetary policies work its way through the economy, inflation, and hence cash rates, will likely reduce.

3.3.1. Sensitivity on WACC (Q6)

Sensitivity tests have been performed on WACC by applying flat % changes to the best estimate values.

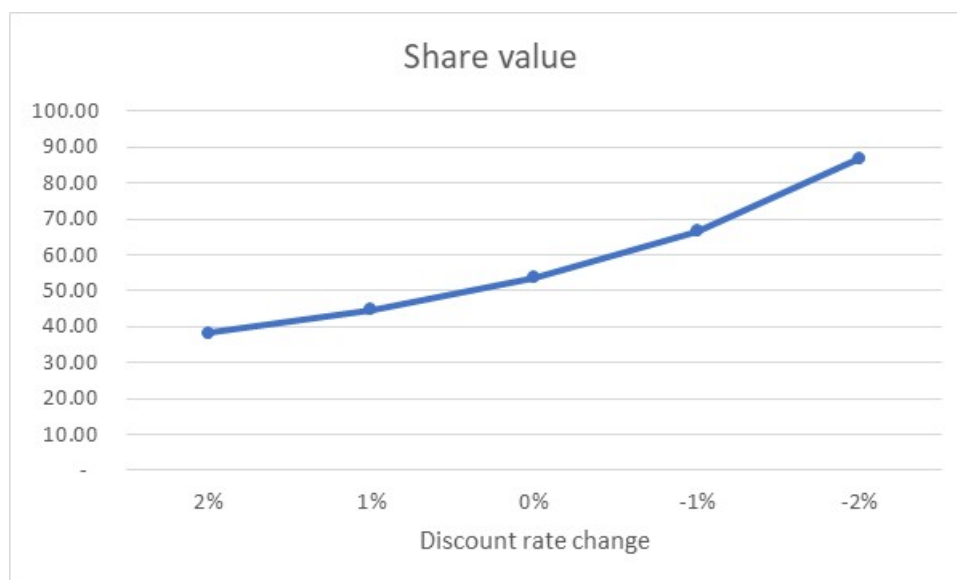
Discount rate change	Share value	Difference
2%	38.22	-28.8%

¹³ Accessed <https://www.afr.com/companies/mining/s-and-p-threatens-less-diversified-bhp-with-double-downgrade-20210824-p58ld3> on 7/8/2022

¹⁴ Accessed <https://www.forbes.com/advisor/investing/fed-funds-rate-history/> on 7/8/2022



1%	44.77	-16.6%
0%	53.70	0.0%
-1%	66.59	24.0%
-2%	86.84	61.7%



As can be seen above,

- Share value is sensitive to the discount rate used and the absolute change in value is multiple times that applied to the discount rate.
- An increase in discount rate leads to a decrease in value and vice versa.
- The absolute change is greater when discount rate is reduced than when it is increased, similar to the convexity effect observed in bond prices.

Given share value's sensitivity to the discount rate adopted, it is imperative to pay close attention when setting this assumption.

4. Conclusion and Recommendation

4.1. Best Estimate Value (Q7&Q2)

Best estimate value based on the model and assumptions discussed in Section 3 is 53.70AUD¹⁵. Note that 74.3% of this value comes from the terminal component which demonstrates the importance of terminal growth rate and terminal discount rate assumption.

¹⁵ Share value has been converted from USD to AUD using exchange rate on 7/8/2022.



Valuation details can be found in Appendix 1.

4.2. Scenario Testing (Q7)

A high-level scenario testing whereby both FCFF and discount rate were assumed to move in the same direction (overestimation/underestimation) has been conducted to show potential extreme deviations from the best estimate valuation.

Description	FCFF change	DR change	Share value	Difference
Overestimation	-10%	2%	31.06	-42.2%
Best estimate	0%	0%	53.70	0.0%
Underestimation	10%	-2%	104.63	94.8%

Similar to discount rate, there is a disproportionate impact on share value between these scenarios.

4.3. Buy and Sell Price (Q8)

Given the uncertainty in our projection and the sensitivity of valuation to changes in assumptions as shown above, we believe it is appropriate to adopt buy and sell safety margin when purchasing or selling the stock.

In addition, given the disproportionate impact on share value when overestimating compared to when underestimating, we believe it is reasonable to set the sell margin to be higher than the buy margin.

Final proposal is as follows:

Option	Safety margin	Adjusted value
Buy below	-10%	48.33AUD
Sell above	20%	64.45AUD

Comparing this to the actual 41.25AUD¹⁶ observed on 30/6/2022 suggests that BHP shares might have been trading at below their intrinsic value and hence were worth including in PI's portfolios.

(1913 words excluding footnotes; 2020 words including footnotes)

¹⁶ Accessed <https://au.finance.yahoo.com/quote/BHP.AX/history?p=BHP.AX> on 7/8/2022



Appendix 1 – Valuation details

Projection	Unit	2021/12/31	2023/6/30	2024/6/30	2025/6/30	2026/6/30	2027/6/30	Terminal
Production - Copper	kt	1,484	1,518	1,552	1,588	1,624	1,661	
Production growth rate - Copper			2.3%	2.3%	2.3%	2.3%	2.3%	
Price - Copper	lb	4.31	4.18	4.10	4.02	3.94	3.86	
Price growth rate - Copper			-2.0%	-2.0%	-2.0%	-2.0%	-2.0%	
Revenue - Copper	US\$M		13,994	14,026	14,059	14,091	14,124	
Production - Iron ore	kt	258,802	264,671	270,673	276,812	283,089	289,509	
Production growth rate - Iron ore			2.3%	2.3%	2.3%	2.3%	2.3%	
Price - Iron ore	wmt	115.34	90.08	76.40	64.79	64.79	64.79	
Price growth rate - Iron ore			-15.2%	-15.2%	-15.2%	0.0%	0.0%	
Revenue - Iron ore	US\$M		23,842	20,679	17,935	18,342	18,758	
Production - Metallurgical coal	kt	35,336	34,510	33,704	32,917	32,147	31,396	
Production growth rate - Metallurgical coal			-2.3%	-2.3%	-2.3%	-2.3%	-2.3%	
Price - Metallurgical coal	t	259.71	259.71	259.71	217.03	181.36	151.56	
Price growth rate - Metallurgical coal			0.0%	0.0%	-16.4%	-16.4%	-16.4%	
Revenue - Metallurgical coal	US\$M		8,963	8,753	7,144	5,830	4,758	
Production - Energy coal	kt	14,410	12,517	10,873	9,445	8,205	7,127	
Production growth rate - Energy coal			-13.1%	-13.1%	-13.1%	-13.1%	-13.1%	
Price - Energy coal	t	137.68	137.68	137.68	110.41	88.54	71.01	
Price growth rate - Energy coal			0.0%	0.0%	-19.8%	-19.8%	-19.8%	
Revenue - Energy coal	US\$M		1,723	1,497	1,043	726	506	
Production - Nickel	kt	79	80	82	83	85	87	
Production growth rate - Nickel			2.0%	2.0%	2.0%	2.0%	2.0%	
Price - Nickel	t	19,651	20,542	21,158	21,793	22,447	23,120	
Price growth rate - Nickel			3.0%	3.0%	3.0%	3.0%	3.0%	
Revenue - Nickel	US\$M		1,647	1,730	1,818	1,910	2,006	
Production - Potash	kt						2,175	
Production growth rate - Potash								
Price - Potash	t						562.50	
Price growth rate - Potash								
Revenue - Potash	US\$M						1,223	
Revenue adjustment			106.7%	106.7%	106.7%	106.7%	106.7%	
Revenue - Total	US\$M		53,526	49,810	44,809	43,637	44,145	
EBIT margin		48.6%	49.4%	49.9%	49.9%	49.9%	49.9%	
EBIT	US\$M		26,421	24,832	22,339	21,755	22,008	
Adjustments e.g. depreciation	US\$M		6,415	6,574	6,736	6,903	7,073	
Tax	US\$M		-10,711	-10,067	-9,056	-8,819	-8,922	
Net operating cashflow	US\$M		22,125	21,339	20,019	19,838	20,159	
Capex	US\$M		-5,795	-5,938	-6,085	-6,235	-6,389	
Other investing cashflow/increase in NWC	US\$M		-685	-702	-719	-737	-755	
Net investing cashflow	US\$M		-6,480	-6,640	-6,804	-6,972	-7,144	
Terminal growth rate								2.7%
Free cashflow	US\$M		15,645	14,699	13,215	12,866	13,015	263,252
US government bond yield			3.21%	3.23%	3.14%	3.05%	2.96%	2.83%
Credit spread			3.45%	3.45%	3.45%	3.45%	3.45%	3.45%
Cost of debt			6.77%	6.79%	6.70%	6.61%	6.51%	6.38%
Cost of equity			11.56%	11.56%	11.56%	11.56%	11.56%	10.06%
Debt to asset ratio			29.40%	29.40%	29.40%	29.40%	29.40%	29.40%
Corporate tax rate			40.54%	40.54%	40.54%	40.54%	40.54%	40.54%
WACC			9.34%	9.35%	9.33%	9.32%	9.30%	
Terminal discount rate								8.22%
Present value	US\$M		14,308	12,293	10,112	9,010	8,344	155,949

Valuation	
Value of BHP	210,016
Total debt	22,425
Weighted average number of shares	5,062
AUD/USD	0.69
Value per BHP share	53.70
Terminal proportion	74.3%