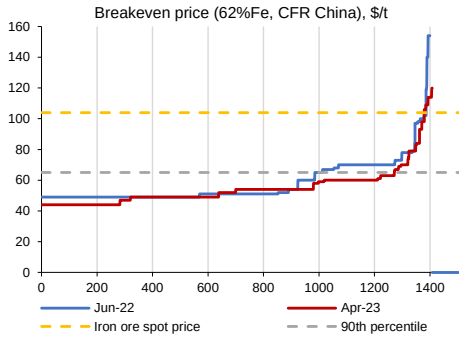
Sales Desk Macro Strategy

26 April 2023 Global

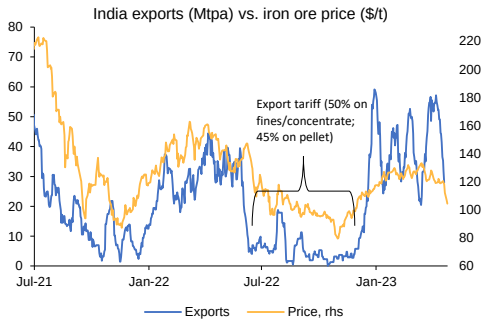
METALS AND BULKS

Iron ore cost curve



Source: Company reports, Platts, TDM, Macquarie Strategy, April 2023. Note: inc. sust. capex and royalties

Indian supply already responding to lower price



Source: Macquarie Vessel Analytics Desk, Macquarie Strategy, April 2023

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Commodities Comment
Iron ore cost curve, updated

Feature Article

- We have updated our iron ore cost curve, using cash costs reported by companies for Q4 2022, and Q1 2023 average freight rates and quality/premium discounts, as well as the Q1 average 62%Fe benchmark iron ore spot price of $125/t.
- Since our last published update in June 2022, the cost curve (CFR China) has moved lower, driven largely by a ~40% reduction in freight rates, which has more-than-offset increased cash costs.
- Of our sample, which covers 94% of seaborne exports, we calculate the 90th percentile at $66/t. In reality, this will be slightly higher due to the omission of Chinese domestic production and some high-cost supply from our sample, due to a lack of cost data. Still, this suggests that the iron ore price could fall by ~$30/t from spot until there is a meaningful supply response.
- That said, there are numerous factors that could step in to support prices before the cost curve is truly tested, one of which being restocking by mills taking advantage of the lower iron ore price following almost a year of holding low raw materials inventories.
- On the flipside, significant global steel production cuts (e.g. a Chinese production cap combined with ex-China demand weakness) plus improved supply this year from lower-cost producers could see the iron price trade well into the cost curve.
- The biggest move lower has been at the top end of the cost curve from Indian producers after the removal of export tariffs on low grade iron ore fines and pellets in November.
- Meanwhile, the breakeven price for Ukrainian fines has increased due to the impact of the war on cash costs.
- Vale has also moved up on our cost curve due lower Fe content in Q1 2023 iron ore sales, likely due to a lower proportion of supply coming from the Northern System, reducing the premium received.
- For producers of high-grade iron ore and agglomerated products, breakeven prices have remained relatively unchanged since June last year, as the narrowing of premiums for pellet and 65% Fe fines has offset the impact of lower freight rates.

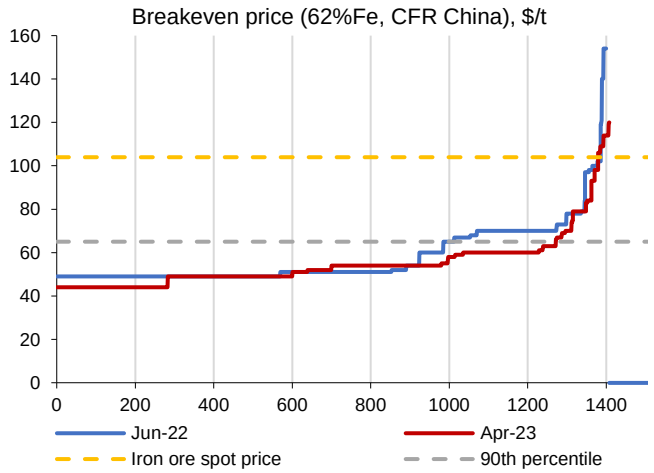
Latest News

- Mineral Resources reported **iron ore** shipments of 4.5Mt in the the March 2023 quarter and has maintained guidnace for FY23 of 17.2-18.8Mt. Shipments from Utah Point were 2.4Mt, lower than production of 2.9Mt due to shiploader outages and wet weather impacts. 2.1Mt was produced and shipped from the Yilgarn hub, 29% of which was lump after production recommenced in October 2022.

Iron ore cost curve, updated

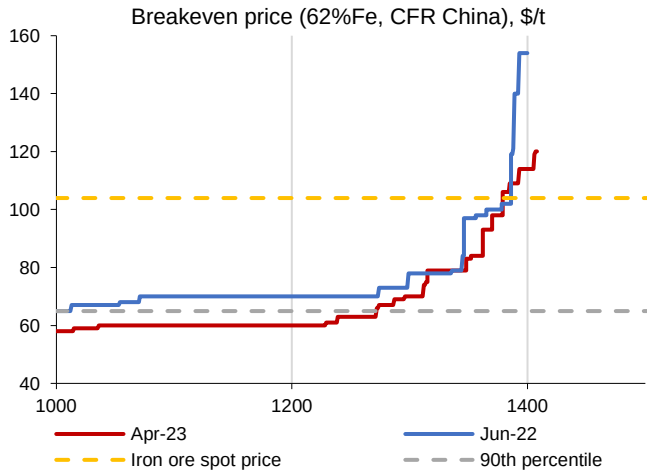
- We have updated our iron ore cost curve, shown in fig. 1. For the updated curve, we have used cash costs reported by companies for Q4 2022, but used Q1 2023 freight rates and quality/premium discounts, as well as the Q1 average 62% Fe iron ore price of $125/t.
- Using 2022 shipment volumes, our sample covers 1,408Mt of supply, accounting for 94% of seaborne exports last year.
- Since our last assessment in June 2022, the iron cost curve has moved lower. While inflation has provided upwards pressure on cash costs, this has been more-than-offset by a decline in freight rates over the past ten months, causing the decline in breakeven prices on a CFR China basis, while the removal of India's export tariffs has had a significant impact on the upper end of the cost curve.

Fig 1 Iron ore cost curve



Source: Company reports, Platts, TDM, Macquarie Strategy, April 2023.
Note: inc. sust. capex and royalties

Fig 2 Removal of India tariffs brings down top of curve

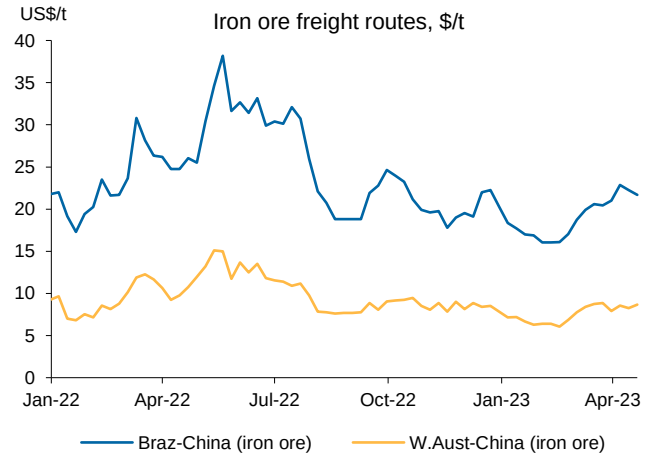


Source: Company reports, Platts, TDM, Macquarie Strategy, April 2023.
Note: inc. sust. capex and royalties

Decline in freight rates drives move lower in cost curve

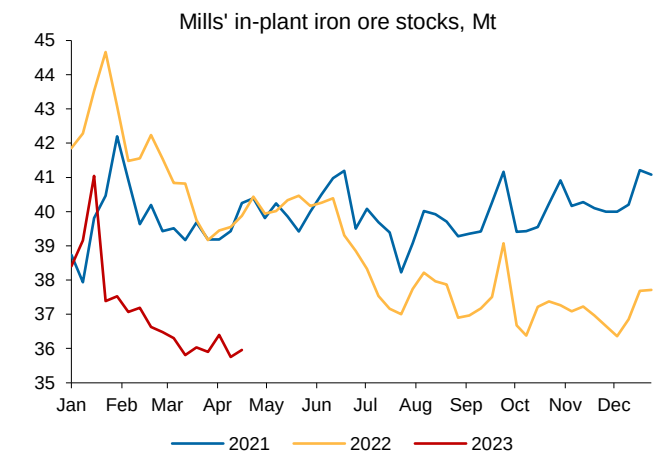
- Our sample puts the 90th percentile at $66/t and the 95th percentile at ~$85/t - considerably lower than in our previous cost curve (prev. $80/t and $90/t respectively). In reality, the 90th percentile is most likely higher than our estimates as domestic Chinese supply and other high-cost seaborne supply is excluded from our sample due to lack of cost information.

Fig 3 Freight rates averaged much lower in Q1 2023 vs. June 2022, but now on the rise again



Source: Bloomberg, Macquarie Strategy, April 2023

Fig 4 A restocking drive could help iron ore price find support before dipping far into the cost curve



Source: Mysteel, Macquarie Strategy, April 2023

- The shift in the cost curve has largely been driven by a significant reduction in freight rates since mid-2022. Our updated curve uses Q1 2023 average freight rates of $18.15/wmt for Brazil to China, $7.28/wmt for Australia to China and $11.43/wmt for India to China. These rates are ~40% lower than the spot rates used in our June 2022 cost curve.

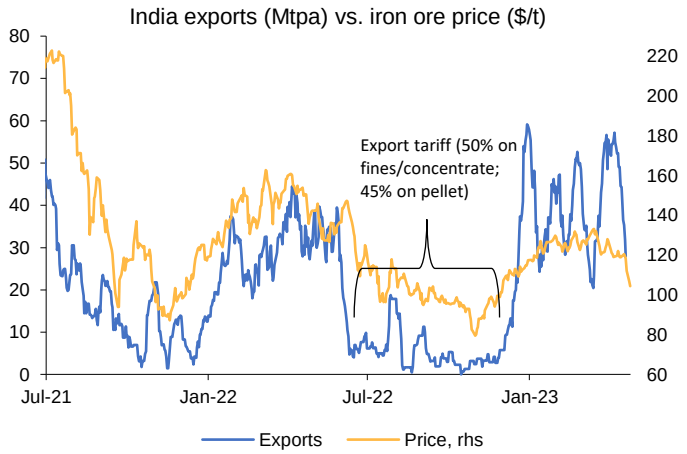
Indian exports decline as spot drops below breakeven price

- Indian producers have experienced the biggest movement in breakeven prices since June 2022, driven by the removal of tariffs that were in place between May and November 2022 on iron ore and pellet of 50% and 45% respectively. We now calculate the breakeven price for low-Fe Indian fines at $83/t, and pellet at $109/t.
- For pellet, the impact of the tariff removal on the quality-adjusted breakeven price has been partially offset by a reduction in the pellet premium received by producers, which has fallen from $35/t in June 2022 to an average of $17.4/t in Q1 2023.
- For exports of Indian fines above 58%Fe, the 50% tariff was reduced in November to 30%. This keeps the breakeven price for fines with a higher Fe content above low-grade fines, at $119/t, despite the value adjustment.
- Our estimated breakeven price of $110-120/t for Indian pellet and high-grade fines producers helps to explain why Indian iron ore exports have held up well in recent months, despite a fall in the iron ore spot 62%Fe index price from over $130/t in March, but have now started to dip as the price has dropped down to ~$100/t.

Fig 5 Iron ore can fall further without triggering a meaningful supply response

Source: Platts, Macquarie Strategy, April 2023

Fig 6 … except for India, which is already reducing exports



Source: Platts, Macquarie Vessel Analytics Desk, Macquarie Strategy, April 2023

Ukraine the exception as cash costs rise, Vale also moves up the curve

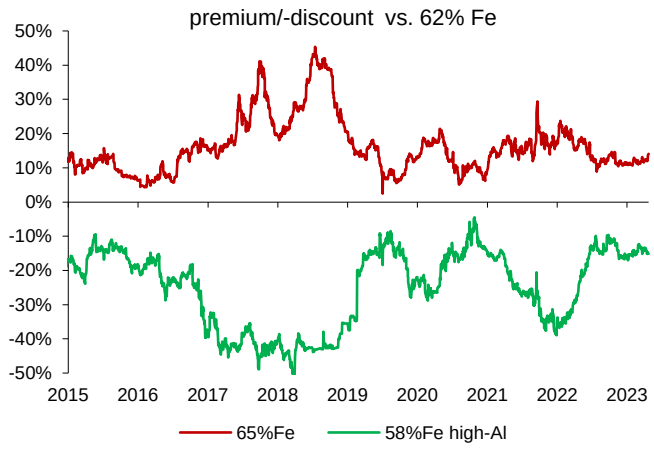
- While breakeven costs for most producers have declined since our last cost curve, Ukraine is the main exception. We calculate the breakeven price for Ukrainian producers has increased by $14/t since our last cost curve, to $114.
- This is mostly due to the impact of war on cash costs, with Ukrainian producer Ferrexpo reporting an average C1 cash cost of $83.3/t in 2022, almost 50% above the cost of $55.8/t in 2021.
- As well as war impact, Ferrexpo also attributed the higher costs per tonne to lower production volumes and increased input costs – especially given the energy-intensive process of pellet production (the company states that historically, over 40% of C1 costs is energy. In 2022, energy alone accounted for 49% of the C1 cash cost).
- However, we note that while our cost curve is CFR China, almost all Ukrainian supply is now being sent to Europe via rail, and so likely benefits from a lower freight rate than that included in our cost curve.

- We also note that Vale has moved up on our cost curve due lower Fe content in Q1 2023 iron ore sales, reducing the premium received. Vale reported an average Fe content of 61.6% for the quarter, down from 62%Fe+ in 2022, and ~63% in 2021. Vale's products also contained a higher percentage of silica than in previous years, at 7.2% on average in Q1 2023.
- The lower quality iron ore was likely due to a lower proportion of supply coming from the Northern system; while Vale reported iron ore production growth of 5.8% YoY in Q1 2023, this was concentrated in the Southern and Southeastern systems, while production from the Northern system declined.

Lower 65% Fe and pellet premiums impact high quality producers

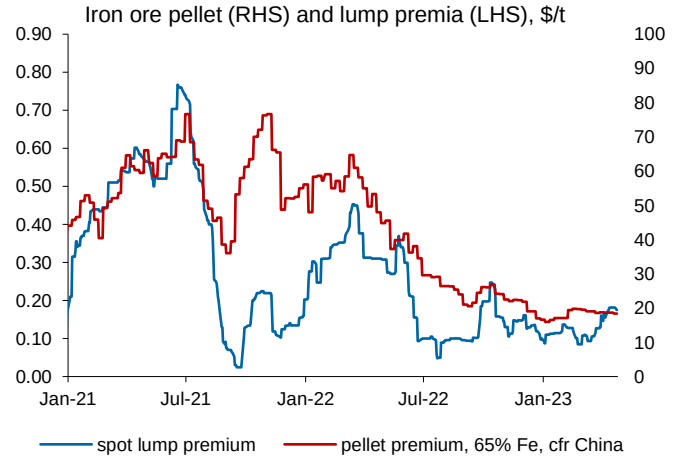
- Meanwhile, producers of high-Fe iron ore pellets have seen little change in their breakeven prices, due to a narrowing of the 65% Fe premium over the 62% Fe index from 16% to 12%, and a lower pellet premium (averaged $17/t in Q1 2023 vs. $35/t in last cost curve), offsetting change in freight rates.
- For example, our estimate for Vale pellet breakeven price has increased by $8/t, to $63/t. While cash costs have remained constant, and freight rates have fallen substantially, this has been more-than-offset with a $18/t change in the pellet value adjustment.
- Similarly, other producers of high-Fe iron ore (Karara, Mt Gibson Koolan Island, Champion Iron) have only seen narrow changes in their breakeven prices.
- Meanwhile, the discount for 58%Fe iron ore remained at 15% in Q1, the same as in June 2022. With the spot iron ore price also only moving narrowly (+$5/t) in this timeframe, the value adjustment for low quality producers is similar to in our last cost curve.
- The Q1 2023 average lump premium is also similar to our last cost curve, at $7/t.

Fig 7 Narrower 65% Fe premium offsets fall in freight rates for high Fe producers



Source: Platts, Macquarie Strategy, April 2023

Fig 8 Same goes for pellet producers, as pellet premium stabilised at low level in Q1 2023



Source: Platts, Macquarie Strategy, April 2023

Move lower in cost curve gives further for iron ore to fall

- While our sample puts the 90th percentile at $65/t, in reality it is likely higher than this due to the omission on Chinese domestic production (which we estimated to be 295Mt in 2022), and 6% of seaborne supply, much of which is high cost.
- For example, our vessel tracking data shows increasing exports of African iron ore (excluding South Africa), for which there is limited public cost information, but likely high cost (especially West African, due to the need for transhipping as many ports have a low depth).
- We estimate that Sierra Leone supply from Tonkolili has a breakeven price of $106/t due to relatively high cash costs and low-quality ore value adjustment. The estimated breakeven price for Gerald Group's Marampa Mine is lower, at $75/t, due to the higher Fe content, but volumes were small in 2022, and this remains above the 90th percetile.
- The move lower in the cost curve means that there may be plenty of room for iron ore to move lower before enough supply cuts occur to bring support to the iron ore price.

- In 2022, when the iron ore price dipped to $80/t, we saw some high-cost Australian producers halt operations, including Strike Resource's Paulsons East following its first shipment, and CuFe. It was also reported that Mineral Resources, which previously had an estimated breakeven price of $97/t for Utah Point and $102/t for the Yilgarn Hub, was considering reducing production.
- However, given the lower freight rates currently, the spot price would likely need to go lower for a supply reaction from high-cost Australian producers. We calculate that Mineral Resources' breakeven price fell to $84/t for Utah Point and $93/t for the Yilgarn Hub in Q1 2023.
- Having said this, freight rates hit a seasonal low in Q1, and have started to increase. Though gains could be limited from weak demand from China (especially if a cap on steel production is enforced), any seasonal improved in rates could bring the 90th percentile slightly higher over Q2/Q3 2023.
- Meanwhile, there are other factors that could offer support to the iron ore price before the cost curve is truly tested. This includes potential restocking of iron ore by mills, taking advantage of the lower iron ore price having kept raw materials inventories at a low level for almost a year (fig. 4).
- On the flipside, a significant reduction in iron ore demand – e.g. steep cuts in Chinese steel production, plus ex-China weakness – as well as increased supply from lower cost producers, could see the iron ore price trade well into the cost curve.

Fig 9 Macquarie iron ore cost curve

	Cash cost, US$/t (wet), FOB	Quality-adjusted (62%Fe sinter fines) breakeven price, US$/t (dry), CFR China	Volume, mtpa	Average grade, %Fe
BHP	18	**44**	283	60-62%
Rio Tinto	21	**49**	318	60-62%
Kumba	40	**51**	38	62-65%
Roy Hill	25	**52**	61	60-62%
Vale (fines)	20	**54**	252	61-64%
CSN-Brazil	21	**54**	28	62-64%
Assmang	38	**55**	17	62-64%
IOC (fines)	40	**58**	18	65%
Minas Rio	35	**59**	21	65-67%
FMG	17	**60**	193	58-60%
CAP - Chile	50	**61**	10	65%
Vale (pellet)	51	**63**	33	65-67%
Mt Gibson - Koolan Island	61	**66**	2	65%+
Mauritania	38	**67**	13	58-62%
Atlas Iron	32	**69**	9	57%
Peru	45	**70**	16	65%
Marampa - Sierra Leone	45	**74**	2	65%
Iran (SOEs)	37	**75**	1.5	63-65%
Champion Iron	64*	**79**	9	65%+
Sino Iron - Australia	67	**79**	24	65%
India - Low grade fines	30	**83**	4	<60%
Utah Point (Min Res)	67	**84**	10	58-59%
Yilgarn Hub (Min Res)	71	**93**	8	58-60%
Karara	84	**98**	9	65-68%
Tonkolil - Sierra Leone	45	**106**	5.4	58%
India (pellet)	103	**109**	8	65-67%
Ukraine (fines)	83	**114**	13	63-64%
India - High grade fines	62	**119**	1	60%+
Iran (private)	55	**120**	1.5	58-59%

*all in sustaining cost. Note: Using Q4 2022 reported cash costs (where avaliable). Value-adjusted breakeven calculated using Q1 2023 average freight, iron ore price & premiums/discounts. Source: Company reports, Platts, TDM, Macquarie Strategy, April 2023. Note: Including sustaining capital and royalties.

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