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# Long-term iron ore price modeling: Marginal costs vs. incentive price

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ABSTRACT

The paper studies and applies the approaches to forecast long-term (LT) real prices of iron ore. This price is crucial for valuation of investments in Greenfield iron ore projects on the horizon of more than 5 years. The forecast is obtained by three different approaches which are usually used by investment bank analysts: marginal costs approach and 2 approaches based on calculation of incentive price. The paper concludes that there has been a structural shift on the iron ore market and LT iron ore prices will be higher by 20–30% than the average of industry forecasters suggest. This is related to the 2 key factors which were taken into account in this study—depletion of existing iron ore deposits and targeted return on investments for new projects. In addition, escalated industry costs inflation is claimed to be the factor which will bolster nominal iron ore prices at high levels in the long-term. Using a Monte-Carlo simulation approach, confidence interval for future iron ore price was estimated.



## Introduction

Iron ore[2] is the key input in pig iron production, which is then used to manufacture steel. Iron ore as well as many other commodities is noted for both persistent trends and rapid turn-arounds in terms of global prices. There was a long period of declining prices in real USD terms from mid-1960s to early 2000s, which led to underinvestment in new iron ore supply projects (Fig. 1). Generally there was no interest for companies to invest in greenfields on the market for which demand prospects and investment returns were questionable. So when 10 years ago China's steel production boom has set to emerge, tight iron ore supply conditions on the back of robust demand growth allowed the iron ore price to take off (Sukagawa, 2010). From 2003 to 2012 price has increased 5-fold to $127/t on FOB Brazil basis.

This growth can be attributed to 4 key characteristics of the iron ore market:

- **Robust iron ore demand driven by China.** Global iron ore demand grew 6% yoy during the last 10 years while China's one added more than 15% yoy. Global iron ore consumption exceeded 1900 million metric tonnes (mmt) in 2011 of which China consumed almost 1000 mmt [Worldsteel, 2012].
- **Persisting supply constraints.**[3] There is generally not enough existing iron ore capacity to satisfy ever growing demand for iron ore, which encourages implementation of new projects. However, this new supply is not able to keep up with the demand. Implementation of new projects is impeded by a number of reasons such as infrastructure bottlenecks, skilled labor shortage, growth in capital intensity, increased regulatory risk with rising taxes globally, relocation of business to regions with immature business environment like Africa, lack of new equipment, etc. (De Angele, 2011).
- **Steep cost curve, deposit depletion and operating costs inflation.** Steep 4th quartile of the iron ore supply (cost) curve leads to high price sensitivity to even small changes in demand. As noted in many reports, China is the marginal iron ore producer almost entirely occupying the highest cost 4th quartile of the iron ore cost curve and, therefore, determining iron ore price (Malanichev and Pustov, 2011). This right part of the cost curve becomes even steeper with the time because China's iron ore production costs inflation, which grew more than 25% yoy historically, exceeds inflation of countries on the left side of the curve. This is amplified by rapid deposit depletion heading up to 3% per annum globally which is partially represented by declining % Fe content in iron ore [Hamilton, 2011].
- **High level of industry consolidation** with the BIG-3 players (Rio Tinto, BHP-B and Vale) accounting for close to 70% of the international iron ore trade (Zhu, 2012). This indicates that the

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[2] Hereinafter "iron ore" stands for iron ore fines, 62% Fe. Iron ore is the key input in pig iron production; the latter is used to produce steel.

[3] Terms "production" and "supply" are used interchangeably.

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iron ore market is oligopolistic with the BIG-3 being able to influence market prices and receive a higher price premium compared with a market of perfect competition. A good example of BIG-4's strong stance on the market is the 2010's shift from the 40-year-old benchmark system of negotiated annual contracts to quarterly contracts directly linked to the iron ore spot market [Wilson, 2012]. This move allowed the BIG-4 to extract higher profits from the growing spot prices.

These high prices make the iron ore market very attractive for newcomers aspiring to bring new supply to fill in the demand gap and earn solid profits. But in order to justify capital investments in new projects future price assumptions are required. Given that iron ore projects have a long lead time nature, with engineering and construction taking up to 10 years (Correa and Grimaldi, 2012), investments need to be evaluated on the long-term horizon. Therefore, 2022 year was taken as a proxy to long-term period. Usually long-term prices used in financial models are converted into real USD terms to neglect inflation. So the true question is, where the long-term price in real USD terms is headed—is it going to grow further on the wave of Chinese development or fall significantly as it was seen in the past?

According to consensus forecast by the leading investment banks[4], the iron ore price would ease to $88/t in the long-term from around $150/t in 2012 (Fig. 2). At first glance this looks logical considering that the current price is exceeding the past high by 3-times and currently proved iron ore reserves would suffice as many as 40 years of consumption at today's rates. The historical analysis of commodity price cycles confirms that price peaks were always not sustainable (Cashin et al., 1999). Moreover, the concept of LT price itself assumes that the market would cool down after the boom period. China would decelerate its steel production and iron ore consumption growth. India would not become “a second China” as it does not need that much iron ore to be imported because it has enough domestic iron ore to produce steel. Iron ore supply tightness would ease with the entry of new projects, which total volume in theory could account for almost 3 billion metric tonnes in the next 10 years, if projects are delivered within the announced timeframes. This exceeds current global production by as much as 1.5 times.

However, there are several reasons to doubt that the consensus forecast of LT iron ore price properly reflects the new reality of rapid deposit depletion, constrained supply growth and escalated cost and capex inflation:

- It is not clear what assumptions stand behind the consensus forecast as there is no explicit relationship between supply–demand balance and iron ore price in the available models.
- There are no modern transparent models verified by scientific community. Available models like the World Bank's one or the model considering the effects of Carajas iron ore on global iron ore prices (da Silva Neto, 1993) have been developed long time ago and do not take into account structural changes on the iron ore market.
- Traditionally, available to the authors forecasts do not explicitly take into account iron ore deposits depletion as well as escalated industry operating and capital costs inflation. To convert prices from real to nominal terms they usually use just a US consumer prices inflation or GDP deflator, which leads to underestimation of forecasts.
- Based on the 10-year retrospective analysis, it is evident that consensus forecasts are usually lower than actual iron ore prices. The reason for this is that usually market analysts simply assume LT price to equal the average historical price over the cycle.

Thus, this research aims at achieving 3 following objectives, which would help clarify if prices could stay at those high levels for at least a decade to come:

- Overview and debate pros and cons of existing approaches to LT price forecasting.
- Explicitly state and discuss assumptions used to forecast prices including deposits depletion as well as industry operating and capital costs inflation.
- Show a possible range of forecast prices and evaluate its upside and downside uncertainties.

## Overview of approaches to LT price forecasting

The paper analyzes LT price forecasts produced via three key approaches which are usually used by commodity analysts from investment banks [e.g. Barclays, Merrill Lynch, Citi, Itau BBA, J.P. Morgan, 2011], analytical agencies [e.g. CRU, 2011] and industrial companies [e.g. Cochilco, 2008]:

(1) Marginal costs (MC) approach;
(2) Global marginal incentive price (MIP) approach;
(3) BIG-4 MIP approach.

Marginal costs (MC) approach generally assumes that LT price equals marginal operating costs (Jones, 1986), i.e. highest production costs needed to bring the last piece of supply to the market. The 2 elements of data required in this approach are operating costs split by country and assumptions regarding future demand growth (Table 1).

The MC approach gives the lowest threshold of prices at a given demand, because it assumes that a new project, being marginal, will never pay back the invested capital.

The second and third approaches use the concept of incentive pricing. This concept is based on the notion that producers will only invest if they believe that prices will be high enough to cover all their operating and capital costs and provide target return on capital over the life of the mine project (Berry and Cooper, 2011). Both approaches assume that LT price equals marginal incentive price. The key difference between global marginal incentive price (MIP) and BIG-4 MIP is that the former considers incentive prices for the whole pool of announced projects. While the BIG-4 MIP is based only on incentive prices for projects owned by BIG-4, which assumed to have the best knowledge and bargaining power on the market [Wilson, 2012].

## General assumptions for MC and global MIP approach

In the long-run a number of key assumptions should be used to determine LT prices:

- As **a proxy for the LT period global iron ore demand growth[5] in 2012–2022** is taken: compound annual growth rate (CAGR) of 1.8%, which is a decrease from 7.0% over the past decade due to an expected slowdown of steel consumption growth in China. This will expand the global iron ore market by 384 mmt to reach circa 2189 mmt (Fig. 3). In comparison

[4] Consensus is an average of Citi, Macquarie, J.P. Morgan, UBS, Merrill Lynch, Morgan Stanley, Credit Suisse.

[5] All S–D balances are calculated for 63% Fe content.