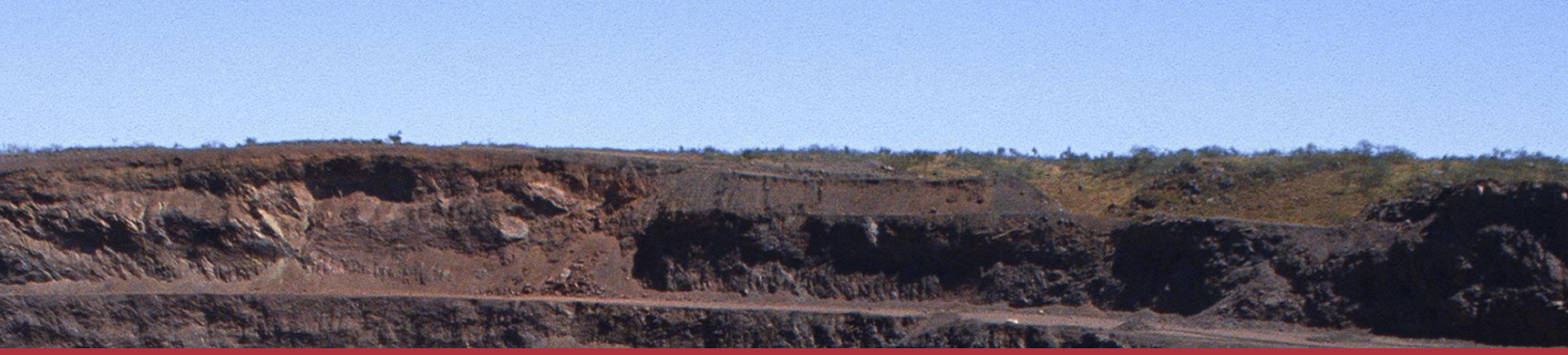

QUEEN'S ENERGY & COMMODITIES ASSOCIATION

Iron Ore Primer

Metals & Mining

October 30, 2017

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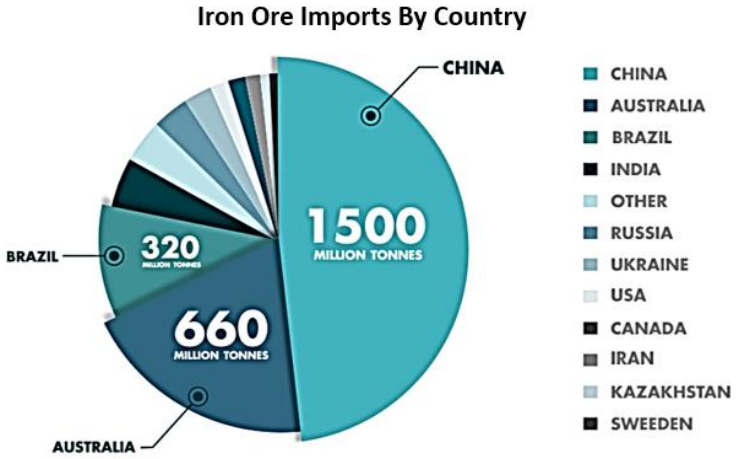
Introduction

Iron has been in use for over 6,000 years. In the past, iron ore was primarily used as craft tools; however, metallurgic and scientific advancement such as the Bessemer process in 1856 and rapid industrialization led to more widespread commercial applications. In the former, the Bessemer process allowed for more economically-viable mass production of steel by extracting carbon out of cheap carbon-rich iron instead of adding carbon. Since then, we have seen steel become a pillar of modern society, with uses of steel ranging from infrastructure and construction to automobiles, machinery, pipelines, and a wide range of commercial and industrial applications. Unsurprisingly, 98% of iron ore used today is used towards steelmaking and thus iron ore is an important base metal to understand in context of the modern economy.

Market Fundamentals

The largest producers of iron ore are China, Australia, and Brazil. Together they comprise roughly 75% of all iron ore produced. In comparison, the largest importers of iron ore are China, Japan, and South Korea – with China comprising over 67% of global imports while Japan and South Korea account for 9% and 5% respectively. Since the infrastructure boom from 2008-2012, almost all the iron ore mined domestically in China has been used to support infrastructure growth. As result, iron ore prices today are heavily influenced by the Chinese market.



http://www.ironorefacts.com/the-facts/iron-ore-global-markets/

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For the past several years, there has been significant global over-supply of iron ore. In turn, iron and steel prices have plummeted. The current long-term market dynamics are uncertain as industry growth is tied to China's economy. Nevertheless, the current trend is a rising preference for higher quality iron ore to produce higher grade material. In an over-supplied market, successful iron ore producers are those that compete on the front of quality rather than quantity.

Pricing

Unlike other commodity prices, iron ore prices are less transparent and are only priced at set daily times. For example, prior to 2010, iron prices were quoted on an over the counter basis on one-year fixed contracts.

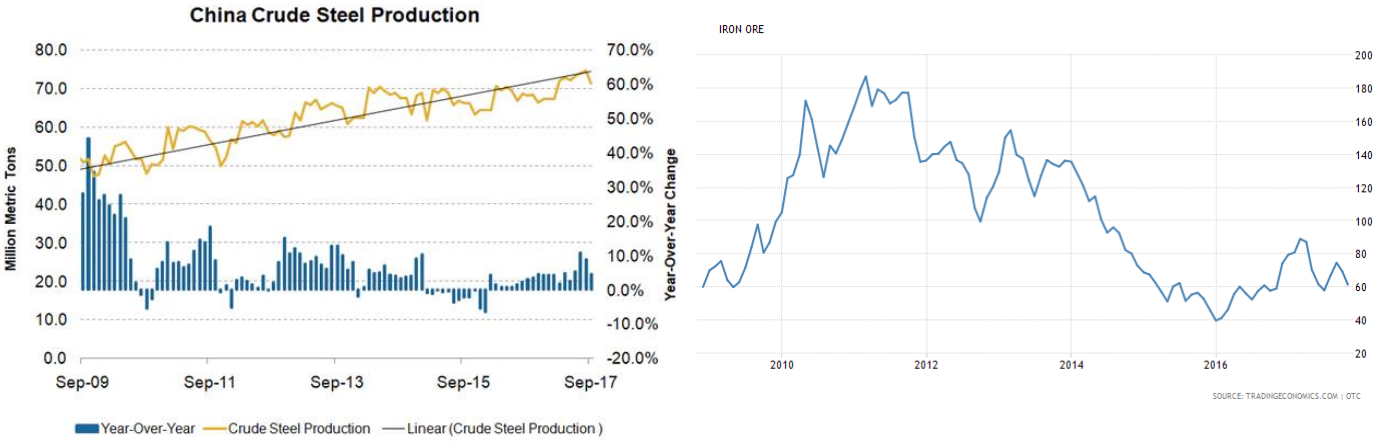
In 2008, iron ore demand spiked in Australia and Brazil, China's largest iron ore suppliers, as they struggled to fulfill demand created from China's infrastructure boom. In turn, China's steel mills began purchasing iron ore from India on an ad hoc basis. This resulted in the creation of spot price indices for iron ore. Simultaneously, the Steel Index, founded in 2006, began collecting spot prices in 2008 for iron ore traders, producers, and consumers. In the latter part of 2008, China's demand for steel reached a tipping point when companies realized the one-year-contracts they were locking into were priced higher than current spot prices. For this reason, companies defaulted on overpriced year-long contracts during the 2008 financial crisis.

Eventually this led to global miners moving their industrial steel mill distributors, processors and customers to contracts linked to shorter indices. Specifically, China currently buys iron ore based on monthly average prices. Average pricing arrangements are benchmarked using the UK Steel Index, a globally recognized iron price assessment agency. The Steel Index receives prices of physical iron ore spot market trades from companies importing or exporting to China. To produce a volume weighted average daily price per tonne, the index removes high and low-end outliers, and standardizes prices based on trading products. The price is published five times a day and, unlike most other commodities, is not quoted continuously throughout the trading day. This means there is no live spot price. Additionally, the Steel Index is used to determine settlement prices of over-the-counter derivatives and the clearing of futures contracts traded on the Singapore Exchange, Dalian Commodity Exchange, and the CME Group.

Macroeconomics

The dynamics of supply and demand have had a resounding effect on iron prices. As China accounts for nearly 65% of global iron imports and being the world's third largest producer of iron ore, the country's market has driven fluctuations in the commodity's pricing. With iron being a key ingredient in the production of steel, the demand of steel can substantially affect the price of iron. Considering that China also supplies over 50% of steel worldwide, the nation's ability to drive shifts in the global market and exhaust iron ore inventories has significant implications on the price of iron. In recent years, Chinese President Xi Jinping has pushed for the implementation of pollution restrictions. Many of these restrictions were focused on limiting the production of steel and the emissions associated with the processing of metals. The production caps are often enforced during winter months, when coal plants ramp up operations to provide power for heat in Chinese cities. Subsequently, steel production in China is cyclical - high during the summer and low during the winter. (Shown below)

Chinese Steel Production Vs. Price of Iron Ore Market Sentiment



Source: Market Realist | Trading Economics & OTC Markets Group

The yearly change in Chinese steel production somewhat correlates with the price of iron. As year-over-year changes are larger, the price of iron seems bullish (Late 2009, 2010, 2013.) Oppositely, as steel production growth rates fell and became increasingly negative, the price of iron slipped.

Furthermore, Chinese steel mills aim to improve steel quality by using higher grades of iron (rather than the 62% fines traditionally incorporated in steel processing) and/or entirely replacing iron with alternative ores. Although iron extraction levels have remained relatively constant, much of its downstream demand has fallen. It is worth noting that iron inventories have reached 2-year highs, creating an abundance of iron (seen in the figure below) and putting downward pressure on prices. Consequently, the falling demand for iron in Chinese steel mills has led equity research firms to downgrade their outlooks on the price of the

commodity. BHP Billiton expects that the supply glut will continue to grow in the next 5-10 years, further pushing the price down.

Conversely, China's growth has been a leading driver for iron ore demand over the past decade. As its housing and auto industries boomed, the demand for steel and other materials derived from iron has increased. 88% of global growth in steel production between 2001 and 2011 is attributable to Chinese steel demands. Although China's expansion has begun slowing, demand for iron-derived materials is likely to remain relatively stable with anticipated growth in emerging markets. Rapid growth rates in India, South-East Asia and namely Africa will pave the way for manufacturing sector growth and infrastructure spending, both increasing demand for steel and other iron-derived products.

The Supply Chain Process: Going from Iron Ore to Steel

The complete supply chain of finding iron ore to extracting it, refining it, and milling it for steel's final application is a strenuous process that generally begins with the discovery of iron ore deposits by drilling hundreds of feet into the ground. Then, after a deposit is discovered and multiple feasibility reports are conducted, multiple holes are drilled hundreds of feet into the ground, and then filled with explosives to break down the rock. After this rock is broken down, it is further crushed into pellets and then transported to be refined and milled. This process of mining is more specific to U.S. iron mining as different methods are used to mine iron ore depending on the geography of a deposit, however, the refining and milling processes are very similar across the globe.

After arriving at the refinery, the pellets must be refined into a form of highly concentrated iron known as pig iron (95% iron) and then further oxidized into steel. The ore typically contains 30-68% iron (again depending on the geography of a deposit) in oxide form that has to be separated and smelted into steel. To do so, iron ore is crushed and mixed with coke, a form of almost pure carbon made by removing the impurities in metallurgical coal, and small amounts of fluxes (minerals – namely limestone, used to remove impurities in the ore). This mixture is then fed into a blast furnace with alternating layers of coke.

Then, oxygen heated to 1200˚C is blasted through the iron mix, oxidizing the coke to form carbon monoxide which reacts with, and heats the iron to melt the iron. After, the molten iron and any slag (impurities) is drained from the bottom of the blast furnace. Steel is then made from molten pig iron by further purifying the metal. This is done using a basic oxygen furnace, which blasts oxygen through the pig iron and lowers the levels of impurities such as silicon, carbon, manganese, and phosphorus. The blast furnace method described produces about 70% of worldwide steel, however 30% is produced using electric arc furnaces (EAFs). EAFs differ in that they are made for smaller scale operations, use scrap material, and rely on low energy costs to be viable.

This crude steel is then milled into one of two types of steel product, flat or long products. Flat products are slabs that are rolled into coils and coated. They are primarily used in manufacturing industries for building products such as large consumer appliances and

automobiles. Long products on the other hand are usually made for use in construction, such as I-beams and rebar.

Projects

In July 2016, the province of Quebec promised a $133 million investment in TATA Steel's Direct Shipping Ore facility on the border between Quebec and Labrador. The deal was made during China's strong steel demand in mid-2016. The expansion of the existing facility will likely bring over $400 million worth of investments to Quebec while producing 4.2 million tonnes of pellet feed and sinter fines each year. The deposit comprises of 25 hematite deposits with a total potential of 122 million tonnes. Holistically, the mine serves the strategic role of supplying TATA Steel's European mills with Canadian iron ore.

The Western Australia government is looking to sign an agreement with the Balla Balla Infrastructure Group (BBIG) to develop an iron mine worth AUD$5.6 billion. The project will employ thousands of locals and lead the construction of a 160-kilometer railway that connects the facility to a port and ultimately, the global market. BBIG affirms that extraction will reach 6-10 million TPY. The mine will further solidify Australia's position as the world's largest extractor of iron ore.

Market Outlook

As China's economy is the largest driver of iron ore and steel prices, China plays a vital role in determining future iron ore prices. As a recap, amidst the global financial crisis, China instituted an economic stimulus package that encouraged the use of credit to support its economic growth. This was especially acute in the Chinese steel industry that was already subsidized by the government. In conjunction, the two programs led to a Chinese steel industry is overleveraged and suffers from extreme overcapacity. Ultimately, our opinion is in line with market expectations: amidst overcapacity and oversupply of the steel industry, a global downgrade in iron ore to a price range in the low 60s to high 50s will be necessary.
The severity of the downgrade will be dependent on the success of China's administration to address overcapacity. The current Chinese administration has propped up unprofitable steel companies and has favored M&A deals and sending overcapacity to other Asian markets.

Therefore, our opinion is that iron ore devaluation will occur in a two-stage process. First, in the next 5-years there will be greater consolidation in among China's SOE steel producers. The implication is that overcapacity will be gradually alleviated as M&A deals are time-consuming processes. During this period, we expect iron ore to be priced at its current range of low 60s and high 50s. Second, as China's "one-belt one-road" program matures, overcapacity will be sent overseas and Chinese iron ore demand will fall to global standards. Thus, iron ore prices will fall at a steeper rate following this period.

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