China's Influence on the World's Iron Ore Market

A Supply-Side Perspective

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Abstract

The literature on commodity 'Super Cycle' attributes the sustained increase in metal prices in recent years to burgeoning demand stemming from China's growth. However, few studies look at China's role in the metal commodities market from a supply-side perspective. This paper zooms in to the market of iron ore and examines how, in response to its high demand for iron ore, China is making an active effort to increase supply both through its domestic production and its investments in overseas mines. Based on historical data, the paper estimates that the production increase generated by China's investments in overseas iron ore mines will be significant and that prices could be 20% higher without these capital injections. In addition, the paper also examines how the stock price of BHP Billiton, one of the largest iron ore mining companies, reacts to the investment news. The paper finds that BHP returns generally fall in response to the news announcement, which serves as a confirmation that people expect sufficient supply-side effects to be generated by these investments.

I. Introduction

The recent global recession was preceded by a commodity price boom that was unprecedented in its magnitude and duration. Real prices for metals, for example, have more than doubled in five years from 2003 to 2008. There is a growing consensus among the current literature that commodities were at the beginning of a multi-year 'super-cycle' driven by demand growth in the emerging economies and, in particular, China.

Iron ore is one typical example of commodities whose prices have increased dramatically since the 2000s. The rapid growth of China, and in particular, the growth of its steel industry, plays a pivotal role in sustaining iron's price boom. In 2009, the year after the global financial crisis, Chinese government passed a massive 4 trillion yuan fiscal stimulus. The majority of the stimulus found its way into the steel industry, which exerted such an upward pressure on iron ore demand that prices on iron ore arriving at China's Tianjin port surged by nearly 70% that year, even though global demand stalled.

However, little surveyed in the literature is the fact that China is also the world's largest producer of iron ore. In addition to expanding the production capacity of its domestic miners, China is also investing heavily in overseas iron ore mines to secure its sources of iron ore. The Heritage Foundation's China Global Investment Tracker, a dataset that tracks large Chinese overseas investment, documents more than 20 iron mine-related investments made by Chinese companies since 2005, with total investment value exceeding $16 billion. Iron ore mining is a capital-intensive operation. By providing capital for iron ore mining, China is also adding to the world's supply of iron ore, which, in theory, should bring down iron ore prices.

This paper aims at examining the impact of such investment activities on the world's iron ore production capacity, and in turn, their potential impacts on prices. Looking from a supply-side perspective, this paper aims at providing a more complete picture of China's influence on the world's iron ore market in addition to the existing demand-side focused analysis.

The plan of the paper is as follows. Section II provides a survey of literature on China's influence on the world's metals market; Section III provides a background of the iron ore market and its pricing mechanism; Section IV describes my first approach to the problem: extrapolation based on past data, and the approach's key results; Section V describes the second approach: test for significance based on current data, and the approach's key results; Section V concludes.

II. Literature Review

In 2005, Alan Heap of Citigroup published what became a much-quoted piece of research, in which he argued that what was occurring in metals and mining was not just a regular cycle, but the beginning of a very strong and sustained 'super cycle'. The primary driver of this super cycle was 'higher trend growth in global demand, driven particularly by China's growth' (Heap 2005). A large body of literature in support of the ‘super cycle’ theory has since blossomed. Some authors described how the composition of growth in China, particularly high investment rates that support industrialization and urbanization, have contributed to strong demand for minerals (e.g., Yu 2011, Garnaut 2012). Some pointed out that the lagged response from the supplying industry was another factor leading to the great metals boom (Humphreys, 2010). Roache 2012 attempted at quantifying the impact of China demand on commodity prices. Using China’s industrial production and apparent consumption[1] for each commodity as key variables in his model, Roache concluded that China’s aggregate economic activity has a significant impact on the price of base metals and other commodities. While demand-side analysis of China’s influence in the world’s metal market is the norm, there have been few attempts at examining China’s role from a supply-side perspective. In addition, most literature looks at the metals market as a whole and very few attempts at creating a model specific for the iron ore market.

III. Background

A. The Iron Ore Market

Iron ore is the raw material used to make pig iron, which is one of the main raw materials to make steel.

[1] Apparent consumption intends to pin down the exact demand for a particular commodity by a country, using Apparent Consumption=Domestic Production+ Imports- Exports.

Mining iron ore is a high volume and low margin business since the value of iron is significantly lower than other base metals. It is highly capital intensive, and requires investments in mining facilities as well as in infrastructure such as railways and harbor to facilitate the transport of iron ore. For these reasons, commercial mining operations are dominated by a few countries as listed in Table 1. In 2005, the top nine iron ore producing countries produce close to 70% of the world's iron ore, with China alone accounting for 43% of the world's iron ore production. Brazilian mining corporation Vale, Anglo-Australian companies BHP Billiton and Rio Tinto Group are the world's largest iron ore producers.

Table 1.
Top Producers of Iron Ore (kt)

	2000	% share	2005	% share	2010	% share
China	131,015	22.7	344,732	43.0	595,601	57.5
Australia	7,049	1.2	6,203	0.8	6,005	0.6
Brazil	27,723	4.8	33,884	4.2	30,898	3.0
India	21,321	3.7	27,125	3.4	38,685	3.7
Russia	44,536	7.7	48,410	6.0	47,934	4.6
Ukraine	25,697	4.5	30,782	3.8	27,349	2.6
S. Korea	24,937	4.3	27,309	3.4	35,065	3.4
USA	47,878	8.3	37,222	4.6	26,843	2.6
Canada	8,904	1.5	8,274	1.0	7,666	0.7
Other	237,193	41.2	236,880	29.6	219,368	21.2
Total	576,253	-	800,821	-	1,035,414	-

Source: World Steel Association

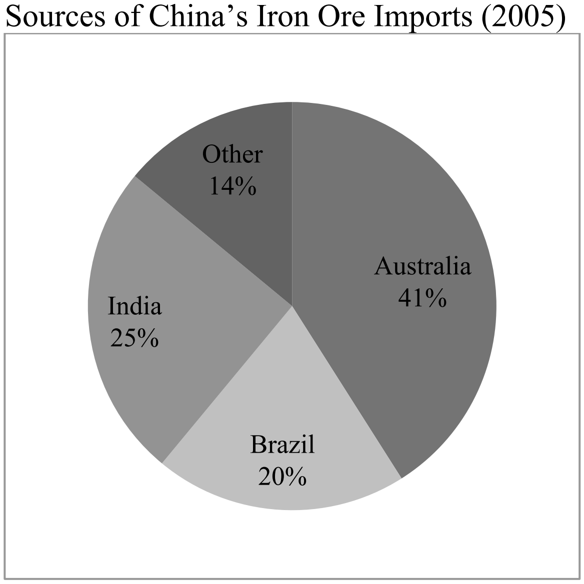
China is currently the world's largest consumer of iron ore, which is accounted for by the fact that it is the world's largest steel-producing country. China's domestic production of iron ore is far from enough to satisfy the demand from its burgeoning steel industry that is driven by its booming housing market and its infrastructure-focused growth. In 2003, China surpassed Japan to become the world's largest importer of iron ore. In 2008, China's imports accounted for nearly half of the world's iron ore exports (Table 2). Nearly 90% of China's imported iron ore comes from Australia, India and Brazil (Figure 1).

Table 2.
Top Iron Ore Importing Countries (mt)

	2000	% share	2005	% share	2008	% share
China	70.0	14.0	275.3	38.6	444.0	49.4
Japan	131.7	26.3	132.3	18.5	140.4	15.6
S. Korea	39.0	7.8	43.5	6.1	49.5	5.5
Germany	47.5	9.5	39.1	5.5	44.3	4.9
France	19.7	3.9	19.5	2.7	18.3	2.0
Italy	17.6	3.5	17.6	2.5	16.3	1.8
UK	16.8	3.4	16.1	2.3	15.3	1.7
USA	15.7	3.1	13.0	1.8	9.2	1.0
Other	142.5	28.5	157.7	22.1	162.3	18.0
Total	500.5	-	714.1	-	899.6	-

Source: United Nations, Trust Fund on Iron Ore, the Iron Ore Market, 2008-2010

Figure 1.
Sources of China's Iron Ore Imports (2005)



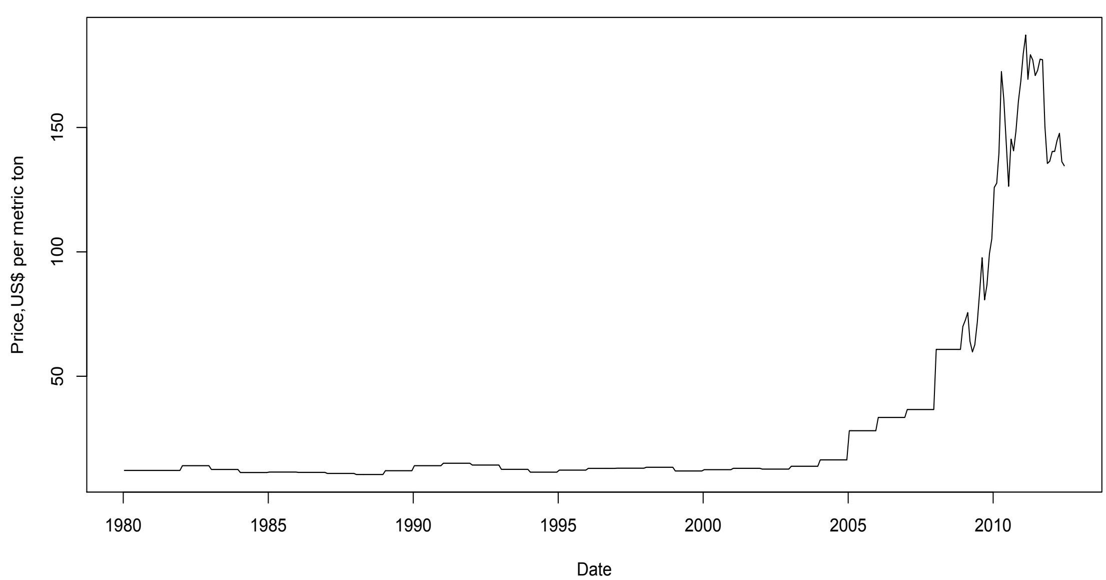
Source: China Economy Information Network

B. Iron Ore Pricing Mechanism

Over the past few decades, iron ore is sold on annual or multi-year term contracts. Once a year, a handful of miners and steelmakers meet to decide on a price for the following term. Usually, the first deal reached sets a benchmark to be followed by the rest of the industry.

This annual pricing system has however in recent years begun to break down, with participants along both demand and supply sides calling for a shift to short-term pricing. Given most other commodities already have a mature market-based pricing system, it is natural for iron ore to follow suit. Figure 2 shows the evolution of prices for 62% iron ore arriving at China's Tianjin Port over time. The breakdown of the annual pricing system can be observed in the increase in price volatility since 2010.

Figure 2.
China Import Iron Ore Fines 62% FE spot (CRF Tianjin port)



Source: IMF

In the current literature, there have been surprisingly few attempts at modeling the process of iron ore price formation in the international market. The broader literature (as summarized in Section II) examines price boom of a larger assortment of metals (copper, zinc, etc), not that of iron ore alone.

In a study called 'An Econometric Model of the Iron Ore Industry', the World Bank analyzes the market formed by 24 major participants of iron ore trade to develop a pricing model for iron ore. The main variables included in their model are effective productive capacity and apparent consumption of iron ore by those countries. In addition, the World Bank Model is sophisticated in its analytical treatment because it takes into account the oligopoly characteristic of the market, and therefore introduces the principles of game theory to analyze the process of price formation. In this paper, I will use the World Bank Model as a basis for my model, but leaves out the game theory aspect of the model due to time constraints.

III. First Approach: Extrapolation Based on Past Data

A. Problem Specification

The Heritage Foundation's China Investment Tracker is a comprehensive dataset that documents large Chinese investments in overseas non-bond assets that are larger than $100 million since 2005. Investments recorded in the dataset span all industries, including mining, energy, transport, and take place in countries all over the world.

Chinese companies have been investing heavily in overseas iron ore mines. The dataset shows that up to June 2012, 23 transactions related to investment in overseas iron ore mines have been made, with a total investment value exceeding $16 billion. Table 3 lists these transactions.

Table 3. List of China's Investment in Overseas Iron Mines

Date	Investor	Partner	Country	Investment	Share	Sector
10/2005	Sinosteel	Midwest	Australia	$600m	50%	Iron
04/2006	CITIC	Mineralogy	Australia	$2,920m	-	Iron
04/2008	Hopu	Lung Ming	Mongolia	$150m	-	Iron
07/2008	Sinosteel	Midwest	Australia	$1,310m	50%	Iron
09/2008	Shagang	Grange	Australia	$360m	36%	Iron
12/2008	WISCO	-	Liberia	$110m	-	Iron
02/2009	Shougang	-	Peru	$1,000m	-	Iron
02/2009	Valin	Fortescue	Australia	$770	17%	Iron
03/2009	WISCO	Thompson	Canada	$240m	19.9%	Iron
05/2009	Najinzhao	Cardero	Peru	$100m	-	Iron
06/2009	Ansteel	Gindalbie	Australia	$130m	24%	Iron
07/2009	Xiyang	-	Russia	$480m	-	Iron
11/2009	Baosteel	Aquila	Australia	$240m	15%	Iron
11/2009	WISCO	Centrex	Australia	$250m	15%	Iron
12/2009	Shunde	-	Chile	$1,910m	70%	Iron
12/2009	CIC	CVRD	Brazil	$500m	-	Iron
05/2010	East China Mineral	Itaminas	Brazil	$1200m	100%	Iron
06/2010	China Railway Materials	African Minerals	Sierra Leone	$260m	12.5%	Iron
07/2010	Chinalco	Rio Tinto	Guinea	$1,350m	45%	Iron
01/2011	WISCO	Adriana	Canada	$120m	60%	Iron
03/2011	Hanlong	Sundance	Australia	$180m	16%	Iron
08/2011	Shandong Iron	African Minerals	Sierra Leone	$1,490m	25%	Iron
04/2012	Hebei Iron and Steel	Alderon	Canada	$200m	20%	Iron

Source: China Global Investment Tracker, Heritage Foundation

By going further into the details of each investment, the following observations can be made:

(1) State-owned steel-making companies, such as Baosteel, Ansteel, Sinosteel, made most of the investments. These companies usually enjoy easy access to loans provided by domestic state-owned banks. The key rationale for their investments is to secure long-term supply of iron so as to be less dependent on mining giants such as Rio Tinto and BHP Billiton.

(2) Projects associated with the investments differ in nature: Some are entirely new projects while others are expansions of existing projects. Capital injected by Chinese companies is used in the building of plants and mining facilities to increase production capacity of the mine. A significant portion is also spent on the building of infrastructure such as railways and ports to support the transport of iron ores once they are ready to be shipped.

The goal of this paper is to evaluate the impacts of these investments in the world's iron ore market. In particular, how much additional supply of iron ore can these investments generate, and with the increase in supply, to what extent will prices be affected?

To answer these questions, the first step is to model a relationship between iron ore prices and production capacity of the major iron ore producers. The second step is to estimate the increase in production capacity that these Chinese investments are expected to generate.

B. Price and Production Capacity

Theory

Given the enormous infrastructure requirements of this industry, the supply of iron ore is highly inelastic. It takes time for prices to rise to a point where companies are willing to commit substantial amounts of money to investment and for banks to finance them. It also takes time to evaluate the feasibility of mining projects. Hence, in addition to rising demand for iron, supply constraint is another key reason leading to iron ore's substantial rise in price. As the simple demand-supply framework in Figure 3 shows, as demand shifts from D_1 to D_2, the inelastic nature of the supply curve causes a larger increase in price than it would be if supply were more elastic.

Figure 4 illustrates two major effects of Chinese companies' investment in the production capacity of overseas iron ore mines. First, there will be an increase in supply of iron ores, particularly those available for the Chinese steelmakers. This is represented by a rightward shift of the supply curve from S_1 to S_2. Since the life of a typical iron ore mine lasts decades, we can assume that the increase in supply, and in turn, its impact in price, is permanent. Second, as a larger capacity enables companies to be more responsive to increases in supply, supply also becomes more elastic. Overall, we expect prices to fall as production capacity increases.

Figure 3.
The Effect of Inelastic Supply on Price

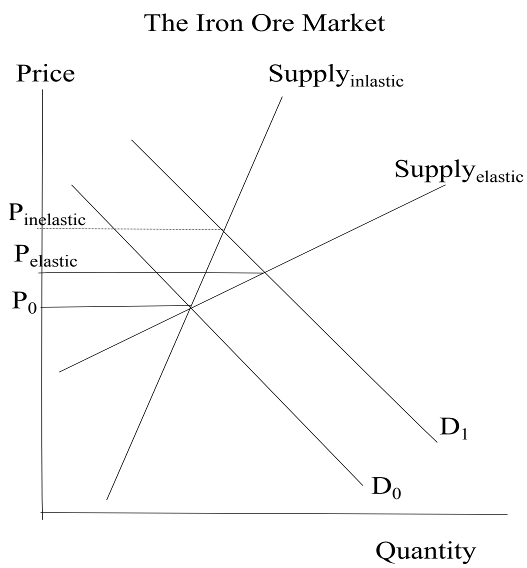
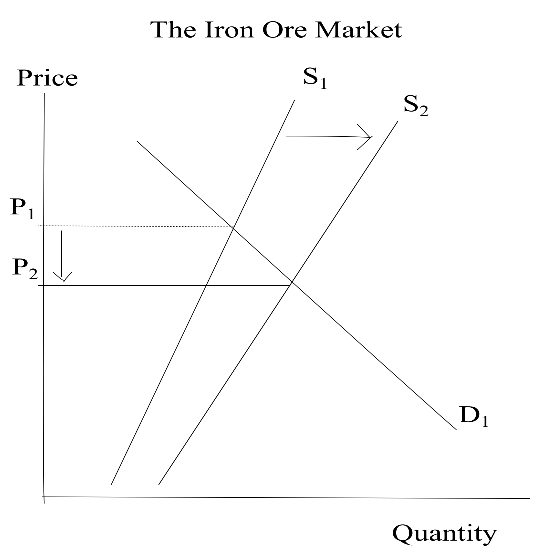


Figure 4.
The Effect of Production Capacity Increase on Price



Model

I use the following model to estimate the impact of production change on price in the iron ore market:

$$\textbf{Price}_t = \beta_0 + \beta_1 \textbf{Price}_{t-1} + \beta_2 \textbf{Production}_{t-1} + \beta_3 \textbf{Steel}_{t-1} \qquad \textbf{(1)}$$

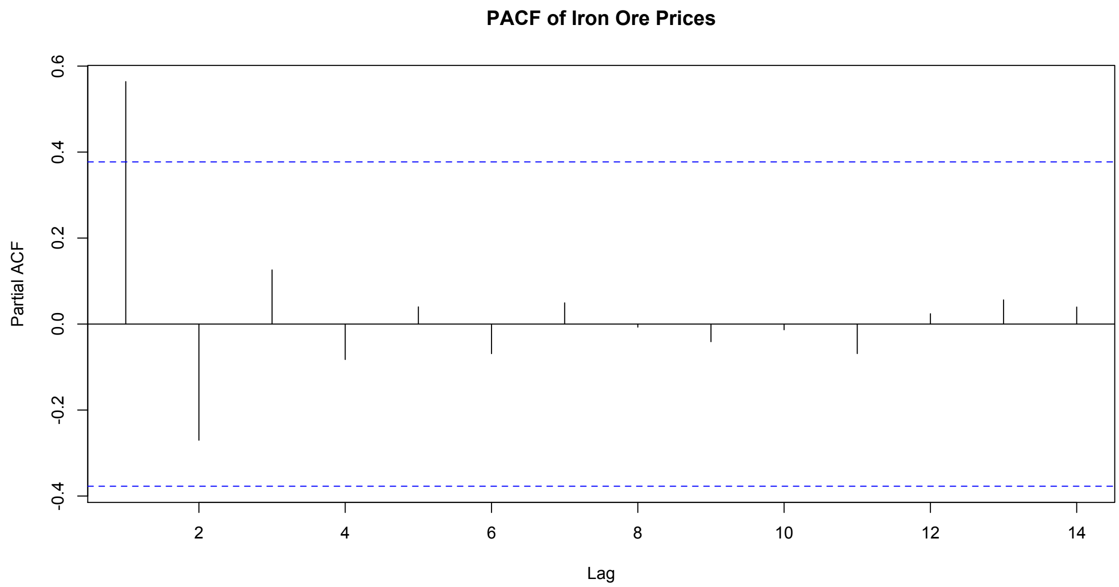
The sample period starts from 1980 and ends in 2006. The recent 5 years of data is excluded from the model because the annual pricing mechanism gradually breaks down in this period and including these data might complicate the estimation results. Overall, data is sampled at an annual frequency, which is in line with the annual pricing mechanism. **Price** is the annual price of iron ore arriving at China's Tianjin Port (US$/metric tons), obtained from the IMF. **Production** is the total iron ore production of Australia, Brazil and India (kt), the top three countries where China imports iron ore. For the demand side, I use **Steel**, which is China's annual steel production (kt), as a proxy for iron ore demand[2]. Data for iron ore production and steel production are both obtained from the World Steel Association.

Figure 5 is a PACF (Partial Autocorrelation Function) plot for the annual iron ore prices. It has a significant spike only at lag 1, meaning that all the higher-order autocorrelations are effectively explained by the lag-1 autocorrelation. Hence, the lag of price by one period P_{t-1} is used as a regressor. Both Production and Steel are lagged by one period

[2] I have also tried using Apparent Demand (=domestic production+imports-exports) as a proxy for iron ore demand as used in the Roache and World Bank papers. However, the result is suboptimal to using steel production as a proxy. Reverse causation that runs from price to components of apparent demand such as domestic production might have complicated the results.

because annual negotiation of iron ore prices is done at the beginning of the year, which should be reflective of the demand and supply conditions of a year ago.

Figure 5.



Results

Table 4 below summarizes the OLS regression result. The three regressors: $Price_{t-1}$, $Production_{t-1}$, $Steel_{t-1}$ are all significant at 5% level. Steel production is the most significant factor that affects the price of iron ore. The sign of the coefficient on production is negative, which is in line with the theory described above. The model estimates that when iron ore production is increased by 1 million tons, the price of iron ore is expected to decrease by $0.183 per metric ton.

Table 4.
Iron Ore Price Model (1980-2006); Dependent variable: $Price_t$

Regressor	Coefficient	Standard Error	T-statistic
Constant	8.467	4.088	2.071.

$Price_{t-1}$	5.515e-01	2.151e-01	2.564*
$Production_{t-1}$	-1.829e-04	7.552e-05	-2.422*
$Steel_{t-1}$	6.359e-05	1.631e-05	3.899***

r-squared=0.8911
Adjusted r-squared=0.8762
F-statistic: F(3,22)=59.98
p-value=9.416e-11***

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'0.1

C. Capital Investment and Capacity Change

The second step is to estimate the increase in production capacity that these Chinese investments are expected to generate.

Estimation based on News Reports

One method is to gather data on expected production increase from newspaper reports. Since the investments are of the magnitude of at least $100 million and are therefore significant, they are covered in sufficient details by major financial news sources such as Bloomberg, Financial Times, WSJ, etc.

Table 5.
Expected Annual Production Increase

Date	Investor	Partner	Country	Expected Annual Production Increase/mt	Expected Time for First Production
10/2005	Sinosteel	Midwest	Australia	-	-
04/2006	CITIC	Mineralogy	Australia	24	<3 years
04/2008	Hopu	Lung Ming	Mongolia	7.8	In operation
07/2008	Sinosteel	Midwest	Australia	-	In operation
09/2008	Shagang	Grange	Australia	6.6	>3 years
12/2008	WISCO	-	Liberia	-	-

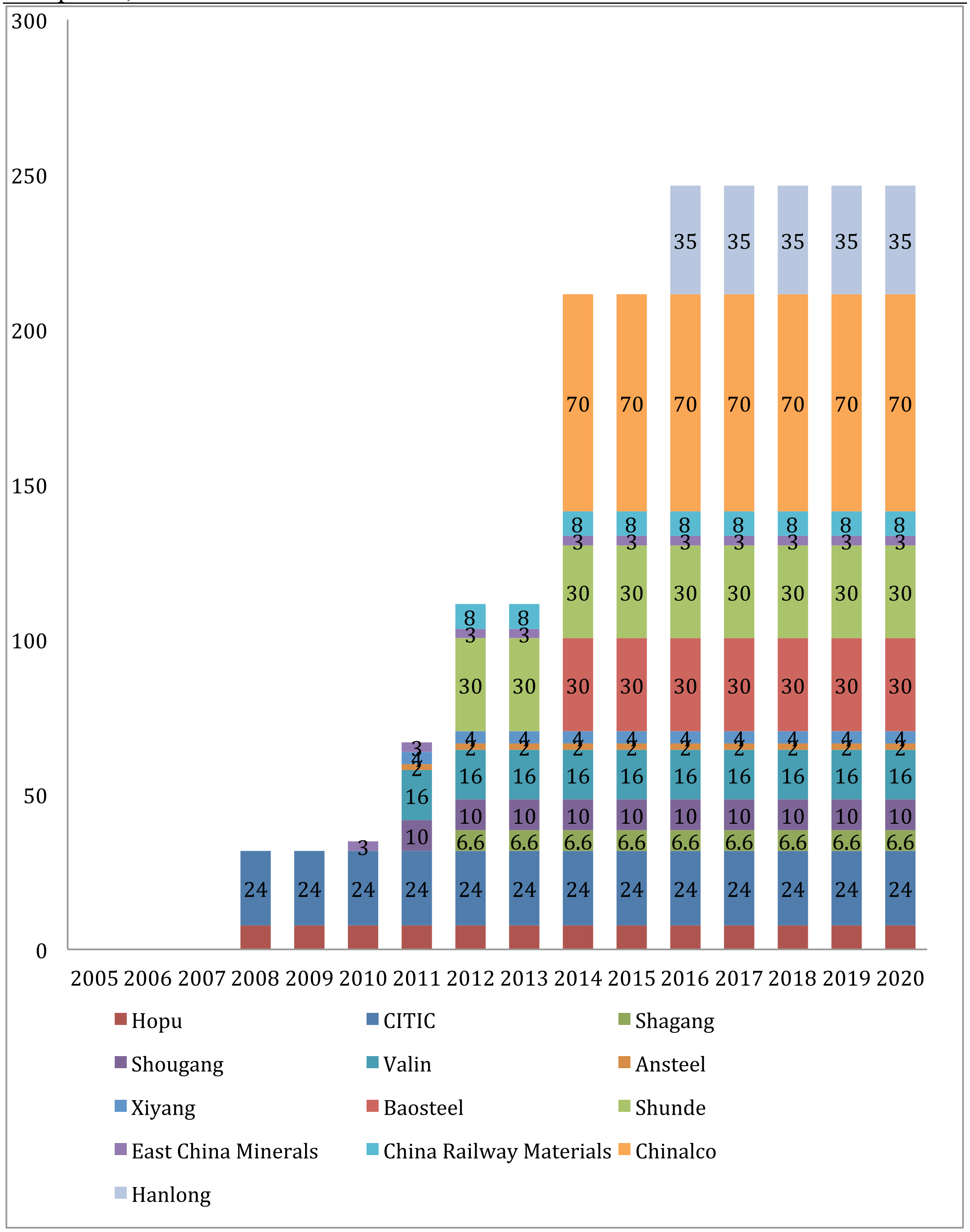
02/2009	Shougang	-	Peru	10	< 3 years
02/2009	Valin	Fortescue	Australia	16	< 3 years
03/2009	WISCO	Thompson	Canada	-	-
05/2009	Najinzhao	Cardero	Peru	-	-
06/2009	Ansteel	Gindalbie	Australia	2	< 3 years
07/2009	Xiyang	-	Russia	4	< 3 years
11/2009	Baosteel	Aquila	Australia	30	Feasibility Study
11/2009	WISCO	Centrex	Australia	-	Feasibility Study
12/2009	Shunde	-	Chile	30	< 3 years
12/2009	CIC	CVRD	Brazil	-	-
03/2010	East China Minerals	Itaminas	Brazil	3	In operation
04/2010	China Railway Materials	African Minerals	Sierra Leone	8	< 3 years
07/2010	Chinalco	Rio Tinto	Guinea	70	> 3 years
01/2011	WISCO	Adriana	Canada	-	Feasibility Study
03/2011	Hanlong	Sundance	Australia	35	Feasibility Study
08/2011	Shandong Iron	African Minerals	Sierra Leone	-	-
04/2012	Hebei Iron and Steel	Alderon	Canada	-	-

Source: major financial news

Table 5 gives information for expected production increase and expected time for first shipment to occur. Based on news reports alone, 13 out of the 23 transactions in the list have the information available. Expected time for first shipment is categorized as ‘in operation’, ‘<3 years’, ‘>3 years’ and ‘in feasibility study’.

In Figure 6 below, I forecast the annual increase in iron ore production for years 2005 through 2020 based on the 13 transactions that have complete data. In making the predictions, it is assumed that mining life lasts through 2020. For mines ‘in operation’, it is assumed that increased production materializes immediately. It is assumed that production increase occurs in 2 years for those categorized as ‘<3 years’, 4 years for those categorized as ‘>3 years’ and 5 years for those still in ‘feasibility study’.

Figure 6
Expected Increase in Annual Capacity through Chinese Investments, by Investing Companies, 2005-2020



It is estimated that on average, annual iron ore production will increase by 157 million metric tons for the time period 2005-2020. According to this estimate and our estimated model for iron ore pricing above, Chinese investment in iron ore mines abroad is expected to bring down price by 157*0.183=$28.7 per metric ton. This represents about 23% of iron ore price, which averages at $120 per metric ton from 2008-2012.

There are obvious limitations for the estimation methods described above. First, there is considerable missing data for estimation based on newspaper sources. Second, information released at the time that the investment is made carries significant uncertainties. On one hand, production might not go as planned. For example, CITIC's 2007 investment in Mineralogy incurred considerable cost surge later, which significantly impedes production. On the other hand, production capacity might increase more than expected as more iron reserves are discovered or efficiencies increase due to economies of scale.

Estimation based on Past Mining Projects

A second method is to look into past mining projects whose capacity increase through capital investments have already been realized.

Table 6 lists 26 iron ore mining projects that have already been completed or are at their advanced stages of development in recent years (2009-2011). For each project, data on its capital expenditure and new capacity is reported. The data is collected from multiple sources, including Australia's Department of Agriculture, Fisheries and Forestry (ABARES) that publishes information on ongoing projects in Australia in its bi-annual publication 'Minerals and Energy: Major Development Projects', as well as the websites of major mining companies such as Rio Tinto, Vale SA and BHP Billiton where information on mining projects is usually available.

Table 6. List of Completed Iron Ore Mining Projects

Project	Company	Project Type	New Capacity /Mt	Investment/ Millions
Cape Lambert Port and Rail Expansion	Rio Tinto	Expansion	133	3100
Dampier Port Expansion	Rio Tinto	Expansion	5	230
Port 55	Fortescue	Expansion	100	2400
WAIO Inner Harbor	BHP	Expansion	240	2200
Utah Point Berth Project	Port Hedland	Expansion	18	225
Chichester Hub 55	Fortescue	Expansion	40	1500
Hamersley Iron Brockman 4 (Phase B) and Western Turner Syncline	Rio Tinto	Expansion	27	1100
Koolyanobbing	Cliffs	Expansion	2.5	254
Western Australian Iron Ore Rapid Growth Project 5 (RGP5)	BHP	Expansion	50	5650
Hamersley Iron Brockman 4 Project (Phase A)	Rio Tinto	Expansion	22	1500
Western Australian Iron Ore Rapid Growth Project (RGP4)	BHP	Expansion	26	2150
Hope Downs Stage 2	Hancock	Expansion	8	350
Extension Hill DSO Project	Mt Gibson	New	3	80
Hope Downs 4	Rio Tinto	New	15	1600
Jimblebar Mine and Rail	BHP	New	35	3400
Karara Project	Gindalbie	New	10	2600
Sino Iron Project	CITIC	New	28	5200
Nullagine Iron Ore Project	BC Iron	New	3	52
Mesa A	Rio Tinto	New	25	901
Pardoo Direct Shipping Ore Project	Atlas Iron	New	3	24
Carajas	VALE	Expansion	30	2478
Vargem Grande-Itabiritos	VALE	Expansion	10	1259
Conceicao Itabiritos	VALE	Expansion	12	1174
Carajas Serra Sul	VALE	New	90	11297
Tubarao VIII	VALE	New	7.5	636
Simandou	Rio Tinto	New	95	10000

Source: ABARES, Rio Tinto, VALE, BHP websites

Some investments are made in entirely new projects. Some investments are used for expanding the capacity of existing projects, which usually involve upgrading existing infrastructure and mining facilities.

Figure 7. Capital Investment and Capacity Increase, by Project Status

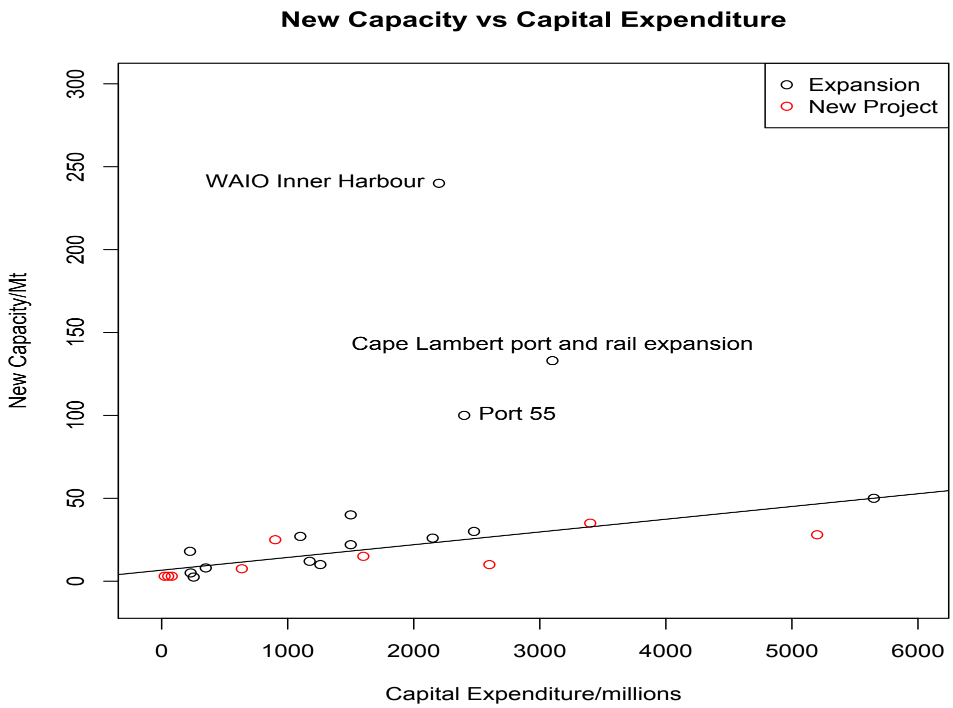


Figure 7 plots capacity increase vs. capital expenditure for the 26 mining projects. Except for three outliners, namely WAIO Inner Harbor, Cape Lambert Port & Rail Expansion and Port 55, all other data points share a strong linear relationship. The three outliners are all expansion projects. The fact that they all lie above the regression line shows that for investments in existing projects, it is possible to generate even larger capacity increase for a given amount of capital expenditure. To make a conservative estimate, I leave out the three outliners and use the remaining data points to run a regression of capacity increase on capital investment:

Capacity Increase=β_0+ β_1 Capital Expenditure **(2)**

The Regression Result is summarized in the following table:

Table 7.
Capacity Increase vs. Capital Expenditure; Dependent variable: Capacity Increase

Regressor	Coefficient	Standard Error	T-statistic
Constant	6.637	2.481	2.675*
Capital Expenditure	0.00768	0.000657	11.704***
r-squared=0.8671			
Adjusted r-squared=0.8608			
F-statistic: F (1,21)=137			
p-value=1.152e-10***			

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'0.1

Though there are other significant factors at play in determining capacity increase (as shown by the significance of the coefficient on the constant term), the relative high r-squared value suggests that the model based on capital expenditure alone is a reasonably good fit. The linear model shows that in a typical iron ore-mining project, $1 million capital investment translates into 0.00768 million tons increase in capacity.

Our list (Table 3) documents a total of $15,780 million's investment in iron ore mines made by Chinese companies. Using the estimates above, it is expected that investments will translate to about 15780*0.00768=121.19 million tons' increase in iron ore production capacity. This figure can be construed to be on an annual basis if we assume that each project has a long mining life. Based on the price model (1), the increase in capacity will bring about $121.19*0.183=$22.2 per metric ton's decrease in iron ore prices, which represent about 18% of the average iron ore prices from 2008-2012.

Past mining projects provides more verifiable and complete data and therefore a better estimate than news sources. However, there might be bias since data is only gathered from large companies for projects taken place in Australia, Brazil and Peru only. Given more time, I should expand the list of mining projects to obtain a less biased estimate.

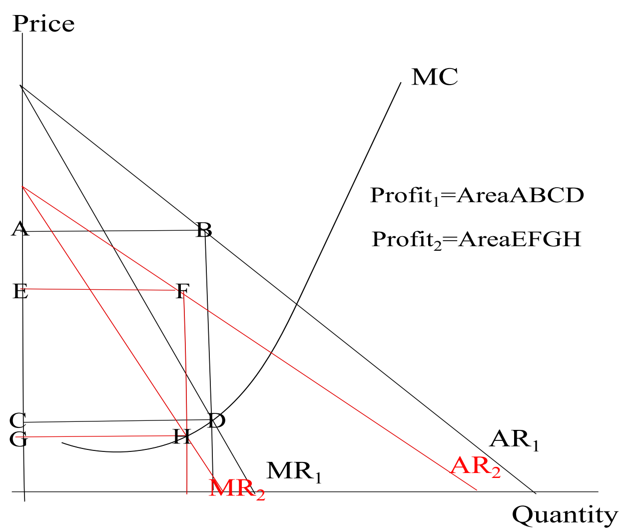
IV. Second Approach: Test for Significance Based on Current Data

In the first approach that is based on historical relationships between production capacity and price, I reach the conclusion that capacity increase generated by Chinese companies' investment will on average make iron ore prices 20% lower than what it would otherwise be.

If the impact on future iron ore prices is indeed strong, then market information should have immediately reflected people's expectation about the future price change at the time the investment is announced.

This section examines how the stock price of BHP Billiton, one of the largest iron ore mining companies in the world, reacts to the news of Chinese investments in other iron ore mining companies. Recall that most of the investments are made by state-owned steel-making companies, and their major rationale for investments is to lessen dependence on large mining companies like BHP. As illustrated in Figure 8, after Chinese companies acquired stakes in other iron ore mining companies, people would expect demand for BHP products to fall. This is represented by a leftward shift of the demand curve from AR_1 to AR_2. For a monopolist, profit is maximized at MR=MC. It can be seen from the figure that BHP profit shrinks. Since stock price reflects people's expectation about future profitability of a particular company, the theory suggests that BHP stock price would fall at the time of the news announcements.

Figure 8. BHP: Change in Profits after Chinese Investments in Other Mining Companies



Event study methodology has been widely used to examine security price behavior around events. A standard practice is to model the events using dummy variables to test the null hypothesis that market efficiently incorporates information and therefore, in the period surrounding public announcement, security returns become abnormal (cannot be accounted for by the usual factors such as market, industry and firm-wise conditions other than the event).

Data

News Announcements

My criterions for locating the dates of the announcements are: (1) It is the date for the first occurrence of the investment news in a major newspaper source; (2) There is considerable certainty conveyed in the news that the investment will go through. For example, government approval has been granted. Out of the 23 transactions in the list, three are omitted due to lack of information on exact date of the news announcement (2005 Sinosteel in Midwest, 2009 Najinzhao in Cardero and 2009 CIC in Vale); three are omitted due to uncertainty (2006 CITIC in Mineralogy, 2008 WISCO in Liberia and 2008 Hopu in Mongolia). This leaves 17 transactions in the news announcement list:

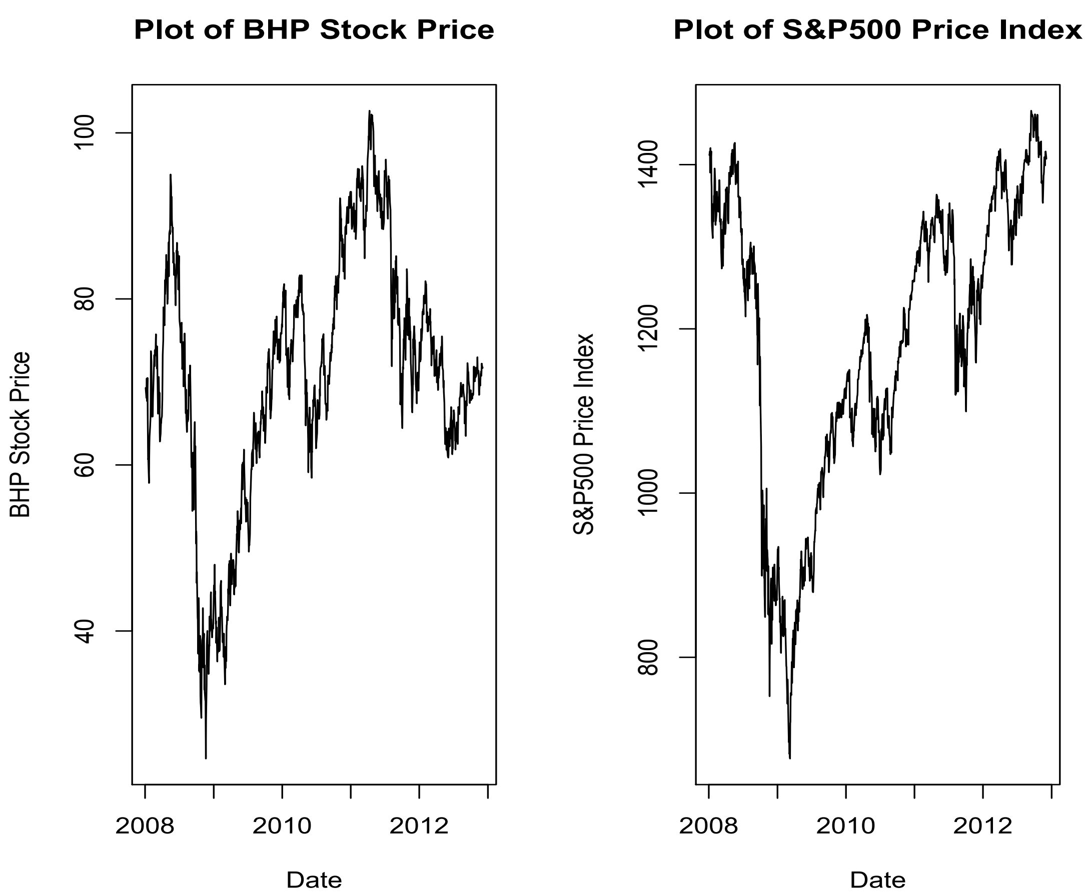
Table 7.
News Announcements

Date	Investor	Partner	News Source
07/11/2008	Sinosteel	Midwest	http://www.nytimes.com/2008/07/11/business/worldbusiness/11iht-sinosteel.4.14435772.html
09/25/2008	Shagang	Grange	http://www.bloomberg.com/apps/news?pid=newsarchive&sid=aVq6XG0BoQbo&refer=asia
02/09/2009	Shougang	-	http://www.peruviantimes.com/09/shougang-hierro-peru-to-invest-1-billion-to-expand-production-at-marcona/1628/
02/24/2009	Valin	Fortescue	http://www.dowjones.de/site/2009/02/fortescue-metals-sells-165-to-hunan-valin.html
06/11/2009	WISCO	Thompson	http://english.peopledaily.com.cn/90001/90778/6676322.html
06/23/2009	Ansteel	Gindalbie	http://www.abnnewswire.net/press/en/60932/Australian_Market_Report_of_June_23:_Global_Economy_Outlook_Downgraded.html
07/17/2009	Xiyang	-	http://af.reuters.com/article/metalsNews/idAFSHA29443920090717
11/17/2009	Baosteel	Aquila	http://www.chinamining.org/Investment/2009-11-17/1258443662d31236.html
11/05/2009	WISCO	Centrex	http://articles.marketwatch.com/2009-11-05/industries/30738319_1_iron-ore-project-mine-stake
12/30/2009	Shunde	-	http://business.globaltimes.cn/industries/2009-12/495449.html
03/24/2010	East China Minerals	Itaminas	http://www.reuters.com/article/2010/03/24/brazil-iron-ece-idUSN2418544820100324
06/15/2010	China Railway Materials	African Minerals	http://www.miningweekly.com/article/african-minerals-inks-iron-ore-deal-with-china-railway-materials-2010-04-01
07/29/2010	Chinalco	Rio Tinto	http://www.bbc.co.uk/news/business-10803814
01/17/2011	WISCO	Adriana	http://www.reuters.com/article/2011/01/18/adrianaresources-idUSN174667020110118
03/18/2011	Hanlong	Sundance	http://online.wsj.com/article/SB10001424052748704608504576207913375721184.html
08/01/2011	Shandong Iron	African Minerals	http://www.businessweek.com/news/2011-08-01/african-minerals-jumps-on-1-5-billion-shandong-mine-accord.html
04/13/2012	Hebei Iron and steel	Alderon	http://www.bloomberg.com/news/2012-04-13/hebei-steel-to-spend-195-million-on-alderon-stake-ore-venture.html

Stock Price

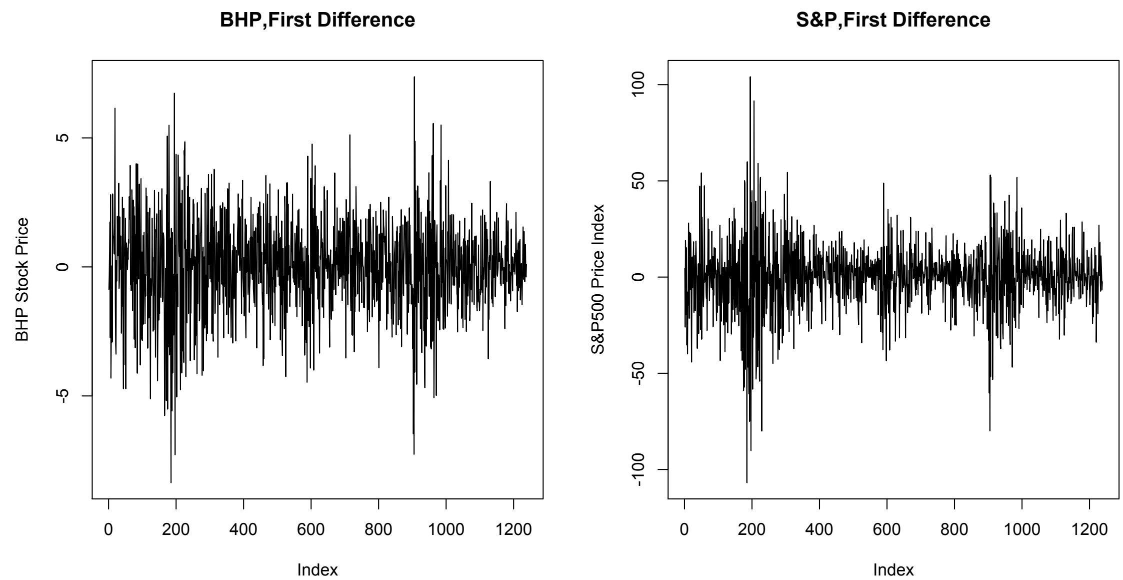
Data on BHP Stock Price and S&P500 Price Index are sampled on a daily frequency (01/03/2008 to 12/01/2012) from the CRSP stock database. The price series (Figure 9) seems to be wandering about rather than behaving like a random walk. This suggests working with the series of differences, i.e. the daily changes.

Figure 9.



The next figure (Figure 10) graphs the daily changes, i.e. first difference of the original data. The series becomes much more noise-like. The mean level appears approximately constant. There are 3 periods of extra-variability, but overall it appears reasonable to proceed as if the series were stationary.

Figure 10



Model

I use the following model to test for the significance of the news shock to BHP stock price:

$$\textbf{BHP Return} = \beta_0 + \beta_1 \textbf{Market Return} + \beta_2 \textbf{Shock} \qquad \textbf{(3)}$$

Where **BHP Return** is the daily percentage change of BHP stock price;

Market Return is the daily percentage change of S&P500 Price Index

Shock$_i$ is a dummy variable that takes on the value 1 if a news announcement occurs i trading days before. For example, Shock$_1$ examines stock returns 1 day after the news shock. $Shock_{1,2}$ examines stock returns both on the first and second days after the news shock.

The coefficient β_2 thus captures the effect of news shock on BHP's stock return, when holding market-wise factors constant.

Table 8 summarizes the regression results. Coefficients on $Shock_1$, $Shock_2$, $Shock_3$, and Shock5 are all negative, which suggest that BHP stock returns drop on Day 1, 2, 3 and 5 after the news announcements. This is in line with our hypothesis that stock returns drop as people expect future profitability of BHP to fall since Chinese companies will buy iron ore from the mining companies that they are investing in, thus divesting demand away from BHP. However, the coefficients on $Shock_1$, $Shock_2$, $Shock_3$ and Shock5 are all insignificant due to the large standard error. In the next step, I make the dummy equal to 1 for the three days after the news announcement ($Shock_{1, 2,3}$). This reduces standard error. The coefficient on $Shock_{1, 2,3}$ becomes significant at 10% significance level.

Table 8.
Regression Results on News Shock; Dependent variable=BHP Return

	(1)	(2)	(3)	(4)	(5)	(6)
Market	1,51***	1.51***	1.51***	1.51***	1.51***	1.51***
Return	[0.031]	[0.032]	[0.031]	[0.032]	[0.032]	[0.031]
$Shock_1$	-0.674					
	[0.45]					
$Shock_2$		-0.169				
		[0.45]				
$Shock_3$			-0.549			
			[0.45]			
$Shock_4$				0.023		
				[0.45]		

$Shock_5$					-0.318 [0.45]	
$Shock_{1,2,3}$						-0.479. [0.27]
r-squared	0.6509	0.6505	0.6513	0.6510	0.6511	0.6517

Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'0.1

The lack of significance of the coefficient on the news announcements could be due to the following reasons: First, even though the news have been selected on the basis that they are reported at a stage when it is highly possible that the investments will go through, uncertainty still exists. There is usually a time lag of 3 to 5 years between capital investments and first production of iron ore. The long time lag diminishes people's expectation about the possible effects of these investments on BHP profitability. Second, as demand from China continues to soar, people would expect the impact on BHP's profits to be minimal. The fact that Chinese companies are actively investing in overseas mines is an indication that iron ore is very much in demand. This causes people to hold positive outlook towards BHP's future profitability.

V. Conclusion

This paper starts with a list of China's investment in overseas iron ore mines and explores China's role in the world's iron ore market from a supply-side perspective. The paper examines the idiosyncratic nature of iron ore's pricing mechanism and uses historical data to model the relationship between production and price. The paper also explores a list of recent mining projects done in countries like Australia, Brazil and Peru, and establishes a relationship between capital expenditure and capacity increase in a typical iron ore mining project. Based on these two sets of established relationships, the paper estimates that the effects of these Chinese investments on iron ore production and prices are very significant. Iron ore prices would be about 20% higher without Chinese companies' injection of capital to the iron ore mines.

The paper also tests for the significance of these investments by looking at how the news announcements serve as shocks to the stock price of BHP Billiton, one of the largest iron ore mining companies. BHP's stock returns typically drop after the news announcements. This indicates that the capacity increases generated by these investments are of a significant scale that people expect sufficient diversion of demand away from BHP towards the invested mining companies. The long time lag needed for production increase to be realized as well as conflicting signals sent by these investments news to the people are possible reasons why the effects of the news shocks are not significant in our regression exercise.

Due to the limitation of time and data, a few questions are left unexplored. First, does a Chinese company's takeover (or partial takeover) enhance the efficiency of the mining company? Would companies from other countries have sufficient capital and incentive to invest in these iron ore mines if Chinese companies do not choose to invest? Answers to these questions can help us determine how much credits we should give to Chinese companies in their efforts to increase the world's supply of iron ore. Second, the investments on our list start from 2005 and later. The production capacity increases brought about by these investments have not been realized in most cases. As a result, the estimations by this paper are mostly on an 'expected basis'. When we eventually have data on the actual capacity increase and the corresponding price change, we can have more convincing evidences on China's contribution to the world's iron ore supply.

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