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ASSESSING THE COMPETITIVENESS OF THE SUPPLY SIDE RESPONSE TO CHINA'S IRON ORE DEMAND SHOCK

LUKE HURST

CRAWFORD SCHOOL OF ECONOMICS AND GOVERNMENT, AUSTRALIAN NATIONAL
UNIVERSITY
LUKE.HURST@ANU.EDU.AU

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EABER SECRETARIAT
CRAWFORD SCHOOL OF ECONOMICS AND GOVERNMENT
ANU COLLEGE OF ASIA AND THE PACIFIC
THE AUSTRALIAN NATIONAL UNIVERSITY
CANBERRA ACT 0200 AUSTRALIA

Abstract

This article examines the scale of China's demand shock and the supply-side reaction in established and fringe iron ore regions. It outlines the short-run constraints on supply expansion and explores the supply-side response to understand whether the long-run iron ore market adjustment has been competitive, or influenced by strategic supply and price interventions by incumbent producers.

Keywords: iron ore; market adjustment; competition; oligopoly

Introduction¹

China's demand for iron ore already dwarfs established markets in Japan and the rest of Asia. The massive scale and fast pace of China's demand growth has required significant adjustment to the patterns of trade in the global iron ore market and supported a large and sustained price rise from US\$13.83 in 2003 to US\$128.87/t in 2012, after peaking at US\$187.18/t in 2011.

At the start of the iron ore industry consolidation period in 1990 the Big 3 (Rio Tinto, BHP Billiton, and Vale) accounted for 31.4 per cent of global supply. In 2003—the early stages of China's demand boom—iron ore industry consolidation had led to the Big 3 accounting for 65.8 per cent of global production.

The industry consolidation and large scale of the iron ore price boom led Chinese steel industry stakeholders and commentators to level accusations that the Big 3 Asian market exporters were exploiting market power to gain short-run rents during the market adjustment. In 2012, Wang Xiaoqi, Vice Chairman of CISA, said, “The iron ore market should be determined by, and reflect, real supply and demand. However, monopoly practices and price manipulation have exerted a big impact on prices” (Du 2012).

BHP Billiton's ex-Chief Operating Officer, Alberto Calderon rejected the idea that the Big 3 exploited bargaining power during the market adjustment, stating, “How does OPEC affect the oil price? Does anyone think it manipulates the price of oil? The price mechanism is not manipulated. What OPEC does is control supply. So how do the three players in the iron ore market control supply when all we ever do is produce at 100 per cent of our capacity and that is in all our production reports? The only thing we could ever do would be to manipulate expansions in supply” (Uren 2012, p. 175).

Whether the iron ore price boom was caused by short-run constraints on supply expansion or whether it was the result of a strategic response by the incumbent producers is the main question under scrutiny in this article. Specifically, two supply-side interventions will be analysed: a supply-withholding cartel and a price bargaining cartel. The article will assess the barriers to implementation of strategic supply-side interventions and analyse iron ore market outcomes

¹ I am indebted to Shiro Armstrong, Peter Drysdale and Ligang Song for comments on drafts of this paper.

following China's demand shock to understand whether the adjustment has been impacted by strategic supply-side behaviour.

To analyse the competitiveness of the iron ore supply adjustment in response to China's demand shock, this article describes the scale and pace of China's iron ore demand shock along with the short-run adjustment of the market; it then analyses the nature of the iron ore supply response over the short and long run; next, it examines Asian iron ore market pricing outcomes following China's iron ore demand shock to understand the competitiveness of the supply response.

1. Evidence of a supply-withholding cartel?

The traditional strategy of a supply-withholding cartel is to deter entry by fringe suppliers to protect its long-run position in the market. To strategically withhold intra-marginal supply from the market in a coordinated way while deterring fringe development would require the incumbent cartel to hold intra-marginal mineral concessions without developing the deposits. By 'sitting' on undeveloped mineral concessions the cartel would maintain the key barrier to entry—owning an intra-marginal iron ore project—without bringing intra-marginal production to market. By delaying the development of intra-marginal production, incumbent firms will effectively protect the marginal producer's position in the market (and their producer surplus) by not meeting demand with cheaper output.

To control the development of intra-marginal supply in a coordinated way, a cartel must overcome several barriers. These barriers include contractual obligations of mineral developers to host governments; asymmetric payoffs for producers in the cartel due to different operating costs; and uncertainty about project development. The difficulty in organising a coordinated supply response in the iron ore market was summed up by the Australian Competition and Consumer Commission (ACCC) in its investigation into the potential impact to competition of a merger between Rio Tinto and BHP Billiton, where it stated, "There are a number of capacity expansion projects that are likely to be undertaken by alternative suppliers of iron ore lump and iron ore fines in the short term, including by independent suppliers operating in Australia. In addition, there are a number of likely and potential medium to long-term capacity expansion projects that may be undertaken by alternative suppliers. If these expansion projects proceed, the costs to the ... firm of withholding production and infrastructure capacity in terms of foregone opportunities to supply iron ore lump and iron ore fines are potentially long lasting and significant ... Uncertainty regarding which independent capacity expansions would be undertaken in the medium to long term and the total extent of independent supply would be likely to introduce significant uncertainty in relation to the profitability of any withholding strategy of the merged firm" (ACCC 2008, p. 7).

There are also institutional barriers to implementing a supply-withholding strategy. Mineral development contracts (MDCs) are entered into between mining companies and host governments. MDCs contain clauses relating to the

project development timeframes to bring minerals to market. When project development timelines stipulated in MDCs are not met, punishments are often implemented, such as fines or expropriation of mining rights. An example of this relates to the Guinean government re-allocation of Simandou Blocks 1 and 2 concessions from Rio Tinto to BSGR in 2008, with Vale purchasing a 51 per cent stake in 2010. Rio Tinto had been trying to develop the project since it was awarded permits for all four blocks in 1997 but the Guinean government declared that Rio Tinto was developing the mine too slowly, citing progress benchmarks that had been missed, and implying that the company was simply hoarding the Simandou deposit—keeping it from competitors while focussing on mines elsewhere² (Keefe 2013).

The Simandou saga also provides an example of the competition between the Big 3. In April 2014, Rio Tinto (2014, p. 3) filed a complaint in the US District Court against Vale where it claimed, “Vale feigned continued interest in pursuing a deal with Rio Tinto so that it could extract more of Rio Tinto’s highly confidential business and technical information”, going on to accuse the defendants of “theft of Rio Tinto’s valuable mining rights”.

As suggested by the ACCC statement above, the sheer number³ of projects required to be developed to satisfy China’s iron ore demand would make it difficult for a cartel to agree on the optimal sequencing of project development given the uncertainty inherent in mine development. In Australia, for example, there were 48 iron ore projects in various phases of development across 30 different companies in 2012; across Africa there were at least 27 major iron ore projects—all these projects have different development risk profiles and different delivery timelines agreed to with the host governments (BREE 2012, pp. 130–133).

Agreement on a withholding strategy between the Big 3 would also be difficult as each of Rio Tinto, BHP Billiton and Vale’s operating cost structures differ. The different operating costs mean that the cartel producers would have incentives to deviate from the strategy (bring online more production). The fragmentation of the production response would make it extremely costly to monitor cartel members’ production and the different operating cost structures would limit the ability of the higher cost cartel producers—in this case Vale—to punish defection from the cartel strategy by Rio Tinto or BHP Billiton.

The iron ore industry consolidation in the lead up to China’s demand boom did not lead to a highly concentrated market, as the ‘Big 3’ tag would suggest⁴. Over the 2003 to 2012 period, the iron ore industry had medium concentration as measured by the Herfindahl-Hirschman Index (HHI)—the iron ore export HHI remained between 0.12 and 0.16 and never exceeded 0.25 (the value above

² Corruption and bribery appear to be the cause of the Simandou mine rights re-allocation but the lack of development provided a legitimate reason for the re-allocation.

³ There are few individual projects, which are able to alter the market supply in a significant way given the scale of China’s demand; it is the aggregate production of many new projects that will impact the market, and coordination across three firms and many projects would be extremely difficult.

⁴ The ‘competitive fringe’ refers to iron ore producers who are not part of the Big 3.

which is considered to indicate “highly concentrated markets” by the US Department of Justice (USDOJ)). As of 2012, the Big 3 had ownership stakes in 110 of 1,328 global iron ore projects outside of China⁵ and accounted for 61.2 per cent of global exports.

Despite the high level of iron ore industry fragmentation, the Big 3 maintain a dominant position in low cost production. The low costs of the Big 3 ensure their long run position as intra-marginal producers. As at September 2014, Rio Tinto’s average CFR to China cost is around US\$47/t, BHP Billiton’s is around US\$50/t, and Vale’s is around US\$62/t—the next large low-cost iron ore exporter to China is Fortescue, which has operating costs of around US\$71/t (Pascoe 2014).

The concentrated position of the Big 3 in low-cost production means that they are protected from market entry over the long run as there are few remaining known iron ore deposits which can enter the Asian market below US\$65/t. While this position provides incentives over the short run for the Big 3 producers to withhold supply to maximise super normal profits, it does not provide evidence of a cartel.

Industry consolidation from 1990 to the start of China’s demand shock does not appear to have deterred market entry by fringe producers during the price boom. As shown in Figure 1, from 2003 to 2009 export growth came mainly from fringe producers, whose output growth averaged around 14 per cent annual export growth over the period (202mt/a to 441.8mt/a) as compared to 6.6 per cent annual growth from the Big 3 (388.5mt/a to 568.4mt/a). From 2010 to 2012, the expansion of the fringe slowed to around 1.7 per cent per annum, while the Big 3’s iron ore exports grew around 8.8 per cent annually⁶.

<FIGURE 1 ABOUT HERE>

The development of the fringe continued in 2014 as Fortescue shipped an additional 84 mt in 2014 (compared to its 2013 exports), more than the combined annual increments to supply from Rio Tinto, BHP Billiton and Vale (30 mt, 40 mt and 10 mt, respectively); another 25 to 30mt came online from other fringe producers (Pascoe 2014).

Over the long run, intra-marginal fringe production is poised to continue to be a major contributor to the iron ore supply response. Based on the reporting of 27 iron ore projects across the emerging iron ore production region of west and central Africa it is estimated that the region has the potential to add 481mt/a to world iron ore export capacity by 2018 (Hurst 2013). This figure is in-line with estimates by RBC Capital Markets (2011) that 475–575 mt/a of iron ore export capacity will become available in Africa by 2016 (based on analysis of 32 iron

⁵ Projects listed in the Intierra database as of January 2012.

⁶ The development of iron ore fringe exports was largely concentrated in Australia in the short run immediately following China’s demand shock. Over the 2003 to 2012 period, Australia’s fringe suppliers rose from accounting for a negligible amount of Australian iron ore exports to accounting for 22 per cent.

ore projects), and by Ocean Equities (2011) that 300 mt/a could be available by 2018 (based on 16 iron ore projects).

Most disclosed estimates of operating costs for west and central African iron ore projects tend to be relatively low due to low labour costs and the high-grade ore, which requires relatively low beneficiation. African free on board (FOB) cost estimates range from as low as US\$20/t for the planned output from Sundance's Mbalam project up to US\$50/t for Sierra Leone's Marampa mine (RBC Capital Markets 2011; Emery 2012). When shipping costs are included, west and central African iron ore will, on average, cost around US\$50–80/t cost and freight (CFR) into China⁷.

The above analysis shows that while the Big 3 have benefited from their low cost position during the short- and long-run iron ore market adjustment to China's demand shock showed, there is little evidence of a coordinated supply-withholding response.

2. Evidence of a supply-side price cartel?

The Chinese state viewed the price boom not only as signalling a supply-withholding cartel but also as a reflection of coordinated pricing strategy by the Asian market supply-side negotiators. In 2010, then Vice Chairman of CISA, Luo Bingsheng, said: "The three giant miners have been using their position to control prices at unreasonably high levels, putting global steel mills in a difficult situation ... it is not price negotiations, it's that they fixed a price and you have to accept, if not, they cut off the supply" (Zhang & Lan 2010).

Prior to 2010, iron ore was priced through annual bilateral negotiations between the largest LTC holders in the Asian and European market. Benchmark negotiations were conducted through a series of one-on-one meetings between major trading partners until a pair agreed on the contract price for the coming year. If the price offer was viewed as 'unfair' by either side in a negotiation—that is, not reflective of the marginal price for the coming year—they could reject the offer until an agreeable price was reached during ongoing rounds of negotiations or the price was settled between other negotiators.

For an importer to accept an 'unfair' benchmark price—a price considered above the marginal producer's operating costs—the exporter would be required to possess a bargaining power advantage. A bargaining power advantage might arise from resource dependence asymmetry—where one party is more reliant on the other to secure iron ore market access. The following analysis assesses whether short-run resource dependence asymmetry existed in the Asian iron ore market and whether there is an indication of a coordinated response from the Big 3 in price negotiations.

China's demand shock placed significant short-run strain on the seaborne bulk freight market, which led to a large price increase for bulk freight. Over the

⁷ Marginal costs for African projects will be much higher and have been accounted for in the risk index, which considers factors such as project infrastructure requirements.

period 2003 to 2012, Australia's freight advantage into the Asian market averaged US\$19.20/t (around 27 per cent of the landed cost)—peaking at US\$60.80/t in May 2008 (around 99 per cent of the benchmark landed price) Brazilian exporters, on average, held a US\$1.12/t freight advantage (around 2 per cent of the landed cost) into the European market over Australian exporters—peaking at US\$8.20/t in November 2003⁸ (around 59 per cent of the benchmark landed cost).

The increased cost of freight effectively increased the isolation of the Asian market from the European market. The increased isolation of the Asian and European iron ore markets is reflected in the increasing dependence of Australian and Asian traders on each other. In 2012, Australia's iron ore was exported to 10 countries, down from 19 in 2003 and its export dependence on China doubled from 34.1 per cent in 2003 to 70.7 per cent in 2012. Australia's increasing dependence on China decreased its export dependence on Japan from 39.3 per cent of total Australian iron ore exports in 2003 to 16.5 per cent in 2012. China's dependence on Australian exporters rose from 39.2 to 47.3 per cent from 2003 to 2012.

The increased price of freight⁹ meant that China reduced its relative dependence on Brazilian iron ore exports, down from 25.9 per cent in 2003 to 22.1 per cent in 2012. But China's demand was unable to be met solely by Australian exports. Despite the increased price of freight, Brazilian exports were required to meet the increased demand from the Asian market. Brazil's export dependence on the Chinese market increased from 22.1 to 48.2 per cent over the period 2003 to 2012.

The importance of Brazilian exports to the Asian market despite the increasing cost of freight indicates the importance of Brazilian supply in linking the global iron ore market; that is, Brazilian exporters are able to operate as intra-marginal exporters in both markets. The link provided by Brazilian exports between the European and Asian markets reduces the switching costs for Asian market buyers and increases the ability of the market to adjust over the short run in comparison to a pure bilateral monopoly, for example, if Australia was the only major exporter to China.

The co-dependency of the major exporters (Australia and Brazil) and importers (China and Japan) in the Asian market following China's demand shock and the inability of any partner to redirect large amounts of supply or demand away from the Asian market over the short run reduced the credibility of boycott threats during price negotiations without coordination. The diminished

⁸ In 2008, Vale ordered 35 of the giant Valemax ships (it planned to own 19 of them) from South Korean company Daewoo Shipbuilding and Marine Engineering; the vessels were expected to come into service from 2011 to 2013. The predicted cost for shipping iron ore using a Valemax is around US\$4–5/t cheaper than using Capesize vessels, which corresponds to savings of around US\$1.6–2 million per shipment (Murphy 2012).

⁹ Under the FOB price mechanism the importer (China) pays for freight.

credibility of boycott threats reduced the potential for exporters to have ‘unfair’ price offers accepted during the benchmark negotiations¹⁰.

There is no indication that the Big 3 coordinated during the benchmark negotiations. The competition between the Big 3 in the Asian benchmark price negotiations was signalled in 2008. The result of the 2008 negotiations saw Vale agree to a 65 per cent price increase with Japanese and South Korean mills; Rio Tinto insisted on a further increase to take account of the freight advantage of Australian exporters to the Asian market. Rio settled with Baosteel, gaining a 79.9 per cent price increase for iron ore fines and 96.5 per cent price increase for lump iron ore—Vale failed in its attempt to have its price revised to that of Australian exporters (Tex Report 2012, p. 10).

The separation of benchmark negotiations in Asian and European markets provides a useful proxy to assess the competitiveness of the benchmark pricing outcomes. CVRD (later Vale) was the export price setter with five different importers in the European market from 2001 to 2009; over the same period BHP Billiton, CVRD and Hamersley were all involved in setting the Asian market price with different importers. The adoption of the price in one market is not automatic for the other market, and the reasonably quick turn-around for the second market to agree to the new price suggests that the initial settled price was considered a competitive deal in the other market (Table 1) (Tex Report 2012).

<TABLE 1 ABOUT HERE>

3. Causes of the iron ore price boom

China’s rapid urbanisation and high investment share of expenditure were the leading causes of the positive shock for steel demand. To meet the increased demand, China’s steel industry expanded rapidly—accounting for 84.4 per cent of global steel production growth from 2000 to 2012. During this period China’s steel production increased from around 128 mt/a to 716.5 mt/a, increasing its share of global production from 15 per cent to 46.4 per cent¹¹.

China’s demand for iron ore is highly correlated to steel demand—blast furnace technology¹² accounted around 85 per cent of China’s steel production in 2011 (around 69.8 per cent the global average) (World Steel Association 2013). The dependence of China’s steel industry on iron ore meant the positive shock in steel demand flowed directly through to the iron ore industry.

The scale and pace of the growth in China’s iron ore demand dwarfed that of Japan’s post-WWII demand shock. During the height of the growth in Japan’s demand for iron ore (1965 to 1975), imports increased from 38.8 mt/a to 132

¹⁰ The spot market provided a platform to sell and buy outside of LTCs but the transaction costs of trading large volumes on a short-term basis is extremely high.

¹¹ At the start of the reform period in 1978, China steel industry produced 31.8 mt/a (accounting for 4.4 per cent of global production).

¹² Blast furnace technology requires around 1.4 t of iron ore to produce 1 t of steel.

mt/a (an increase of 93.2 mt/a). In 2003, China's demand for iron ore imports was just 16.1mt/a greater than Japan's (148.2 mt compared to 132.1 mt, respectively); by 2012 China required 613.4 mt/a more iron ore per year than Japan (745.4 mt compared to 132 mt). China's demand for imports over the period 2003 to 2012 increased 597.2 mt/a; more than six times the magnitude of Japan's from 1965 to 1975.

Japan's unforeseen stagnation in iron ore demand from the mid-1970s came at a time when Japanese consumers or related firms were securing supply through minority equity investment and LTCs led to 'over-contracting'. In the context of stagnating demand and surplus contracted supply, Japanese importers were enforcing *force majeure* on around 37 per cent of contracted Brazilian imports and around 18 per cent of Australian imports, which increased the amount of supply on the 'free market' (supply not tied up by LTC obligations). The increased free market supply, allowed the market to absorb the initial phase of China's demand shock.

During the 1980s, the global iron ore export market grew at around 1.5 per cent a year, increasing to 2 per cent a year through the 1990s; by 2003, iron ore traded in the Asian market at just US\$13.82/t. Despite the persistent low price for iron ore, the demand boom can be traced to 2000 when Chinese, Taiwanese, South Korean and Japanese steel production grew 9 per cent. But the over-contracting of intra-marginal supply by Japanese importers delayed the price signal of China's demand shock.

The persistent low prices and low investor confidence in the years leading up to China's iron ore demand shock meant that iron ore companies had avoided investment and focused on cost cutting and capital efficiency (Radetzki et al. 2008). Humphreys (2010, p. 6) provides an account of the hesitance of mining companies at the beginning of China's demand shock: "The bruising experience of the previous few years and the failure of the recovery in 2000 had left managements cautious about the prospects for the industry. There was also some pressure on them to give priority to rebuilding their balance sheets and to appease their long-suffering shareholders with more generous dividends. Although many acknowledged in their public statements that China had the potential to have a strong positive influence on the industry, the scale of that impact was still very far from clear at this juncture."

The low investment by the industry in exploration, technological development and human capital development in the lead up to China's demand shock reduced the ability of the Big 3 to expand low-cost production over the short run following the demand shock. The low expectations of the coming Chinese demand expansion, and associated low investment by incumbent iron ore producers in the lead up to China's demand shock, are reflected in the money spent on exploration. From 1997 to 2003, the total amount spent on iron ore exploration in Australia averaged around US\$21.03 million annually; from 2004 to 2012 the average annual exploration expenditure was US\$403.80 million (peaking at US\$1.19 billion in 2012) (Figure 2) (Australian Geological Survey Organisation 2000–2012).

<FIGURE 2 ABOUT HERE>

The scale of China's iron ore demand growth was unprecedented and was significantly underestimated by iron ore industry stakeholders. In 2003, the Western Australian Department of Treasury and Finance (WADTF) estimated that planned global expansion of iron ore production could add up to 268 mt/a by 2010, representing a potential 45.4 per cent expansion of global exports over the period. The WADTF's estimation of expansion was "roughly in line with the projected increase in [global] demand" (WADTF 2005, pp. 6–7). Figure 3 shows that the actual growth of global iron ore demand was much larger than predicted; by 2010, global exports had increased by 620.6 mt/a—more than double the potential capacity increase estimated by the WADTF seven years earlier.

<FIGURE 3 ABOUT HERE>

The annual benchmark negotiations created a further lag for the market adjustment as the price signal was only updated once a year. Crawford et al. (1978, p. 162) noted the benefits of a relatively fixed price in LTCs, "The determination of a relatively fixed real price over a five-to-seven year contract period will encourage careful assessment of long-term trends in commodity markets and step-by-step adjustment of real prices appropriately."

But imperfect market foresight by contract holders means that a fixed pricing system can delay the price signal required to trigger the development of supply in response to a demand shock. In 2003, the benchmark price of iron ore in the Asian market was US\$13.82/t. In 2004, the traded price of iron ore increased 18.6 per cent to US\$16.39/t due to the certainty of China's steel demand for the forthcoming Olympics in 2008 and Shanghai World Expo in 2009. But it was not until 2005—five years after the start of China's steel production boom—that the impact of China's demand was clearly signalled with a 71.5 per cent increase in the iron ore benchmark price to US\$28.11/t (Tex Report 2013, p. 9).

The benchmark price lag is illustrated in Figure 4, which shows the delay in the benchmark price as compared to the spot market increase. For example, in the lead-up to the 2008 benchmark settlement (May 2006–February 2008), the spot market price rose from US\$57.71/t to US\$157.32/t (62 per cent fines FOB, Asian market). Despite the significant spot market price rise, the 2008 benchmark price for Australian exporters to China was just US\$89.69/t (Kendall & Lampard 2008).

<FIGURE 4 ABOUT HERE>

The delayed price signal—caused by a glut of low-cost Brazilian iron ore and annual price updates (discussed above)—meant investment in low cost supply expansion was delayed. The investment phase of the boom occurs as incumbent iron ore producers (and potential investors) acknowledge that a price rise justifies a long-run supply adjustment, instead of merely reflecting normal price volatility.

The above analysis outlined the causes for the delay in the expansion of intra-marginal iron ore production, not the reason for the scale of the price boom. The cause of the price boom related to the scale of short-run supply expansion and low price elasticity of bulk freight and iron ore, which led to a significant increase in the cost of marginal production.

Bulk vessels take around two years to build—and China’s dependence on iron ore imports pushed the cost of bulk freight up as the market struggled to expand over the short run. From 2003 to 2008, the cost of shipping iron ore from Western Australia to China increased from US\$9.07/t to US\$23.62/t and from Brazil to China the price increased from US\$19.87/t to US\$61.23/t over the same period. The increased price of bulk freight increased the size of the Australia’s bilateral quasi-rents with China, compared to other relatively distant exporters such as Brazil. In April 2002, the dry bulk freight differential¹³ between Brazil to China and Australia to China was around US\$2.35/t; in July 2008 it peaked at US\$63.75/t (the cost of a ton of iron ore at that time was US\$120.08).

The inelasticity of seaborne freight put a premium on high cost domestic Chinese iron ore production. The large scale of China’s domestic iron ore response is reflected in the boom in the number of producers from 507 in 2000 to 1,511 in 2003 (two years before a price signal had been reflected in the benchmark price), by 2012 there were 3,256.

Most of China’s iron ore mines are small¹⁴, located away from major coastal steel demand, and have low iron content and high impurities. CISA reports the ferric content of China’s iron ore is low and falling. For large mines iron content fell from 31.2 per cent¹⁵ in 2003 to 22.7 per cent in 2012; for small and medium mines the iron content decreased from around 53.1 per cent in 2003 to 9.3 per cent in 2012 (UNCTAD 2014).

The diminishing purity of China’s iron ore reserves and high internal freight costs make Chinese iron ore producers, on average, the highest cost producers globally (Tang 2010, p. 9; MacDonald 2011; Mackenzie 2011). Over the 2011 to 2014 period, Chinese domestic iron ore cost on average US\$140.53/t, US\$20.28/t more than the average price of iron ore imports of the same quality, which averaged around US\$120.82/t.

This analysis suggests the price response to China’s iron ore demand shock reflects a competitive market adjustment to a large and unexpected positive demand shock. The delayed expansion of intra-marginal production was a result of the underestimation of the scale and pace of China’s demand shock along with a delayed price signal to trigger the investment phase of the market adjustment. The delayed expansion of intra-marginal production, along with the

¹³ The transport cost differential is the cost of freight from a relatively far exporter (Brazil) to an importer (China) minus the cost of freight from a relatively near exporter (Australia) to the same importer.

¹⁴ The average output per mine in China reduced from 0.25mt to 0.09mt over the 2003 to 2012 period.

¹⁵ Internationally traded ore usually has 62 per cent iron content.

seaborne freight price boom, supported the short-run expansion of marginal Chinese iron ore producers, which led to the dramatic lift in prices.

4. Predictions for the long-run market adjustment

The aim of this article is not to forecast supply and demand for the iron ore market but to understand the competitive nature of the market adjustment to China's demand shock. The following section discusses some of the emerging trends in what is the production phase of the market adjustment.

As seen above, the recent transition from the investment phase to the production phase of the market adjustment has seen high cost producers in China, and elsewhere, exit the market. BHP Billiton (2014, p. 34) estimates that between December 2013 and August 2014 around 50 mt/a of privately-owned Chinese iron ore production was idled while around 140 mt/a of state-owned and captive mines continued to operate at full capacity.

Intra-marginal supply has grown at a faster pace than China's demand, which has led to a large decrease in the landed price of iron ore from US\$179.63/t in January 2011 to \$68.80/t by December 2014. BHP Billiton President Iron Ore, Jimmy Wilson, announced in late 2014, "Unsurprisingly, high prices over the last decade created the incentives needed for new entrants to join the market and traditional producers to substantially increase supply. As a result, growth in seaborne supply is expected to exceed growth in demand over the short to medium term."

The large-scale entry of intra-marginal iron ore supply signals the market's transition into the production phase of the price cycle. The transition to the production phase over recent years has seen the investments of the Big 3 shift from exploration and project development to reducing operating costs in order to maintain a position within the margin over the long run. In 2014, Wilson noted: "In anticipation of this transition, we turned our focus from major supply chain investment to productivity, cost reduction and capital efficient growth more than two years ago" (BHP Billiton 2014). Recent examples of investments in reducing operating costs include Rio Tinto's US\$581 million investment in automated trains and Vale's estimated US\$3.5 billion investment for 35,400,000 deadweight ton Valemax seaborne freighters (Rio Tinto 2012; Els 2013).

Over the long run, China's demand for iron ore is predicted to slow as its economic growth moves toward consumption-led growth and the Chinese State Council attempts to reduce the country's steel production by 80 mt by 2017, around 10 per cent of steel production in 2014, with a long-run goal of around 600 mt/a by 2030 (Cai 2015).

Beijing's previous attempts to reduce excess capacity in the steel sector have not been successful due to local protectionism. Local officials often ignore Beijing's order to close down steel mills and demolish blast furnaces to protect jobs and tax revenue. In fact, some even expanded production when the central government was asking them to shut down excess capacity (Cai 2015; Drysdale

et al. 2013). For example, China's 2009 *Steel Industry Revitalisation Plan* reiterates the goal to contain production at a proper level through production control and elimination of obsolete capacity. The central government, according to the plan, aimed to reduce steel output to 460 mt in 2009, 8 per cent lower than 2008, and to gradually increase production to 500 mt in 2011. However, China's reported steel production in 2009 was over 567 mt, already 23 per cent over the planned 460 mt and already surpassing the production goal for 2011. The disconnect between the planned and real steel output raises the question about how realistic or believable these planned targets are (Tang 2010, p. 15). After CISA Secretary-General Shan was forced to retire he responded to a question about his regrets during his time as CISA boss, noting, "I do have some. Over the past few years, I wasn't able to better coordinate the Chinese steel industry and the iron ore price negotiations became disorganised. I had intended to encourage mergers, but the sector became more fragmented. I had planned to get rid of outdated mills, but in fact steel capacity increased" (Xiangyang 2011).

The difference between previous attempts to cut steel production and now is the growing public pressure in the wake of substantial environmental concerns. Cai (2015) outlines the newfound pressure on China's steel industry, "[Chinese steel makers] can no longer afford to ignore directives from the central government due to even stronger public pressure. Even an authoritarian government has to respond to people's concerns about health and safety issues. The ever-worsening pollution is reducing people's life expectancy by five years. The tough new emission standards as well as the cost of installing new pollution reduction technology is helping to shut down previously protected mills. One example is Jianyuan Steel and Iron Company, which was once the second largest tax contributor to Qianan County. Its production facility was shut down a year ago due to its inability to install new emission reduction technology that would cost 60 to 70 million yuan."

While the output of China's steel industry is expected to decrease over the long run, there also appears to be a transition in the production technology mix away from iron ore-intensive blast furnaces towards the use of scrap steel. BHP Billiton (2014, p. 30) predicts that the increased pool of scrap steel available will increase as China's manufacturing sector matures and sees a potential doubling of China's use of scrap steel by 2030 (from around 15 per cent of steel production in 2015). In 2015, BHP Billiton's chief executive, Andrew McKenzie, noted: "Longer term, the increased availability of scrap steel in China will impact pig iron demand and, therefore, demand for iron ore" (Stevens 2015).

The transition into the production phase and associated price decrease along with the likely decrease in iron ore demand for China over the medium to long run means that many new and planned development projects in west and central Africa (introduced above), and elsewhere, will enter the market at the margin.

It is difficult to estimate the new projects that will become unviable under the new iron ore price over the short run. An important factor in the short-run advancement of fringe projects will be the level of sunk capital and the capital

required to get iron ore to market—assuming the projects operating costs are intra-marginal. But several projects will suffer the same fate as Switzerland-based Glencore’s Askaf project in Mauritania, where management noted on shutting down the project that, “at current prices there is no prospect for profitable development.”

Over the long run, iron ore projects that are delayed due to the diminishing price will rely on emerging industrial countries such as Thailand and Vietnam closing the steel-intensity gap with high-income countries; and the rise of manufacturing sectors in economies such as India and Indonesia (BHP Billiton 2014, p. 31).

The glut of marginal projects, which are likely to be delayed or abandoned, will provide a buffer similar to that provided by Brazil following Japanese over-contracting in the 1980s. Any large unexpected demand shock is likely to be absorbed more quickly by undeveloped identified reserves that can enter the market over the short to medium term below US\$80/t¹⁶. Given the buffer of identified iron ore reserves; the change to a spot market pricing, which reduces the price signal lag; and the forecast iron ore demand decrease in China, it is highly unlikely we will ever see a price boom of the scale achieved during the current market adjustment.

5. Conclusion

This article sought to answer the question of whether the short-run price boom following China’s iron ore demand shock indicated a competitive supply adjustment or if it signalled a coordinated strategic approach by the Big 3 incumbent suppliers to the Asian market.

China’s iron ore demand shock from 2003 to 2012 was unprecedented in its fast pace and large scale—it dwarfed that of Japan’s during its post-WWII economic recovery and industrialisation. The surge in iron ore demand caused prices to skyrocket in the short run, as high cost marginal producers in China and elsewhere entered the market to fill the short-run supply gap.

While it is true that high cost fringe expansion dominated the supply response over the short run, as would be expected from a supply-withholding strategy, institutional barriers and coordination problems created large barriers to the Big 3 implementing a supply-withholding cartel. The analysis of the market outcomes following China’s demand shock found no evidence of a strategic supplier response.

Recent large-scale intra-marginal iron ore production developments have placed downward pressure on prices. The delay in bringing this supply to market reflects the long lags and uncertainty associated with developing large low cost iron ore projects rather than a supply-withholding strategy.

¹⁶ Assuming delivery to the Asian market.

There is no evidence that the Big 3 coordinated or exploited bargaining power during the benchmark price negotiations in order to have an ‘unfair’ price (a price higher than the marginal price) accepted by importers. The similar price outcomes in the Asian and European markets indicated that the Asian benchmark negotiations resulted in competitive pricing outcomes following China’s demand shock.

The similarity between the settled prices in the Asian and European markets is another indication that the iron ore market is a constrained, not pure, bilateral monopoly. The demand boom in the Asian market was reflected as a global price boom—that is, the demand boom caused by China’s rise was shared by the European market as Brazilian supply was redirected to Asia. The integration of the global market is important when considering the long-run contestability of the market.

The short-run supply gap was caused by natural production expansion constraints on a competitive response to China’s iron ore demand shock. The delayed supply expansion of intra-marginal production was not strategic but reflected the underestimation of the scale and pace of China’s demand shock along with the delayed price signal. The delayed expansion of intra-marginal production along with the seaborne freight price boom supported short-run expansion of marginal Chinese iron ore producers, which led to a price increase.

Over the long run it is likely China will reduce its dependence on iron ore as it relies more heavily on scrap steel production technology and as its steel industry output decreases in the face of growing environmental concerns. As the market adjustment moves into the production phase there are many uncertainties about the future for marginal producers and incomplete projects. Investment has shifted from bringing more iron ore to market to reducing operating costs and ensure producers remain within the margin over the long run.

The reduced iron ore price will have a negative impact on fringe projects, as many will become commercially unviable over the short run. The abandonment of projects will provide a short- and medium-term buffer of identified reserves for any future demand shocks. Given the buffer and China’s decreasing demand for iron ore, it is unlikely the price will ever exceed US\$80/t for a sustained period as was seen over the previous decade.

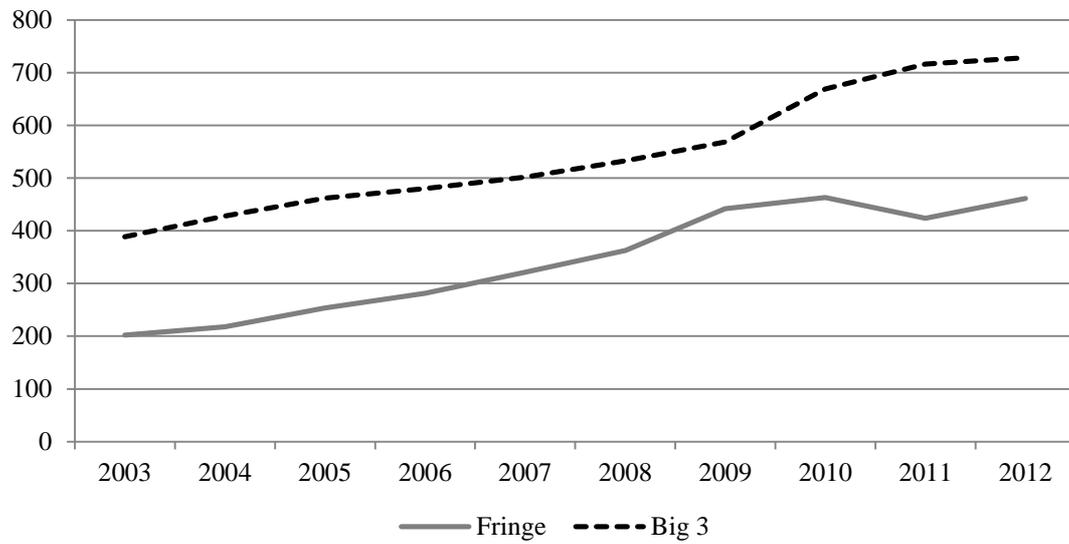
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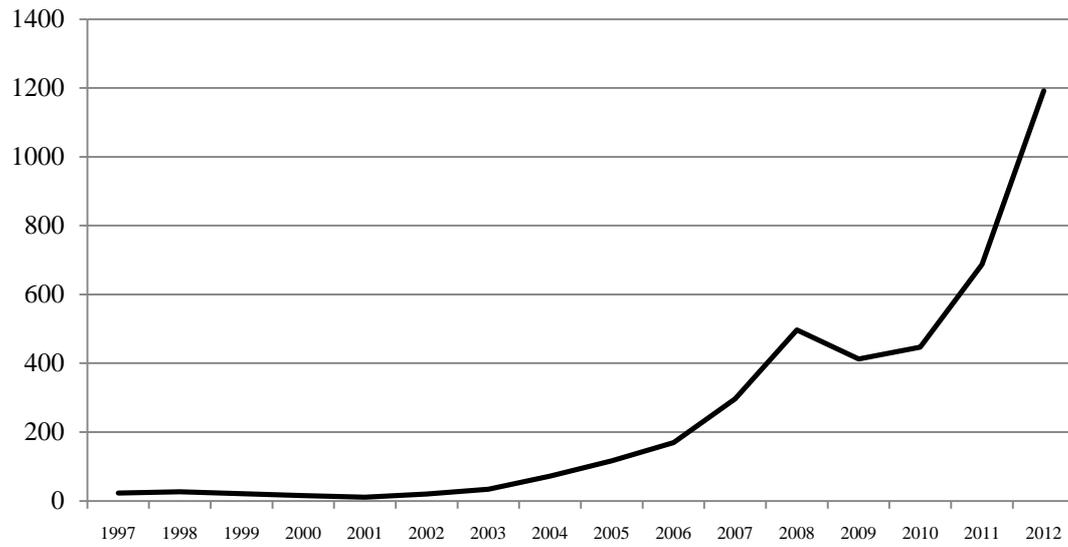
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Figure 1. Iron ore production expansion by Big 3 and fringe producers, 2003–2012 (mt)



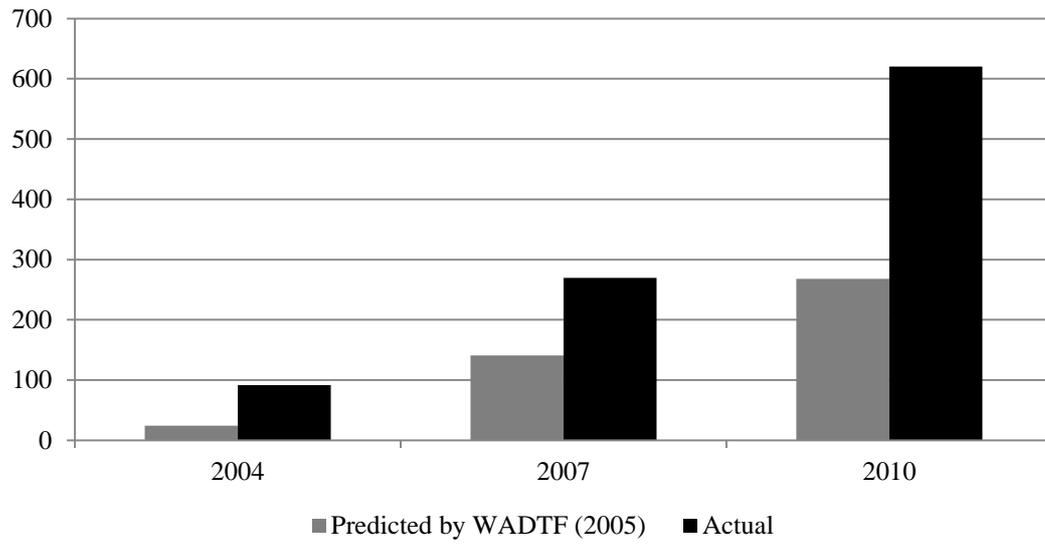
Sources: Ridsdale (2011); Statista (2014); Brazil Mineral & Mining Sector Investment and Business Guide (2012); company reports.

Figure 2. Australian iron ore exploration, 1997–2012 (US\$m)



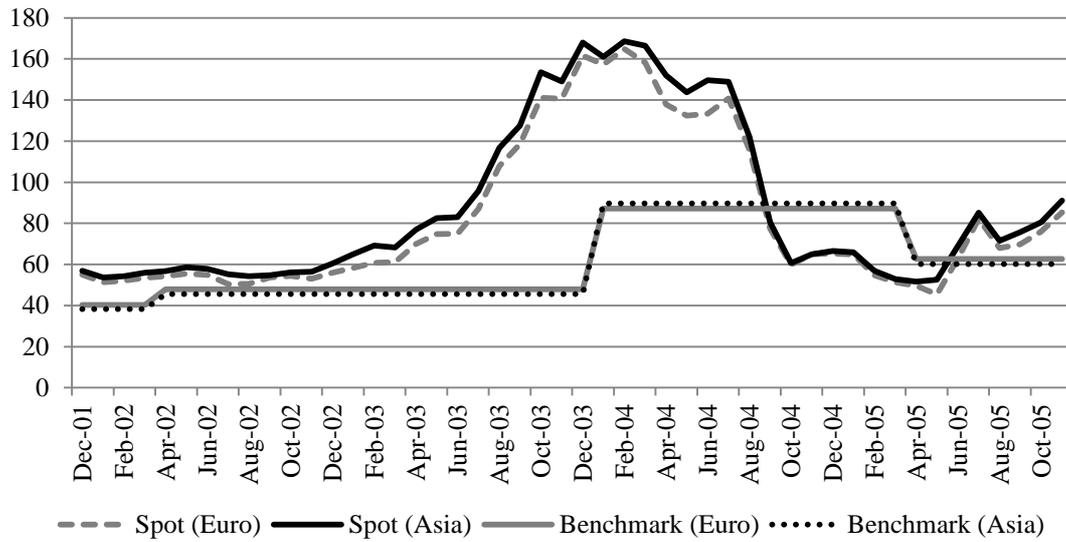
Sources: Australian Geological Survey Organisation, *Australia's Identified Mineral Resources* (2000–2012).

Figure 3. **Predicted and actual iron ore supply expansion, 2004, 2007 & 2010 (mt/a)**



Source: WADTF (2005); various national associations in the *Steel Statistical Yearbook* (2013).

Figure 4. Spot versus benchmark prices, 2006–2009 (US\$/t 62% FOB)



Source: World Bank Commodity Price Data (2013); UNCTAD (2013).

Table 1. Settlement dates and prices in the Asian and European iron ore markets, 2000–2009 (US\$/t 62% fines FOB)

Year	Asian settlement date	Setter	Asian Market	European settlement date	Setter	European Market
2001	26/03/2001	Hamersley Iron, BHP Billiton & CVRD	17.97	20/03/2001	CVRD - Italy	18.62
2002	31/05/2002	Hamersley Iron, BHP Billiton & CVRD	17.53	29/05/2002	CVRD - Germany	18.17
2003	21/05/2003	BHP Billiton & Hamersley	19.11	16/05/2003	CVRD - Arcelor	19.81
2004	14/01/2004	BHP Billiton & Hamersley	22.31	13/01/2004	CVRD - Arcelor	23.50
2005	21/02/2005	Hamersley Iron, BHP Billiton & CVRD	38.27	3/03/2005	CVRD - Arcelor	40.30
2006	17/05/2006	CVRD	45.54	15/05/2006	CVRD - TKS	47.96
2007	21/12/2007	CVRD	49.86	26/12/2007	CVRD - ILVA	52.51
		Vale – NSC/POSCO	82.27			
2008*	15/02/2008	Hamersley - Baosteel	89.69	18/02/2008	Vale - TKS	87.17
2009	26/05/2009	Hamersley - NSC	60.14	19/06/2009	Vale - ArcelorMittal	62.59

* In 2008, two benchmarks were negotiated in the Asian market.

Source: Tex Report (2012).