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CHINA'S GROWTH AND ITS IMPACT ON RESOURCE DEMAND AND THE IRON ORE TRADE

PETER DRYSDALE AND LUKE HURST

CRAWFORD SCHOOL OF PUBLIC POLICY, AUSTRALIAN NATIONAL UNIVERSITY

PETER.DRYSDALE@ANU.EDU.AU; LUKE.HURST@ANU.EDU.AU

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Abstract

The paper sets out what has been driving Chinese demand for resources and outlines the main features of the growth of Chinese resource consumption. It explains the impact of Chinese growth on the Australian economy and examines the future of Chinese resource demand. It reviews the potential to supply Chinese resource (and in particular, iron ore) demand and looks at some policy questions that confront China, as a major resource-procuring economy seeking resource security through foreign investment, and resource-supplying countries, such as Australia, in the context of the growth of Chinese demand. The paper argues that increased supply capacity in Africa and elsewhere in the world is likely to put downward pressure on iron ore (and potentially other resource) prices as new projects come on stream over the next five years.

JEL classifications: L72, O13, Q31, Q37

1 Introduction

The past three decades have seen the remarkable emergence of China's economy as the world's second largest in terms of real output and third largest in terms of international trade. This was achieved through opening China to the international market, comprehensive economic and social reform, and ongoing structural change. As part of that process, millions of people shifted from rural to urban employment. China's GDP has grown at the unprecedented rate of 10% a year for much of this period, and per capita incomes rose to US\$7,640 in 2010 in purchasing power parity (PPP) terms. Yet China still faces the challenge of developing the hinterland beyond its coastal regions.

China began its period of modern economic growth as a significantly isolated and self-sufficient economy. The density of its population relative to underlying resource endowments meant that rapid industrialisation and growth would inevitably see a dramatic transformation of China's trade structure from one in which raw materials were prominent exports to one in which energy and resources have come to dominate imports.

China has now emerged as a major player in overseas resource investment and development. India, too, is a growing player in international resource markets.

The international resource industry was dominated in its early days by North American and European investment, often through vertically integrated operations that incorporated the supply of metal products to industrial country markets. That pattern of development changed remarkably around 40 years ago, when Japan emerged as a major consumer of imported minerals and energy (Drysdale 1970). At the time, Japanese end-users had little capacity to invest in the huge overseas projects needed to procure the resources to fuel Japan's rapid industrialisation (Crawford et al. 1978). This was the era in which the emergence of the huge independent suppliers of resources to Japan—and eventually to the rest of East Asia—laid the foundations for the strength and competitiveness of the Australian minerals industry and Australia's leading minerals companies. They became leading suppliers of a whole range of products to the international market, including iron ore, coal, bauxite, alumina, aluminium, copper, nickel, natural gas and uranium (Drysdale 1988, Drysdale and Findlay 2009).

China and India offer opportunity on a scale that already dwarfs established markets in Japan and the rest of Asia for the expansion of resource supplies from resource rich regions such as Australia and Africa, and have already triggered rapid growth in the Australian and African resource industries. As in the past, reaching full potential requires investment from Australian and foreign firms that are already significant players in the international resource business. Perhaps most importantly, it will encourage and require a large injection of additional capital from new investors, both foreign and domestic.

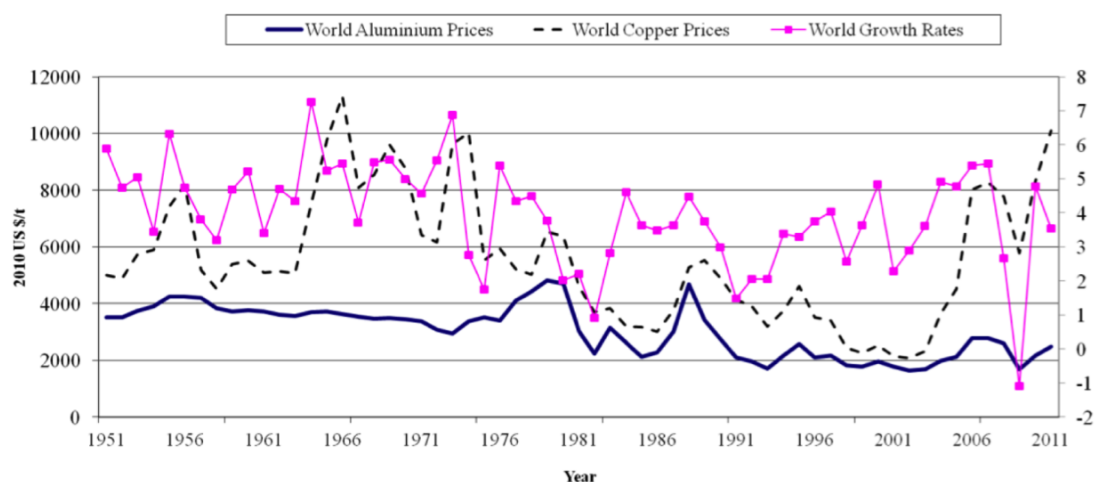
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particular, iron ore) demand and discusses some policy questions that confront China, as a major resource-procuring economy seeking to secure resources supplied through foreign investment abroad, and resource-supplying countries, such as Australia, in the context of the growth of Chinese demand.

2 China's resource consumption

China's impact on global resource demand was initially modest, but that has changed dramatically in the past decade. It is now a large economy, and the inexorable growth in its demand for resources has brought unprecedented tightness to global commodity markets. Markets were taken by surprise with the sudden increase in Chinese demand from the early 2000s. Prices of iron ore rose nearly tenfold and prices of metallurgical coal around fourfold between China's accession to the World Trade Organization (WTO) in 2001, which accelerated its entry to global markets, and early 2011 (see Figures 1 and 2).

Figure 1 Aluminium and copper prices (real), 1951 to June 2011

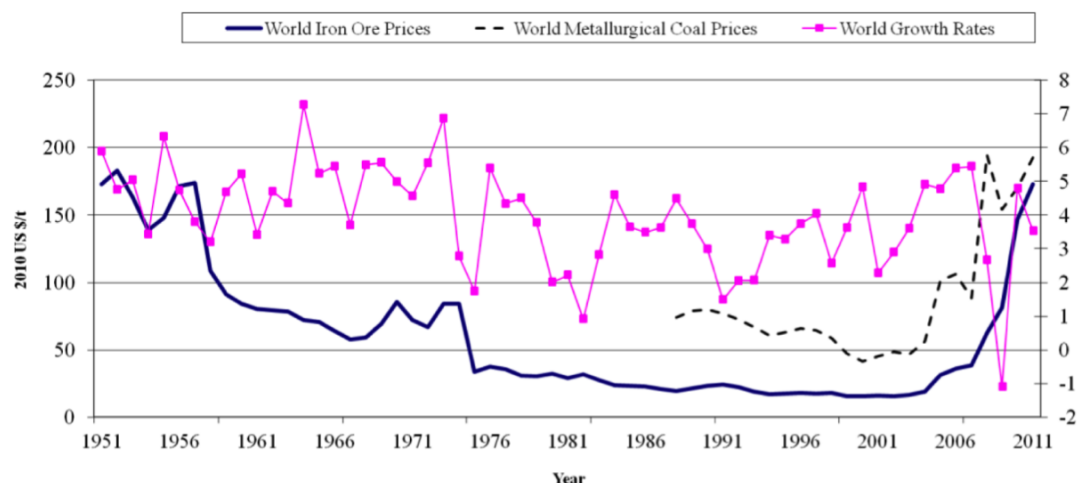


Source: Garnaut (2011).

What caused the exceptional energy and metal demand growth in China in the early 21st century? Strong economic growth is the start of the answer—but Chinese demand for energy and metal imports also grew much faster than economic output.

China accounted for over a fifth of the increase in global demand for petroleum, steel and copper, and for around half of the increase for aluminium and nickel, in the late 1990s, straddling the Asian financial crisis. For the first five years of the 21st century the Chinese share of global consumption growth rose for all energy and metals commodities, to over half for copper, nickel and aluminium. Between 2005 and 2010, China accounted for over 80% of the increase in global demand for nearly all energy and metal products. Outside China, demand for nickel, copper and aluminium fell, but Chinese demand caused the growth of global demand to be strong enough to lift prices close to their highest levels (Garnaut 2011).

Figure 2 Iron ore and metallurgical coal prices (real), 1951 to June 2011



Source: Garnaut (2011).

After the global financial crisis of 2008, high resources prices were driven overwhelmingly by Chinese demand: in the absence of the prodigious growth in Chinese demand for most energy and metallic mineral commodities, reasonable growth in the developing world beyond China would have merely offset the weakness in growth in developed countries, and prices would have languished below trend (Garnaut 2011).

China's per capita use of aluminium and copper has moved on a similarly upward trajectory. Aluminium use is, and has been, much higher in China than in other developing economies at similar levels of income. It is already on par with aluminium use in the US, and nearly as high as use in Japan. Other rapidly developing Northeast Asian economies reached peak levels of per capita use of copper that were more than five times (Korea) and three times (Taiwan) current Chinese rates, but at income levels around three times Chinese levels (Garnaut 2011).

China's natural endowment of coal is richer than that of iron ore. As a consequence, old, autarchic approaches to the use of domestic raw materials were less distorting and had less impact on industrial efficiency than they did in the case of iron ore—the economic pressures for unwinding these approaches were less powerful. Nevertheless, Chinese imports of substantial quantities of metallurgical coal for the first time in the first decade of the 21st century also put upward pressure on world coal prices (Garnaut 2011).

The exceptional resource intensity of Chinese growth had several causes. Two related causes were central: rapid urbanisation; and a high and a rising investment share of expenditure (higher than in any other economy of substantial size, ever).

In order to satisfy the needs of its emerging middle class and continuing urbanisation, China produced 630 million tonnes (mt) of steel domestically in 2010. Around 86% of that production used oxygen furnace technology, and the remainder used electric arc furnaces, which employ scrap steel instead of iron ore as the primary production input. Scrap steel is not yet a significant substitute for iron ore, the major input to oxygen furnace technology, and is unlikely to become one over the medium term (Song et al., forthcoming).

Despite the fact that China possesses the largest quantity of iron ore reserves globally (its production in 2010 was 900 mt), the average grade of Chinese iron ore is very low, at around 30% ferric content. China's domestic reserves are largely in the country's north and west, making transportation to its steel mills, which are mainly in industrialised coastal provinces of the south, very costly. At an estimated US\$120/t and even higher at the margin, the production costs for Chinese iron ore producers are the highest globally; imports have thus become a more reliable and cost-effective solution for inputs into China's steel industry (MacDonald 2011, Mackenzie 2011).

Assuming China continues on its expected growth path, its dependence on iron ore imports will increase as domestic producers struggle to raise their output in the face of rising domestic cost pressures through inflation, exchange rate appreciation and decreasing international freight rates (UNCTAD 2011).

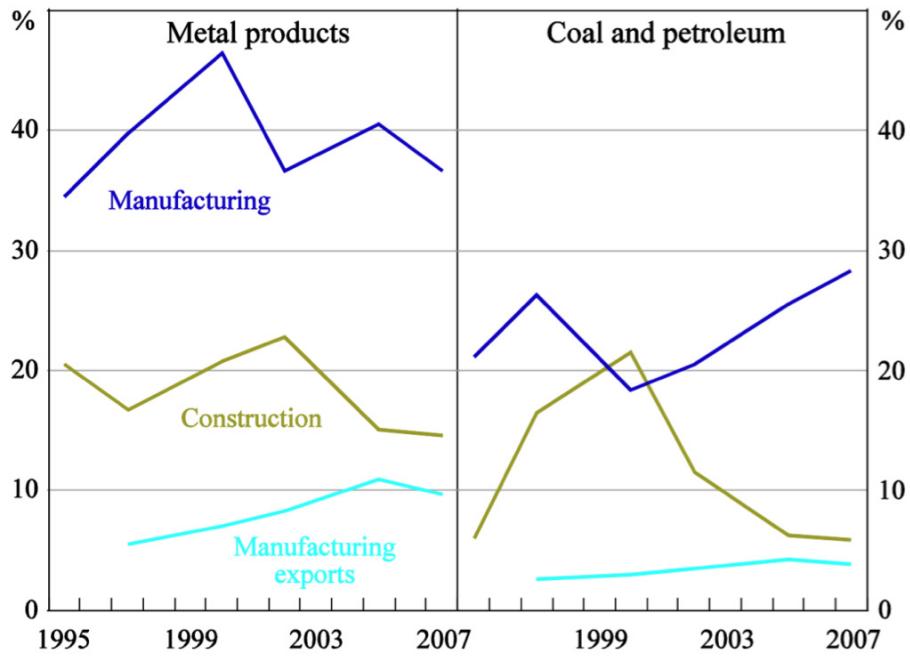
Although the question of what drives Chinese resource demand is related to the question of what drives Chinese growth overall, it is helpful to look at how the resource commodities that China imports are actually used in industry to shed light on the direct sources of its resource demand. Data from various sources suggests that Chinese steel production in the 2000s was used in the construction (50%–60%), machinery (12%–18%), automobile (5%–6%) and home appliance (2%) industries, with at least a quarter of domestic consumption broadly being used by the 'manufacturing' sector (Roberts and Rush 2011).

Iron ore, aluminium ores, base metal ores and coal account for more than half of China's non-oil resource imports. Chinese consumption of imported iron ore and coking coal is driven by steel production (Roberts and Rush 2011). The country's steel industry has traditionally been weighted towards producing 'long' products and low-grade 'flat' products, both of which have important uses in residential and non-residential construction. But in addition to being used in construction, flat steel products—which account for a rising share of production—are used extensively in manufacturing, especially in appliances such as air conditioners and refrigerators, and in steel casing for vehicles. China's automotive manufacturing sector is now the largest in the world; it accounted (in gross output terms) for about 7% of Chinese GDP in 2009—a share that has almost doubled in the past 12 years (Roberts and Rush 2011).

Unlike iron ore demand, the bulk of aluminium ore (bauxite and alumina) demand is driven by the machinery, electronics and transport (particularly automobile) sectors, which together have accounted for around half of total consumption (Hunt 2004).

The chief industrial uses of copper are electrical and electronic products, engineering, construction and automobiles (Tse 2009). According to World Bank figures, 44% of China's copper demand was used in construction and infrastructure (compared to a global average of around 33%). Zinc and lead have important uses in manufacturing, especially in the automotive industry (Roberts and Rush 2011). It's not surprising that manufacturing accounts for a greater share of Chinese resource use than construction: manufacturing accounts for about 40% of China's GDP, while construction accounts for only 6% (see Figure 3) (Roberts and Rush 2011).

Figure 3 Metal products, coal and petroleum—direct use by industry
Share of domestic supply



Source: National Bureau of Statistics of China; Reserve Bank of Australia.

3 China's impact on the Australian resource trade

In 1999, China accounted for less than 5% of Australia's total resource exports, whereas Japan accounted for 23%. In the decade since then, the growth of Australia's resource trade has been entirely focused on China. In 2010–11, minerals accounted for 30.1% (A\$74.1 billion) of Australia's total merchandise exports. In that year, China was Australia's top minerals export market at A\$44.9 billion, ahead of Japan (A\$12.3 billion), Korea (A\$8.2 billion) and India (A\$1.6 billion) (DFAT 2011).

Australia is currently experiencing a resources boom of historic dimensions thanks to a wealth of high-grade resources and relative geographical proximity to China. The strong complementarity between the Australian and Chinese economies and sustained and rapid resource-intensive growth in China has been an important element in Australia's strong economic growth, which continued despite the global financial crisis.

At the same time as contributing to higher minerals and energy prices, China's industrialisation has increased the supply of manufactured goods, the prices of which have remained lower than they otherwise would have. These shifts to higher resource prices and flat or even lower manufactured product prices have been especially beneficial to Australia, given its endowment of the factors of production and its patterns of trade (Findlay 2011).

Figure 4 Australia's terms of trade, 1961 to 2012



Source: Australian Bureau of Statistics (ABS), *Australian National Accounts: national income, expenditure and product*, cat. no. 5206.0, and Treasury.

Australia's terms of trade have not been this high for more than a century (Figure 4). The price of iron ore has increased at an average annual rate of 23% since 2005, and the price of coal at an average of 8% (in Australian dollars). Australia's terms of trade are 65% above the average 20th century level and 85% above the trend of the 20th century, had that continued. As a result, Australian GDP in nominal terms is about 13% higher than it would have been without these relative price changes

(Findlay 2011).

As Garnaut (2011) points out, Australia's exports have diversified away from commodities, which were the lead exports for most of the country's history, so the relative price of commodities had to rise higher than in earlier times to take the overall terms of trade above peak levels reached in the late 19th and most of the 20th centuries. Global demand growth for resources as well as food is reflected in the change in the composition and direction of Australian trade. Resources currently make up 57% of exports, compared with 41% in 2005 (Christie et al. 2011). This growth reflects both price and volume changes in response to Chinese demand (Findlay 2011).

The high rates of corporate investment in the resources sector have been a major factor in the strong economic growth performance of Australia relative to other developed countries in the aftermath of recent financial crises.

Since 2005, the volume of Australian exports of iron ore has grown at an annual rate of 10% (5% for coal). The major structural changes in trade have been the surge in iron ore exports to China (a fivefold increase in volume since 2005, to more than 250 mt), and the growth in coking-coal exports to China, to between 20 mt and 30 mt (Findlay 2011). Lifting these trade volumes has required a huge expansion of investment and capacity in the resource sector.

After several years in which investment in expanding production capacity lagged behind the rise in prices, since 2005 the rates of growth of investment in the resources sector have been rising strongly. Since the global financial crisis, resources have been overwhelmingly the main contributor to exceptional growth in Australian business investment in general. Minerals and energy production and investment together are now larger relative to other sectors in the Australian economy than at any time since Federation.

Iron ore and metallurgical coal have contributed most to the boom in the Australian terms of trade, which began in 2003 and continues today. Both are inputs into the steel industry, and the demand for them derives from demand from Chinese steelmakers. Long-distance trade in metallurgical coal was relatively unimportant until the late 1960s and 1970s, when Japanese steelmaking began to make use of large-scale supply from Australia.

4 The future of China's resource demand

Rapid industrialisation in China has gone hand-in-hand with a rapid rate of urbanisation. The country has now entered what Song (2010) calls the mid-phase of industrialisation, which is more energy- and minerals-intensive than the more labour-intensive early phase. This is what drove the 'sudden surge in China's demand [for] energy and resources after 2002', and led to the dramatic lift in prices around the very low short-run elasticities of supply for minerals and resources.

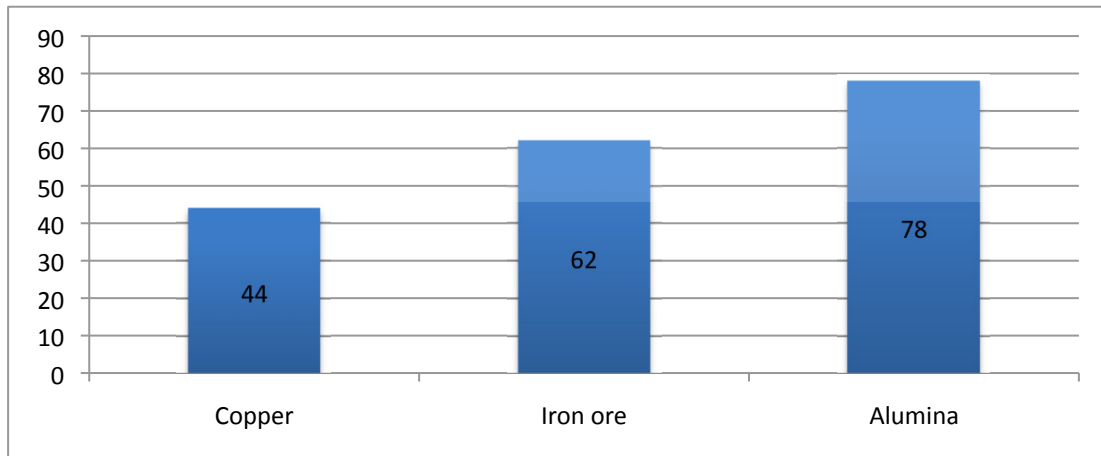
While well-endowed with resources in absolute terms, China's per capita endowment is poor, which has led to its rising demand being reflected in increasing purchases from abroad. China became a net importer of oil for the first time only in 2003 and of coal in 2009; its dependency ratios (net imports divided by total consumption) were 43.8% for copper, 62.1% for iron ore and 78.0% for alumina (Figure 5).

Although there is anecdotal evidence that China has already reached the turning point in its resource consumption, one benchmark that can be adopted is the projection of demand by McKay et al. (2010). Assuming 7% compound GDP growth and referring to work on the Kuznets curve for steel, McKay et al. conclude that China will not reach peak steel consumption per capita until 2024, and possibly after that if it follows a trajectory in the growth of steel demand similar to that of Japan. At present, China's steel output is 600 mt, and it's expected that it will reach or surpass 1 billion tonnes (bt) by 2024, which indicates continuing strong growth in demand for steel and for other minerals and energy (Findlay 2011).

Garnaut (2011), on the other hand, argues that energy use will continue to increase despite climate change considerations, but that its rate of growth will diminish, as will the emissions intensity of energy production. This will have a negative influence on the intensity of China's demand for metals. Garnaut states that 'resource intensity of production will decline rather more rapidly than seems to be the common expectation, and more rapidly still as growth and the investment share of output fall from about 2015' (Garnaut 2011: 20).

Questions are now being raised about whether China's rapid economic growth over the past three decades can be sustained over the next three. The economy faces important structural problems and is challenged to rein in savings and investment to lift consumption and to cut back its external surpluses (Garnaut and Song, forthcoming).

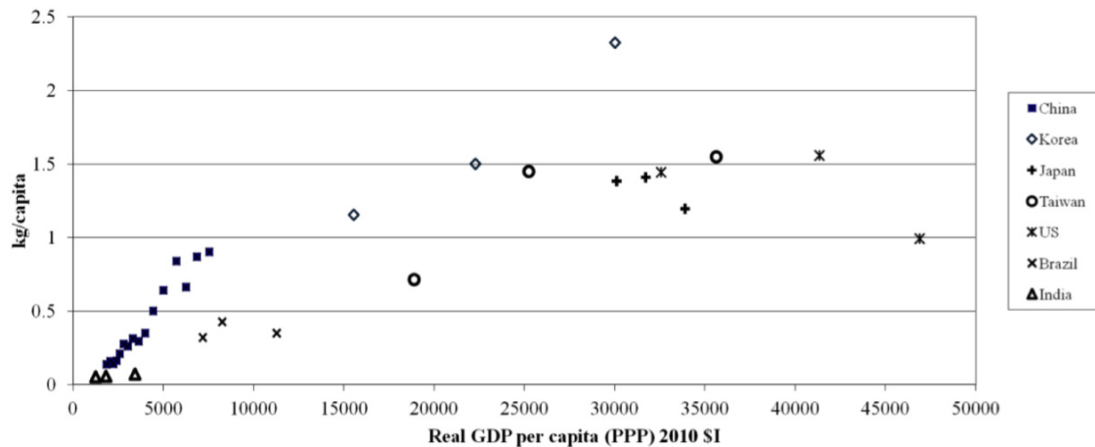
Figure 5 Foreign dependency rate of selected resources in China, 2010 (%)



Note: The foreign dependency rate is the ratio of net imports to total consumption.
 Source: Tse (2012).

China's structural problems have worsened since the global financial crisis as a result of aggressive fiscal and monetary expansion to support economic growth in the context of the global downturn. Asset bubbles and excess capacity have become more serious and widespread, and have prompted many predictions of a hard landing (Huang et al. 2011).

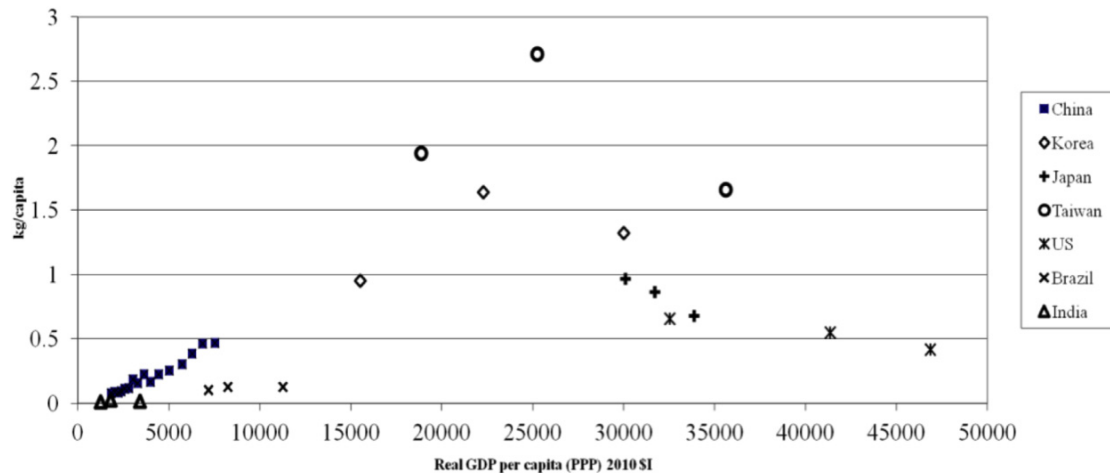
Figure 6 Aluminium use and GDP per capita, 1995 to 2010



Source: Garnaut (2011).

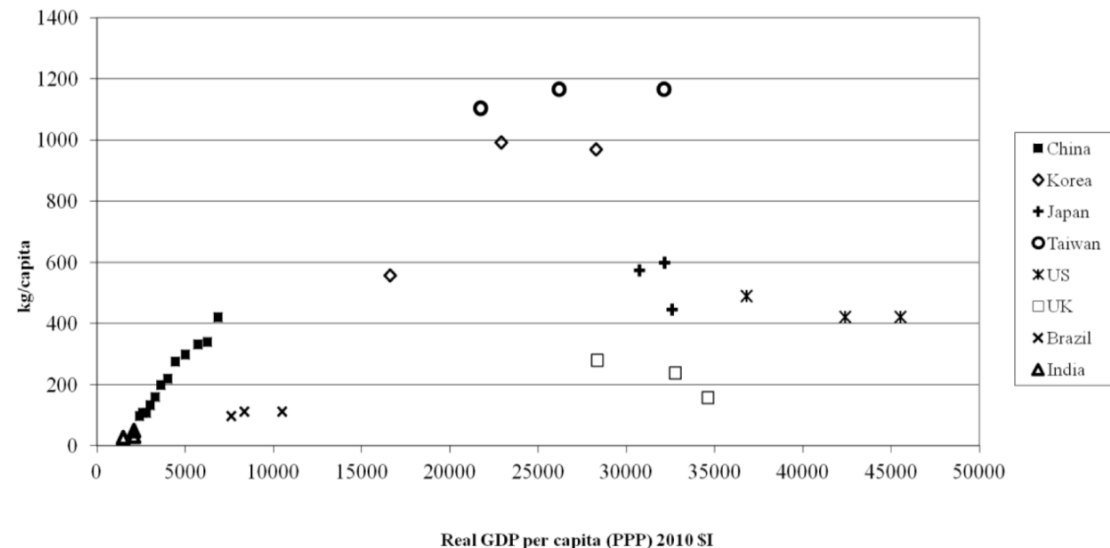
If China fails to transform its development pattern over the next five years, there are risks of a major crisis that would sharply check growth. In the past, the government has stretched the financial and fiscal systems to contain near-term downside risks, but there is a limit to how much longer that approach can be employed (Huang et al. 2011).

Figure 7 Copper use and GDP per capita, 1995 to 2010



Source: Garnaut (2011).

Figure 8 Steel use and GDP per capita (1998–2009)



Source: Garnaut (2011).

A worsening global recession would intensify concerns about a hard landing for the Chinese economy because of the country’s high dependency on trade (almost a fifth of its exports go to Europe) and limited policy flexibility. However, Barclays Capital estimates Chinese economic growth at 9.1% in 2011 and forecasts that it will run at 8.4% in 2012 (see Table 1), arguing that even a steep decline in growth from 9% to 5% would not cause a meltdown.

These optimistic predictions of China’s economic outlook are based on its strong balance sheet, backed by foreign exchange reserves of US\$2.8 trillion, a current account surplus of around 5% of GDP and a strong currency—all factors that give the government enough room to stretch policy and prevent a systemic economic meltdown (Huang 2012).

More important to international resource markets than the immediate outlook for Chinese growth is the likely trajectory of growth in the medium to longer term and the relationship of growth to resource use. Medium to longer term assessment of the pace

and structure of growth also requires taking into account environmental and related constraints that will increasingly affect the pattern of growth.

Table 1 China's economic growth, by five-year plan, 1991 to 2015

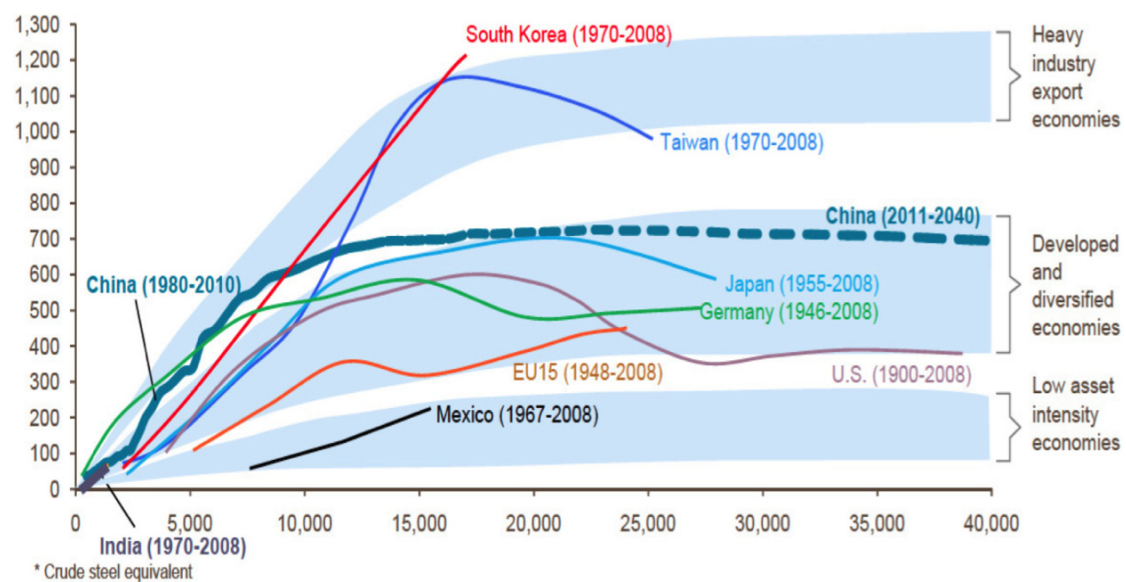
Five-Year Plan	8th (1991–95)	9th (1996–00)	10th (2001–05)	11th (2006–10)	12th (2011–15)
Target (%)	6.0	8.0	7.0	7.5	7.0
Actual (%)	12.3	8.6	9.8	11.2	8.4 ^a

a Forecast.

Source: Huang et al. (2011).

Historical patterns suggest that consumption of metals typically grows with income until income reaches about US\$15,000–20,000 per capita (PPP, adjusted dollars); such growth corresponds to periods of industrialisation and infrastructure building. At higher incomes, growth typically becomes more services-driven and, therefore, the use of metals per capita starts to level off (see Figures 6, 7, 8 and 9) (IMF 2006).

Figure 9 Steel consumption (consumption, kg per capita vs real GDP, \$ per capita)



Source: Ridsdale (2011).

China's current level of per capita income puts it at the mid-phase of industrialisation, a period characterised by a relatively high proportion of manufacturing in the total economy and a relatively high share of heavy industries in total industrial output. This phase of industrialisation is characterised by a pattern of extensive growth in which factor inputs—especially physical capital—play a central role. This is evident, for example, in the sharp acceleration of China's steel consumption. As China enters a period in which the increase in the export share of output is decelerating, Garnaut (2011) aligns its metal intensity growth with Japan's historical rise rather than with the export-oriented economies of Korea and Taiwan (Figure 9).

In 2010, China's middle class numbered around 157 million people—only the US had a larger middle class (Kharas and Gertz 2010). Kharas (2011) forecasts China's middle class to include 1.1 billion people by 2030. The emergence of a middle class

of this magnitude suggests that the country is far from reaching a saturation point for durable goods; for example, China's automobile penetration ratio is a mere 5% of the US level (McKay et al. 2010).

The International Monetary Fund (IMF) estimates that vehicle ownership starts to grow quickly when countries reach incomes of about US\$2,500 per capita in PPP terms (IMF 2005). Rapid growth continues until income per capita reaches about US\$10,000. Saturation level is at about 850 vehicles per 1,000 people. China is projected to have nearly 20 times as many vehicles in 2030 as it had in 2002 (269 vehicles per 1000 people), which is comparable to levels of vehicle ownership in Japan and Western Europe in the early 1970s. If these predictions are accurate, in 2030 China will have more vehicles than any other country and 24% more vehicles than the US. This is a significant driver for steel demand.

The vehicles that will come onto the Chinese market in the decades ahead will be significantly different from vehicles produced in the past; they'll be built from new materials and use different fuels. According to the Indian Steel Alliance, an average of 850 kg of steel and 120 kg of aluminium are required to produce a car (Dargay et al. 2007). The average steel content is expected to fall to 445 kg by 2020.

Aluminium is ideal for use in transport, building and thermal applications. In 2010, China's aluminium consumption is estimated to have increased by 14% and reached 16.3 mt. It is forecast to increase by a further 18% in 2011, to 19.2 mt; this growth is generated by the continuing expansion of non-residential construction and domestic demand for aluminium-intensive manufactures, such as motor vehicles. China, which accounted for 41% of world consumption in 2010, will continue to be a major player in the aluminium market in the medium term (ABARES 2011).

Around half of global zinc consumption is used in galvanising steel, which helps prevent corrosion. Galvanised steel is primarily used in the construction and automobile industries, so demand for zinc is highly responsive to activity in those industries. China's refined zinc consumption is projected to increase by 6% a year to 7.6 mt in 2016. Consumption will be supported as electricity networks continue to expand. For example, galvanised steel will be used in high tension electrical towers under the national grid program, which will connect major grid points throughout the country to improve transmission capacity.

China's continuing urbanisation will also be a major driver of resource demand. Since the beginning of the reform period, the proportion of its total population living in urban areas has more than doubled, from 19% in 1978 to 47.5% in 2010, with a target of 51.5% by 2015 set out in the 12th Five-Year Plan. The continued flow of people from rural to urban areas will require substantial infrastructure to support the estimated 717 million people who'll live in Chinese cities by 2015.

The high rate of urbanisation that characterised the reform period will diminish now that around half of the Chinese population lives in towns and cities. Unlike most other countries, China shows no signs of a vast backlog of investment in transport and other urban infrastructure; rather, there are signs that anticipatory investment may reduce future investment demand. Decelerating urban growth and recent high rates of urban investment will have a negative impact on resource demand growth in the years ahead.

In the mature developed countries, per capita steel use was once much higher than it is today. China's per capita steel consumption is now much higher than the United Kingdom's, similar to the US', and rapidly catching up with Japan's. As with the other metals, however, China's situation looks less unusual when compared with that of Taiwan (which has levelled out at about two and a half times China's current per capita use) and Korea (which has levelled out at about three times).

China's urban concentration ratio (the proportion of its population living in megacities¹) was 20.4% in 2007: 4% lower than the world average, and 8% lower than its predicted share at current levels of Chinese economic development. It is predicted that 32% of the Chinese population will live in megacities by 2020, reaching 37% by 2030 (Wang 2011). Those urban concentration ratios, although significantly higher than the present level in China, are still below current levels in the US and Japan (43% and 48%, respectively).

The emerging megacities will largely develop from today's medium-sized cities, or even from small cities. Over time, new economic and population centres might emerge beyond the Yangtze River delta, Pearl River delta and Beijing–Tianjin–Hebei regions. The Chongqing–Chengdu and Wuhan–Changsha areas, which are still in the early stages of the steel intensity curve, might become two such population centres in decades to come.

Continuing urbanisation and the development of new megacities will be a driving force in the growth in China's demand for steel and copper, which are used in electricity infrastructure and housing construction. Demand for copper is also expected to be supported by growth in exports of copper-intensive goods, such as televisions and air conditioners. China accounted for around 40% of the world's copper consumption in 2010; consumption will continue to grow at a projected rate of 5% a year, and will reach 9.9 mt by 2016.

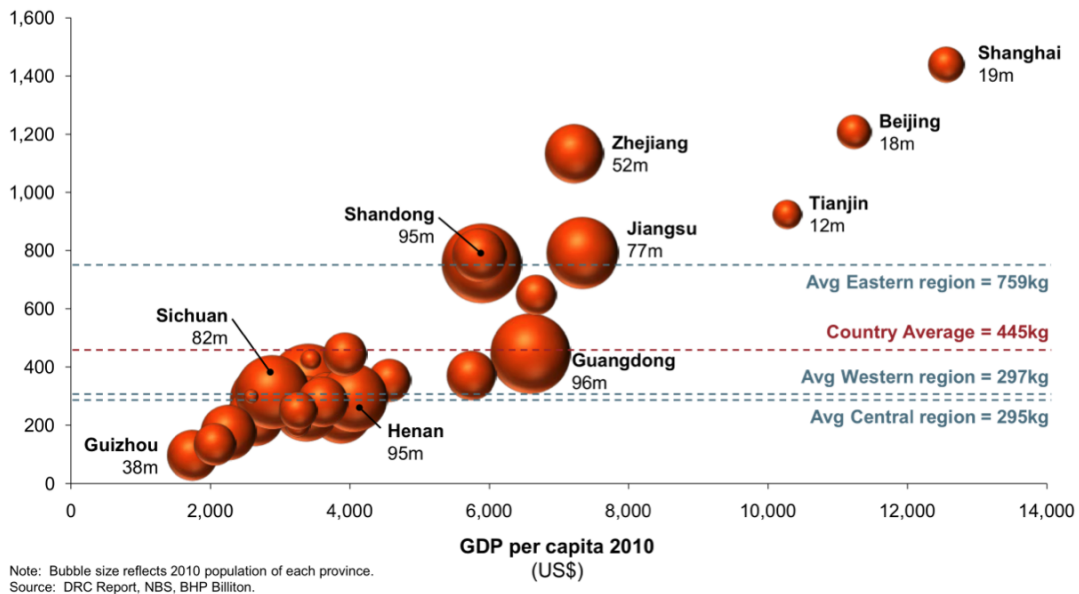
In the medium term, China's steel consumption is forecast to increase from 647 mt in 2011 to 995 mt in 2016, an increase that represents 4.7 times the total steel consumption of India in 2011 (Garnaut and Song, forthcoming). The increased steel demand will be largely driven by demand in a cluster of China's provinces with relatively low steel intensities but strongly positive growth. The central region has an average steel intensity of 295 kg compared to the country-wide average of 445 kg; the eastern region has an average of 759 kg (see Figure 10).

Despite the planned economic restructuring program and associated slowdown in steel demand, a recent 'stress test' presentation by Raw Materials Group for an 'almost worst case growth scenario' assumed China had become a 'normal' country, with 35% rather than the current 45% of GDP going to investment by 2015, domestic GDP growth slowing to 6% a year between 2011 and 2015, and the steel intensity of output remaining constant. Under those assumptions, Chinese iron ore demand would grow by 3.8% a year (Ocean Equities 2011).

¹ A megacity is a metropolitan area with a population of more than 10 million.

Figure 10 China's steel intensity, by province

Chinese steel intensity by province vs. GDP per capita
Finished steel consumption per capita 2010 (kg)



Metallurgical coal is the other major input in steelmaking. China is expected to increase its reliance on imports relative to domestically produced metallurgical coal. Import demand is expected to grow strongly over the medium term for several reasons, including the decreasing quality and increasing cost of domestic coal production, the increasing desire for higher quality coal for the production of higher value steel products, and the increasing number of steel mills in coastal regions close to ports. In addition, new steel mills built in western provinces will increasingly rely on metallurgical coal imported from Mongolia. While China's imports are projected to increase at an average rate of 9% a year to reach 73 mt in 2016, that growth trend is likely to fluctuate as a result of swings in domestic production.

In brief, Paul Braddick (in Yardney 2012) offers the following insights into the character of China's urban population, which will drive the country's resource demand in 2025:

- 350 million more people will move to the cities, adding to the 103 million who have moved since 1990.
- 221 Chinese cities will have more than a million people living in them, whereas the whole of Europe has 35 today.
- 1 million kilometres of new roads and 28,000 kilometres of metro rail will be laid between now and 2025.
- 170 mass-transit systems will be built—twice the number in all of Europe today.
- 1,600 million to 1,900 million square metres of floor space (around the land area of Indonesia) will be constructed each year, as part of five million buildings.
- China is home to half of the world's skyscrapers—defined as buildings over 240 metres tall—currently under construction. In the next decade and a half,

50,000 skyscrapers will be built; this is equivalent of building two Chicagos every year.

- 97 new airports will be built.
- By 2025, 1 in 7 planes assembled by Boeing and Airbus will be delivered to China.
- 1,000 MW of coal-fired power capacity will be commissioned every week, equivalent to 4 mt of new coal demand (although China's rapid move to clean energy could well nullify this prediction as Garnaut suggests).
- One wind farm turbine will be built every hour and a half.

5 China's potential resource supply: the case of iron ore

China's resource needs cover the whole range of minerals and energy resources. Major suppliers have traditionally been those with pre-existing mining capital infrastructure, including Australia (iron ore, coal, bauxite and alumina, copper, zinc); the US (copper); Peru (copper); Brazil (iron ore, bauxite); Chile (copper), India (iron ore, bauxite, copper); and Guinea (bauxite).

Table 2 Iron ore exports, 2010–17 (mt)

	2010	2011	2012	2013	2014	2015	2016	2017
Australia	402	439	493	525	588	678	749	779
Brazil	311	313	333	372	411	443	467	489
India	96	63	43	46	46	46	44	40
Canada	33	34	36	37	37	38	38	38
South Africa	48	54	58	64	67	71	75	79
West Africa ^a	11	12	14	15	17	23	35	47
World exports	1051	1075	1149	1213	1279	1355	1439	1500

a West Africa includes Guinea and Mauritania.

Source: BREE (2012).

The international iron ore market has been dominated by Australian and Brazilian supplies since Japanese demand played a central role in developing the two countries' iron ore regions from the 1960s to the 1980s. In 2011, Australia and Brazil accounted for around 69.6% of global exports (39.4% and 30.2%, respectively); China accounted for an estimated 59.0% (645 mt) of global imports in 2011 (Table 2).

The rapid increase in global iron ore demand has led the established iron ore producers to plan major production expansions, which will add an estimated 871 mt of new production capacity by 2018 (Table 3).

Table 3 Top four producers' capacity expansion plans, 2010 to 2018)

Company	2010 (mt)	2018 (mt)	% of total growth
Vale SA	322	533	26
Rio Tinto	242	454	27
BHP Billiton	137	271	17
Fortescue	41	255	27
Total	742	1513	97

Source: Ridsdale (2011).

Australia

Australian producers have developed significant expansion plans to capitalise on rising demand from China and diminishing Indian exports. Currently, around

US\$60.8 billion of investments are planned for new iron ore mines and to expand current capacity, with another US\$22 billion earmarked for infrastructure projects to support new capacity. These investments are scheduled to occur by 2018. The expansion plans are led by the three big Australian iron ore producers (BHP Billiton, Rio Tinto and Fortescue) as they attempt to push total annual seaborne iron ore trade from 402 mt/year in 2010 to over 1 bt/year by 2018.

The recent historically high prices and accompanying profit margins for iron ore have brought Australia's vast magnetite deposits into consideration in expansion plans (Game-Lopata 2012). Haematite (or 'direct shipping ore', because it can go straight into a steel furnace), has driven Australia's iron ore boom so far. Haematite has a different chemical make-up (Fe_2O_3) from magnetite (Fe_3O_4); magnetite contains less iron than haematite and is therefore of less value in its raw state. Before it can be used in steel production, magnetite needs to be processed (beneficiated), which requires capital-intensive processing infrastructure at or near the mine site.

Australia currently has around 60 magnetite mines in planning or operational phases with total magnetite resources estimated at around 24.1 bt (Table 4). A report published by Deloitte Access Economics last year estimated that the development of the magnetite industry could add \$4.5 billion to national GDP per year and create more than 4,000 jobs (Burrell 2011).

One of Australia's biggest challenges in unlocking its magnetite reserves is attracting investment into the industry, a large part of which will likely come from China. Just as Japan's development and engagement were critical to unlocking Australia's Pilbara haematite reserves in the 1960s, China is now positioned to partner magnetite projects. And with US\$2.8 trillion in foreign exchange reserves and a growing demand for iron ore, the times have never been riper (Siddique 2011, Huang 2012).

An example of China's importance to the development of Australia's magnetite is on display with the CITIC Pacific Magnetite Project, the first major magnetite mining and processing project in Australia. It's a significant step for the budding industry and is set to become the largest magnetite operation in the world; at full capacity, CITIC Pacific will mine around 140 mt a year. Another key to the development of Australia's magnetite industry is the troubled Oakajee port and rail project in Western Australia's mid-west region. The Western Australian Government has been pushing for Chinese companies to become equity partners in the project, which comprises a 45 mt per year deepwater port near Geraldton and a 570 km railway to handle 100 mt per year (Game-Lopata 2012).

Table 4 Australian magnetite potential

State	Planned mines	Total magnetite raw (mt)
WA	29	17,846.6
SA	25	6,048.8
Tas.	3	61.2
Qld	2	137.4
NT	1	3.7
Total	60	24,097.7

Source: Intierra database.

The success—or failure—of the CITIC Pacific and Oakajee projects will have a significant impact on the future of Australia’s magnetite production. Chinese investors are increasingly presented with development opportunities for less capital-intensive direct shipping quality haematite reserves in Africa’s central and western regions.

Brazil

Brazil is the second largest global iron ore exporter. Led by Vale, Brazil’s producers are investing heavily to take advantage of current Chinese demand and the high price of iron ore. The Bureau of Resource and Energy Economics (BREE) forecasts that iron ore exports from Brazil will reach 489 mt in 2017, up from 313 mt in 2011 but well under Australia’s 2017 forecast exports of 779 mt (BREE 2012).

Vale’s medium-term expansion plans include the addition of 211 mt of capacity by 2018. The company will invest US\$10.2 billion by 2014 to expand its Carajás Serra Sul iron ore mine. Carajás, in the northern state of Pará, is the site of the company’s largest single iron ore mine. Vale will also invest US\$2.5 billion by 2014 in the Apolo iron ore mine project in Minas Gerais.

Australian producers hold a cost advantage over their Brazilian counterparts due to their relative geographical proximity to China. In December 2011, Capesize shipping rates from Port Hedland/Dampier to Qingdao (3,458 nautical miles) were around US\$13.50/tonne, whereas Brazilian exporters faced transport costs of US\$30.50/tonne from Tubarão to Qingdao (11,023 nautical miles). Capesize ships from Australia take around 22 days and 12 hours less time to reach Qingdao.²

In an attempt to reduce the cost advantage of Australian producers, Vale has pursued an aggressive strategy to develop Valemax ships that can carry 380,000–400,000 tonnes of iron ore—more than twice the capacity of the current Capesize vessels. During the 10 months leading up to the financial crash of 2008, the Baltic Dry Index³

² Based on 13 knot shipping speed.

³ The Baltic Dry Index provides an assessment of the price of moving the major raw materials by sea. Taking in 23 shipping routes measured on a time charter basis, the index covers Handysize, Supramax, Panamax and Capesize dry bulk carriers carrying a range of commodities, including coal, iron ore and grain.

was consistently above 11,000 and ships were leased at extremely high fees. Regardless of the inflated ore prices, shipping costs exacerbate the distance problem for Vale.

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/tonne cheaper than using Capesize vessels, which corresponds to savings of around US\$1.6–2.0 million per shipment.

Vale's US\$8 billion shipping project is seen as a major strategic step in competing with Australian producers, but there have been problems with the project, including a cracked ballast tank, stiff opposition from the Chinese Shipowners Association and Vale cargoes being turned away from Chinese ports.

On 28 December 2011, the first Valemax ship, the *Berge Everest*, was allowed to dock in Dalian in north-east China. This might signal a changing attitude on the part of the Chinese port owners. The ship is owned and operated by a Singapore-based dry bulk shipowner (Berge Bulk) but chartered long-term to Vale (Wright et al. 2011). Vale is now setting up transshipping operations in the Philippines, which will see the Valemax's iron ore unloaded to smaller ships for delivery to China.

India

As Australian and Brazilian producers rush to meet rising demand from China, India is set to cut exports dramatically. In 2010, India was the world's third largest iron ore exporter, capturing around 9.1% or 96 mt of the global export market (BREE 2012).

In 2011, Indian authorities adopted policies to ensure that their rapidly emerging middle class and urban infrastructure needs would be supported by Indian steel production, served by India's own iron ore riches.

On 2 January 2012, the Indian Government announced a further increase of export tariffs to iron ore lumps and fines of up to 30%. Unless the Federation of Indian Mineral Industries is able to have the tax abrogated, exports for the first quarter of 2012 will be 75% lower than previously expected. The Bureau of Resource and Energy Economics (BREE 2011) forecasts a drop in exports from 63 mt in 2011 to 43 mt in 2012 (Mukherjee and Dutta 2012). The gap left by receding Indian exports will put upward pressure on international prices in the short term and further support the case for rapid expansion in Australia, Brazil and elsewhere (de Krester 2012).

India's National Steel Policy (revised in 2008) forecasts domestic steel production to reach 180 mt/year by 2019–20; current capacity is around 78 mt, and reported production is around 65.5 mt. To meet domestic steel production demand, India would need to increase its annual iron ore production from around 220 mt in 2009–10 to 500 mt over the next decade. If the increase isn't achieved, India will have to upgrade its port infrastructure to ensure that remaining demand for iron ore is met by imports (India Bureau of Mines 2011).

Africa

Africa's total iron ore reserves (measured plus inferred) contain an estimated 34.9bt of hematite⁴ and 17.3bt of magnetite⁵. In comparative terms Africa has similar reserves to Australia, with 37.0bt of reported hematite reserves and 10.4bt of magnetite, although reserve levels provide a limited insight into production potential.

The sustained demand for iron ore from China and diminishing grades of hematite in Australia and Brazil, along with the uncertainty surrounding India's iron ore exports have encouraged miners to pursue assets in operationally risky locations, largely in west and central African countries (Johnston & Reddy 2012).

Despite considerable investment risks, the African iron ore industry is going through a renaissance as low operating costs and vast, high grade discoveries of hematite have overshadowed countries' risk profiles.

The key driver for Africa's growth is not just China's booming resource import demand, but improved political and macroeconomic stability and microeconomic reforms. In the past decade the real GDP of iron ore-rich west and central African countries⁶ has enjoyed a healthy growth rate of 4.0 per cent – the global average for the period was 3.9 per cent (McKinsey & Company 2010).

The improved business environment has benefitted from government debt relief for the most highly indebted countries. Increased pledges of overseas development assistance from donor countries and philanthropic institutions are also providing fresh opportunities to free up resources for investment in human and fixed capital (Donnelly & Ford 2009).

This growth and other political and macroeconomic indicators suggest that Africa may be at a turning point as a global resource supplier. Guinea's Bellzone and China International Fund joint venture operating company Forécariah Guinea Mining is an example of how high risk operations in Africa's are becoming realistic investment opportunities. The project is set to begin exporting iron ore to China in the first quarter of 2012, on schedule (Esterhuizen 2012).

The draw of Africa's iron ore is its relative purity. As ferrous content decreases in Australia and Brazil, unearthed African deposits consistently offer DSO quality resources. But for decades the main obstacle to investing in African mining has been insufficient — often non-existent — infrastructure. Deals that might have looked good on paper were often unviable once the infrastructure costs were factored into the internal rate of return. This situation means that the initial marginal cost for west and central African iron ore will be massive when compared to the marginal costs of expanding production in Australia and Brazil where infrastructure is developed.

⁴ Estimate based on 66 reporting mines (Intierra database).

⁵ Estimate based on 16 reporting mines (Intierra database).

⁶ Average GDP growth across Cameroon, Republic of Congo, Guinea, Liberia, Senegal, Sierra Leone, Gabon.

To develop African resources Chinese operators have support from the US\$5 billion China-Africa Development Fund (CADFund). The CADFund’s stated aim is, “investing directly in Chinese enterprises which have set up operations in Africa or plan to invest in Africa, CADFund will push Chinese and African enterprises to reach their cooperation targets and facilitate infrastructure construction, as well as enhance the social and economic development of African countries.” The Fund provides equity and quasi-equity investment, fund investment and investment management and consulting services for projects in agriculture, manufacturing, infrastructure, natural resources and industrial parks.

In addition to infrastructure development support, China’s renewed investment push into global markets may hold the key for the development of west and central African iron ore. RBC Capital Markets (2011) reports that all-in capital costs to develop a sample of 32 iron ore mine sites across the African continent range between US\$52 billion and US\$54 billion. Current credit ratings for African iron ore countries, coupled with western banks’ unwillingness to invest in such projects, suggest that it is unrealistic to expect these resources will develop in the next 5 to 10 years.

Chinese ODI to Africa has increased 19-fold, from US\$491.2 million in 2003 to US\$9.3 billion in 2009 — Chinese ODI to Europe in 2009 totalled US\$8.7 billion (Hurst 2011) (see Table 5 for Chinese ODI to iron ore rich African countries). Moran et al. (forthcoming 2012) stated that “Chinese investors will be more willing to take on new frontier — or even fringe — projects that the major established oil and mining companies might pass by.” Moran (2010) noted that in 13 of 16 cases analysed, Chinese investors took an equity stake and/or wrote long-term procurement contracts with producers on the competitive fringe.

Table 5 Chinese ODI to Africa iron ore countries, 2003 to 2009 (US\$m)

	2003	2004	2005	2006	2007	2008	2009
Cameroon	5.73	6.98	7.87	16.46	18.51	20.34	25.05
Rep. of Congo	–	5.65	13.32	62.9	65.4	75.42	115.17
Guinea	14.34	25.77	44.22	54.63	69.97	96.37	129.32
Liberia	5.8	6.38	15.95	29.51	29.78	37.36	56.39
Mauritania	1.82	2.13	2.4	20.12	15.14	24.76	31.29
Nigeria	31.98	75.61	94.11	215.94	630.32	795.91	1025.95
Sierra Leone	5.74	18.45	14.89	32.28	43.7	47.47	51.23

Source: Chinese Ministry of Commerce, 2010.

To date, Chinese investors in African iron ore projects have been from large companies and investment funds across the scope of ownership structures. Current African iron ore investors include Wuhan Steel (state owned), CADFund, China International Fund Ltd. (privately owned), Shandong Iron and Steel Group (state owned) and Chinalco (publicly owned).

Looking to the future, China has the necessary capital and an incentive to put downward pressure on the price by assisting the development of African iron ore export capacity in a way that will significantly alter the supply structure. China’s

Ministry of Commerce (MOFCOM) announced in early 2012 that over the next five years it will encourage ODI to increase global stocks to US\$560 billion (an increase of US\$390 billion over the period). This push aims to make better use of China's estimated US\$2.8-3.5 trillion foreign exchange reserves at a time when exports markets are declining and FDI inflows slowing down as a result of the global economic crisis (Edwards 2012; Huang forthcoming 2012).

This future Chinese ODI is not all earmarked for African iron ore projects. But if 14 per cent of the \$390 billion ODI is directed to African iron ore projects over the next five years, it would meet the \$52-54 billion all-in capital costs reported by RBC Capital Markets to develop 32 mines across the continent.

It is essential for African governments to ensure a supportive business environment for these major capital-intensive projects. Chinese banks are able to take a longer-term view of projects in comparison to Western lenders but the Chinese authorities are cracking down on risky investments in the wake of significant and embarrassing losses. China's State Assets Supervision and Administration Commission published new rules in 2012 that hold SOEs and their executives accountable for bad overseas investment decisions (Cai 2012).

Low levels of knowledge capital have also been a considerable obstacle for the development of technology intensive infrastructure and mine sites. Again, China is a promising partner on this front. Unlike Australia, most of Africa's resource-rich countries allow Chinese operators to import a wider range of labour and management. Although this has created cases of significant tension and difficulties it is a key ingredient for Africa's iron ore development which had been previously lacking.

China's aim to secure iron ore supplies in Africa is supported by long-established state relationships, fostered through its triennial Forum of China-Africa Cooperation (FOCAC). The advantage of the strong state ties also provides some assurance and political insurance for Chinese investment in iron ore (SOEs accounted for 69 per cent of China's ODI stocks globally in 2008-09) (see Table 7 above). China's non-interventionist approach to international engagement also permits relationships with regimes where Western governments would be unwilling (Hurst 2010).

Already there are hundreds of iron ore projects under study or being developed in Africa, including some large scale ones, and African governments are pushing to increase their iron ore export capacity while the price is high. For example, the government of Gabon recently reached a deal with BHP Billiton to award them the Belinga iron ore concession after it decided China Machinery Engineering Corporation was not developing the resources fast enough. This kind of 'strike while the iron's hot' mentality by the Guinean government has pushed Rio Tinto to truck iron ore 650km to meet its first ore shipment deadline of mid-2013 from its Simandou mine in Guinea.

Hurst (forthcoming) constructed a risk index for each of the 27 production expansion phases of 17 mines across west and central African. A production expansion phase refers to the expansion of a mine's capacity which is brought online in a staggered fashion. For example, the Forecariah Iron Ore Deposit will come online in two phases

– phase one will have 4mt/a capacity by 2012, the second phase will expand production capacity to 10mt/a by 2013.

The risk index incorporated seven risk categories (host operational risk, host political risk, project infrastructure requirements, investor experience, investor-government relations, funding risks, and Chinese ownership and funding) to construct three risk based scenarios – high, medium and low-risk. Another way of looking at these risk scenarios is to think of low risk projects as having a high probability of coming on stream as designed and within the timeframe planned; medium and high risk expansion phases have a lower probability of meeting their outlined initial production dates, being more likely to be delayed. The likelihood of these higher risk projects coming online in the long-term is nonetheless real and they represent a significant longer term overhang in the market.

Based on the reporting of 17 mines (over 27 production expansion phases), west and central African iron ore production has the potential, in the high-risk scenario, to add 481mt/a to world iron ore export capacity by 2018 (see Figure 5 & Table 8 below). This figure is in-line with estimates by RBC Capital Markets (2011) that 475–575mt/a of iron ore export capacity will become available in Africa by 2016 (based on analysis of 32 mines), and by Ocean Equities (2011) that 300mt/a could be available by 2018 (based on 16 mines).

The low-risk scenario suggests that if all high and medium-risk projects are delayed beyond 2018, 31mt/a (in addition to the 425mt of already forecast global export supply expansion) will come online by 2018 — representing a global export supply overcapacity of 2 per cent. If all medium and low risk phases are achieved on time and high-risk phases delayed, 166mt/a export capacity could come online — representing 10.6 per cent export overcapacity by 2018. If all 27 analysed production expansion phases come online as outlined an extra 422mt/a could enter the global export market by 2018, representing export capacity that would be 27 per cent over currently forecast global demand, see Figure 11 & Table 6 below.

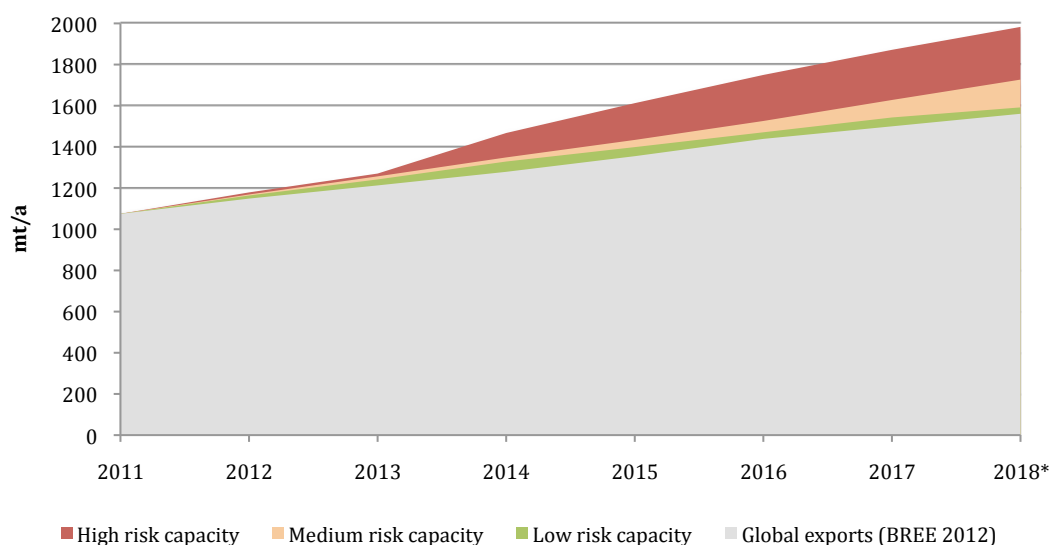
Table 6 Western and central African cumulative export capacity scenarios, 2011 to 2018 (mt/year)

	2011	2012	2013	2014	2015	2016	2017	2018
High risk capacity	1075	1179	1270.6	1467.6	1612.6	1749.6	1871.6	1983
Export overcapacity	0.0%	2.6%	4.8%	14.8%	19.0%	21.6%	24.8%	27.0%
Medium risk capacity	1075	1169	1257	1349	1434	1526	1628	1727
Export overcapacity	0.0%	1.7%	3.6%	5.5%	5.8%	6.1%	8.5%	10.6%
Low risk capacity	1075	1164	1242	1329	1399	1471	1543	1592
Export overcapacity	0.0%	1.3%	2.4%	3.9%	3.3%	2.2%	2.9%	2.0%
Global exports (BREE 2012)	1075	1149	1213	1279	1355	1439	1500	1561*

* BREE forecast export growth for 2010-2017 has been extrapolated linearly for 2018.

SOURCES: BREE (2012); Intierra database; RBC Capital Markets (2011); Ocean Equities (2011); company reports; author's calculations.

Figure 11 Potential global export capacity scenarios, 2011 to 2018 (mt/year)



* For 2018 import growth is assumed to be linear.

Source: Hurst (forthcoming).

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 little processing. African Free On Board⁷ (FOB) cost estimates range from as low as US\$20/t for the planned DSO material from Sundance’s Mbalam project up to US\$50/t for Sierra Leone’s Marampa mine⁸ (RBC Capital Markets 2011; Emery 2012). When shipping costs are included, west and central African iron ore will, on average, cost around A\$50-80/t.

In a business as usual scenario, BREE (2012) estimated that the contract price of iron ore will average around A\$140/t in 2012 and will drop to A\$109/t by 2017.

In the low risk scenario the addition of BREE’s forecast global expansion and African export capacity could decrease the price to A\$80/t Cost, Insurance and Freight⁹ (CIF) into China by 2018; the medium-risk scenario could see the price drop to around A\$65/t; and the high-risk scenario to around A\$60/t.

In the low-risk scenario, west and central African iron ore will push current marginal suppliers — mainly Chinese but also Indian and others — out of the market. If the high-risk scenario is realised some of the new higher cost African capacity will also be pushed out (see Figures 12 & 13 below).

⁷ FOB requires the seller to deliver goods on board a vessel designated by the buyer. The seller fulfils its obligations to deliver when the goods have passed over the ship's rail.

⁸ Note that many of the available estimates are still at the prefeasibility or feasibility stage, and so there exists some potential for cost increases once these operations are in production. Further, much of the pellet feed operating cost estimates for African projects do not include the cost of pelletizing.

⁹ CIF price includes insurance and all other charges up to the named destination port.

The iron ore pricing mechanism is moving away from quarterly and monthly contracts toward a spot market, so the decreases in price caused by the export overcapacity will occur in real time.

If the iron ore price dropped to A\$80/t, low-cost exporters such as Rio Tinto, BHP Billiton and Vale would still have a A\$35-45/t margin. If the high or medium-risk scenarios materialised, the low-cost producers' margins could drop to around A\$25-30/t (see Figure 13 below).

Table 7 Potential global export capacity scenarios, 2011 to 2018 (mt/year)

	2011	2012	2013	2014	2015	2016	2017	2018 ^a
High-risk capacity scenario	1075	1241	1360	1500	1591	1695	1855	1966
Export overcapacity (%)	0.0	8.0	12.1	17.3	17.4	17.8	23.7	25.9
Medium-risk capacity scenario	1075	1207	1301	1413	1489	1573	1680	1741
Export overcapacity (%)	0.0	5.0	7.3	10.5	9.9	9.3	12.0	11.5
Low-risk capacity scenario	1075	1178	1257	1346	1422	1506	1590	1651
Export overcapacity (%)	0.0	2.5	3.6	5.2	4.9	4.7	6.0	5.8
Global exports	1075	1149	1213	1279	1355	1439	1500	1561

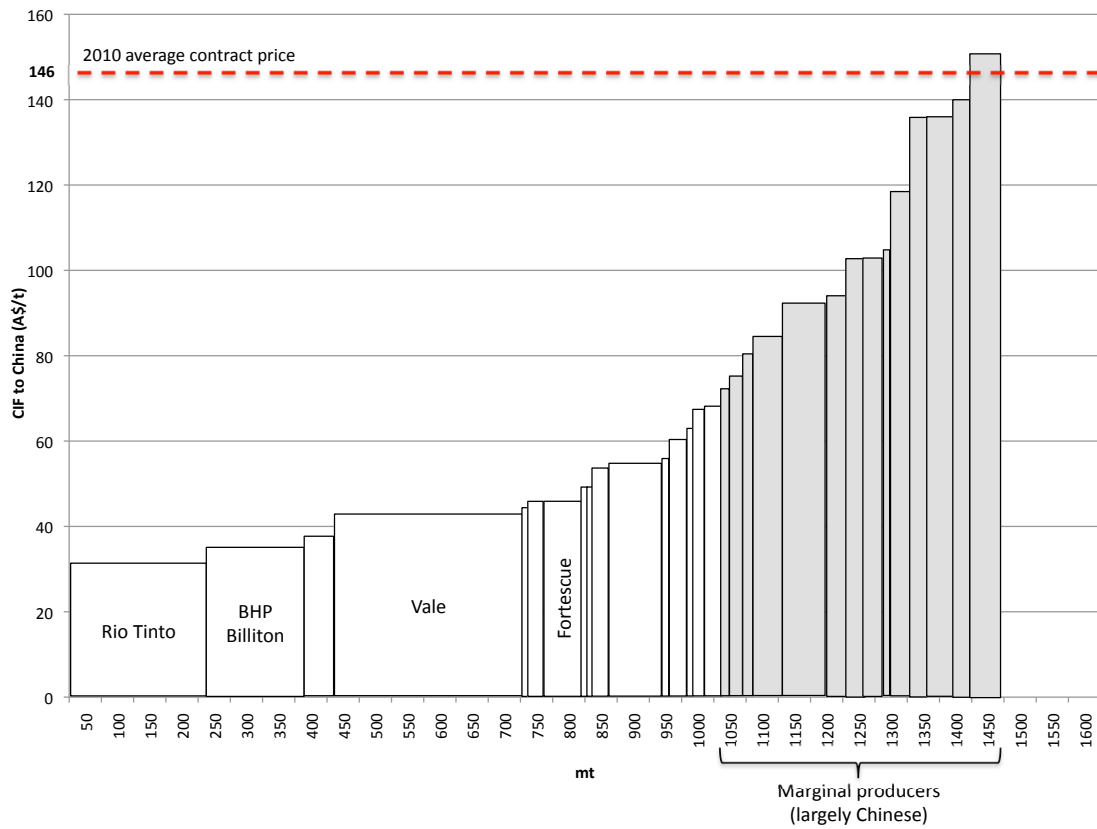
a For 2018, import growth is assumed to be linear.

Note: Rio Tinto's Simandou mine capacity is assumed to come online as 5 mt (2013), +5 mt (2014), +10 mt (2015), +15 mt (2016), +30 mt (2017), +30 mt (2018) in the medium risk scenario.

Sources: BREE (2012); Intierra database; RBC Capital Markets (2011); Ocean Equities (2011); company reports; Hurst (forthcoming 2012).

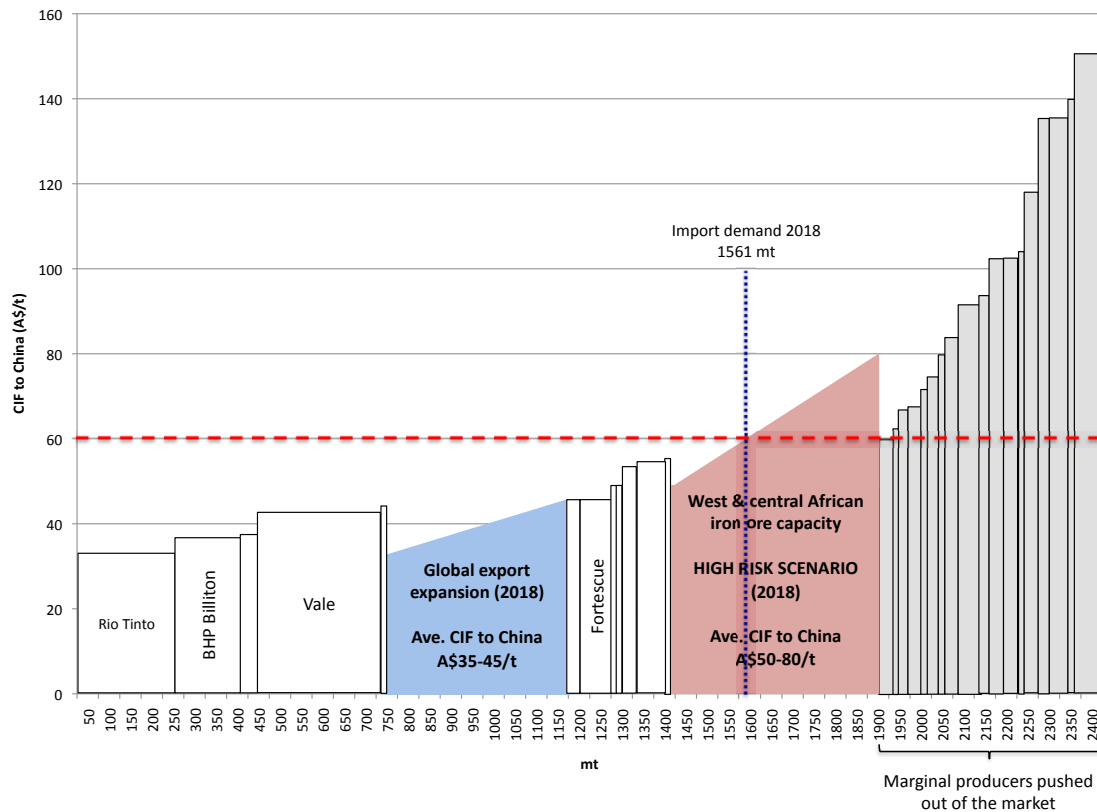
The knock-on effects of these price scenarios would be significant for iron ore-centric economies such as Australia — iron ore is expected to provide A\$59.7 billion to Australia's GDP in 2011-2012 (BREE 2012). A drop in iron ore prices in all the scenarios outlined above would negatively impact Australia's terms of trade, real exchange rate, and revenue collected from the Mineral Resource Rent Tax (MRRT). The falling price would also be another significant constraint for the development of Australia's budding magnetite industry development, which is forecast to add A\$4.5 billion to national GDP per year and create more than 4,000 jobs over the coming decade.

Figure 12 2010 iron ore cost curve & average contract price (CIF to China A\$/t)



Source: Adapted from Mackenzie (2011).

Figure 13 2010 iron ore cost curve with global export capacity expansion and high risk Africa scenario (2018, CIF to China A\$/t)



SOURCES: Mackenzie (2011); BREE (2012); Hurst (forthcoming).

6 Policy questions

In absolute terms, China is well endowed with natural resources, which are the key to fuelling its development. Yet its accessible per capita reserves are low—particularly of resources in high demand, such as iron ore and copper. Chinese authorities are concerned that insufficient supplies will constrain growth and put upward pressure on manufacturing costs.

Those anxieties were exacerbated in the past decade, when international resource dependence increased suddenly, resource prices rose steeply in response to the surge in Chinese demand, and resource security became a national obsession. Overseas investment policies have consequently identified natural resource acquisition as a key strategic objective of internationalisation, and state support has been allocated to achieve that objective (Hurst 2011).

Chinese investment abroad in resource development

The ‘go global’ policy introduced in 1999 aims to encourage Chinese outward FDI (ODI). The policy had three main objectives:

- to support national exports and expand into international markets
- to push domestic firms to internationalise their activities as a means of acquiring advanced technologies
- to invest in the acquisition of strategic resources. (van Wyk 2009)

The objectives of the ‘go global’ policy were consolidated at the Chinese Communist Party’s 16th Congress, which was held in 2002. On that occasion, the authorities pushed hard to sustain the economic reform process and promote global industry champions in the wake of China’s accession to the WTO in December 2001 (Hurst 2011).

The rise of China’s ODI, its resilience during the global financial crisis and its continuing rapid growth have raised questions about the ‘China model’ of investment abroad. Given that the state has direct interests in investing enterprises, Chinese ODI is said to be driven by geopolitical considerations. In this view, Chinese ODI decision-making is not based on profit-seeking assumptions but on geopolitical machinations. This supposed divergence of motivations renders familiar models of ODI unsuitable for analysing Chinese ODI because China is said to pursue political rather than economic advantage.

State-owned enterprises (SOEs) account for an estimated 69% of China’s ODI stocks globally (Table 8). Geopolitical considerations by Chinese SOEs are central to the ‘China model’ argument (Buckley et al. 2007, Huang and Wang 2011). Morck et al. (2008) argue that the embedding of party and state officials at the top structural levels of corporate governance has direct implications for corporate strategy and management. Party officials have direct control but little stake in the firm’s long-term economic performance because massive investment projects aligned with political objectives might be good strategies for career advancement within the central bureaucracies—even if they’re unprofitable in the long-run.

The following passages from two papers on Chinese ODI summarise the core idea of the ‘China model’ of investment abroad:

China remains distinctive from other emerging economies in that many of its MNEs [multinational enterprises] remain in state hands, even though corporatized in order to focus on commercial objectives. State direction means that these firms still align their operations, whether at home or abroad, with the five-year plans and national imperatives. This is a model that is not replicated, in any general objective way, in any of the other leading emerging economies. (Buckley et al. 2007:514)

There probably is a ‘China model’ for ODI, where for China, the motivation for and determinants of ODI differ significantly from those of developed countries [suggesting that] they do not invest in industries where they do well in either domestic or international markets. Rather, they are attracted by advanced development in OECD countries and by resources in non-OECD countries. (Huang and Wang 2011:19)

Drysdale (2011:63) takes a critical view of this conception of Chinese corporate behaviour and argues that concern about Chinese SOE ODI reflecting geopolitical considerations ‘does not appear to have been based on any careful objective analysis’. He stresses that the institutional environment in which Chinese SOEs operate at home is changing rapidly. There is considerable evidence that SOEs abroad actively pursue market conforming strategies, which do not always align with government policy strategies (Drysdale 2011).

There have certainly been recent reforms to SOE corporate management policies. The separation of the party from the management at China’s largest oil firms is a case in point. In the past, the party secretary also held the position of managing director. The new arrangements require these positions be held by different people (Drysdale 2011). This does not ensure that the state has relinquished control, but it does signal a movement towards market-based day-to-day management of SOEs. For example, in 2011 the State-owned Assets Supervision and Administration Commission dismissed Sinosteel’s CEO partly because of the company’s investments in Australia. In turn, that caused Midwest Mining Corp. to suffer huge losses (Hurst and Wang 2012).

Table 8 Investor structure, by industrial and commercial registration, 2008–09

	Share in number (%)	Share in China’s ODI stock (%)
State-owned enterprises	14.8	69.4
Limited liability companies	54.0	21.1
Private enterprises	8.4	1.0
Stock limited corporation	8.0	6.1
Cooperative enterprises	5.7	1.1
Foreign investment enterprises	3.3	0.7
Collective-owned enterprises	1.4	0.4
Hong Kong, Macao and Taiwan-invested firms	1.8	0.1
Others	2.7	0.3

Source: Chinese Ministry of Commerce, *Statistical bulletin of China’s outward foreign direct investment*, cited in Wang and Huang (2011).

Rosen and Hanemann (2011:6) acknowledge that the party's control over the appointment of key personnel in SOEs makes it difficult to accurately assess the determinants of—and incentives for—SOEs' corporate strategic decisions. Those difficulties notwithstanding, the authors argue that 'commercial pressures on Chinese companies are growing rapidly and similarities between Chinese firms in this respect and those of OECD countries are mounting faster than the difference.' For example, in 2006, the State-owned Assets Supervision and Administration Commission pressured SOEs to become more competitive or risk acquisition by their competitive peers. It was also announced that a consolidation strategy would reduce the number of centrally owned SOEs from 155 to between 80 and 100.¹⁰

Access to preferential loans is also seen as distorting the competitive landscape in favour of China's SOEs. This has prompted a movement away from soft loans through the state-owned banking system, and terms are increasingly based on commercial considerations. This was exemplified when the China Development Bank brokered a US\$25 billion syndicated loan for two Russian energy companies in exchange for a 20-year crude oil supply contract. Negotiation stalled when the parties seemed unable to agree on interest rates and appropriate risk premiums, but a final settlement was reached after extensive analysis of historical transaction data, the cost of capital, taxation, transaction costs and the calculation of the appropriate risk premium (Drysdale 2011).

Chinese SOEs are locked into a continuing, dynamic process of reform of the institutions that govern their operation at home. They're also influenced by the environment in which they operate overseas. Corporate governance of China's SOEs is evolving towards a system increasingly driven by market disciplines, and that reform is expected to intensify as their international interests are subjected to more scrutiny by host-country investment vetting agencies. Drysdale (2011:67) suggests that 'Chinese authorities will have to give more and more attention to transparent governance arrangements if Chinese firms are to receive equal treatment to that provided to other multinational investors in international markets.'

Responses to Chinese investment in Australia

Despite their apparent shift to profit-driven operating principles, misgivings about Chinese SOEs' operations and administrative arrangements have been prejudicial to Chinese SOE investment abroad, especially in developed market economies. The approach to receiving Chinese investment in the US has been restrictive, and European authorities have also been cautious.

According to MOFCOM, after Hong Kong and tax heavens such as the Cayman Islands and the British Virgin islands, Australia was the biggest recipient of Chinese ODI in 2009 and 2010. An estimated 90% of Chinese ODI to Australia is from SOEs, and more than 80% of Chinese investment to Australia goes into the mining sector—nearly half into iron ore, and the rest into coal, zinc, aluminium, copper, uranium and so on (Hurst and Wang 2012). It's estimated that Australia was the largest single destination for Chinese ODI between 2004 and 2010 (Scissors 2011).

¹⁰ 'Betting on Africa: how Sinosteel gambled and won', *Caixin Weekly*, issue 21, 20 December 2010.

In Australia, negative perceptions of Chinese SOE investment were associated with the sudden surge in Chinese ODI and with the failure of significant Chinese investment proposals. In that context, the Australian Government introduced additional guidelines covering foreign investment applications from government-related entities. The guidelines were implemented through the Foreign Investment Review Board (FIRB) and are perceived to be directed primarily at Chinese investors (Larum 2011).

Drysdale and Findlay (2009:378) argue that ‘additional requirements’ put on resources projects created greater ‘uncertainty about the treatment of Chinese FDI in the resources sector [and were], at the margin, likely to damage the potential growth of the sector and Australia’s full and effective participation in the benefits from Chinese economic growth through the growth of its market for industrial materials.’

There’s some evidence that Chinese investment in Australia is beginning to wane (Findlay 2011). Should that be the case and should that development be linked to uncertainty in the application of Australian policy, it’s likely to test a very important bilateral economic relationship for Australia and to hinder the development of large China-dependent resource projects.

The increasing politicisation of foreign investment policy is an emerging problem in the development of Australian policy responses to investment activity. As the gateway for major foreign investment proposals, the FIRB has an important mandate in maintaining Australian community confidence in foreign investment through the screening regime it operates. This government agency has also insulated the consideration of foreign investment proposals from political resistance. Very few major projects have been rejected outright on the advice of the FIRB, and the minister responsible for final investment approval has rarely felt the need to reject foreign investment proposals. Some observers and foreign governments—the US among them—have criticised the FIRB, saying it restricts access by foreign investors to the Australian market (Kearney 2007, Stoeckel 2008). Others have argued that, over the years, the FIRB has played precisely the opposite role, keeping Australia open to direct investment from abroad in the face of political pressure to be more restrictive (Drysdale 2011). In fact, in the past decade, the Australian Government has officially rejected only two foreign investment proposals (Drysdale 2011). However, some important projects have been subject to revision and, of course, it’s not clear how many project proposals have been discouraged or withdrawn.

The uncertainties that have arisen in recent years over the treatment of Chinese investment have, therefore, undermined a traditionally open foreign investment regime.

Other policy questions

The relationship with China is not only driving strong growth and structural change in Australia’s economy; it’s also generating debate about resource sector policy. An important issue is the taxation of resource rents. One consequence of higher prices was extraordinarily high profits in the resource sector, and this led to debate over the distribution of resource rents and to a significant change in taxation policy. The Australian Government has recently introduced a minerals resource rent tax of 22.5% (effective) on the resource rents of the coal and iron ore industries, affecting

approximately 320 companies and potentially raising \$11 billion in revenue during its first three years (Novak and Moran 2011). These new taxation arrangements for onshore mining, which extend similar longstanding arrangements that govern the offshore energy sector under Commonwealth jurisdiction, were subject to strong industry resistance and political campaigning—a contributing factor in the downfall of the former prime minister, Kevin Rudd.

Previously, Australia levied taxes on onshore minerals projects in two ways: through company income tax and through state-government royalties, which were linked to sales. Firms in the resources industry were always concerned that higher prices and profits would trigger higher royalty rates, which would be difficult to reverse later if prices were to fall (Findlay 2011).

Royalties are an inefficient instrument for taxing mining activities because they don't tax rents and they induce mines to close earlier than their economic life would justify. Royalties have been subsumed in the new Australian resource tax regime, which has prompted critics to say that mines will continue to close too soon at times when profits are low and there are insufficient profit tax payments against which to credit royalties. However, overall the new resource rent tax regime addresses significant weaknesses in the old resource tax regime for onshore projects in Australia.

The main host-country benefits from resource project development are through income flows, including to governments. There are issues related to the presence of foreign capital in resource sector projects, which include managing their income flow. Resource projects are associated with the presence of variable rents. They involve developing resources that are not replaceable and whose global stock has scarcity value as a result of their limited quantity and uneven geographical distribution. In these circumstances, the value of the resource enjoys a premium or rent over the cost of extraction—at least for infra-marginal projects. UNCTAD (2007: Box VI.3) lays out some options for capturing these rents, including taxes based on revenue, output and profit. There are trade-offs between the costs of collecting and administering these taxes and their effects on economic efficiency.

Income taxes have an effect on the incentive to invest compared to taxes on pure profit (Garnaut and Clunies Ross 1983), while output taxes affect the incentives to exploit a deposit. In the past, tax allocation in the Australian resources sector has been skewed towards the collection of revenues from resource firms via income taxation.

Inefficient taxation regimes run the risk of collapse as circumstances change. The minerals and energy sector tax regime in Australia is complicated by the Australian federal system and the evolution of the distribution of taxation powers between the Commonwealth and the states. It is, however, legislatively and politically robust. In some federal jurisdictions, including those dealing with the offshore production of oil and gas, a variant of a resource profits tax regime has applied for some time. State-levied royalties remained the primary form of non-income taxation of onshore projects until March.

As experience in recent years shows, the profitability of long-lived resource projects can change over time, creating incentives to change the fiscal arrangements where political and legislative systems aren't robust. This is especially the case in periods

when there's a substantial increase in the rent value of resources caused by sharp rises in the terms upon which they're traded (Duncan 2006).

In an advanced economy like Australia, the perception of an unfair and inefficient distribution of rents in projects may emerge, especially in the context of rising prices. This mightn't be an issue for existing projects but could hinder the development of new projects that operate on the same terms as existing projects. Chinese and other investment in Australian minerals in recent times is a consequence of the growth in demand in China. That growth has contributed to rising prices in the same way that, in the 1960s and 1970s, the growth of Japanese demand saw a rise in Australian and global commodity prices. As investment arrives in host countries to take advantage of new profit opportunities in resource production and trade, the distribution of rents becomes an issue in policy debate.

There's scope to implement more efficient taxation regimes. Australia has extended its profit-based tax regime, from the petroleum resource rent tax that had long been applied under federal offshore jurisdiction to onshore mineral resources under state jurisdiction, and has imposed those arrangements upon the states while offering royalties compensation.

7 Conclusion

China's resource demand has risen to historically high levels over the past decade. This expansion of demand across the whole range of resources is set to continue as China's economy develops further, more people join the middle class and rural migrants settle in urban centres.

The rise of China has been central to Australia's strong economic performance, especially over the past decade. Vast quantities of high-quality resources, including iron ore, established know-how, high mining and engineering technology, an attractive investment environment and close geographical proximity to East Asian markets have allowed Australia to profit from China's rise.

The relationship with China is driving not only strong growth and structural change in Australia's economy but also debate about policy in Australia. Important examples are foreign investment policy and the taxation of resource rents.

As China has followed its growth path, its concern about resource security has intensified and the Chinese Government has encouraged FDI as a means of securing resources. This has opened large-scale development opportunities in the resources sector, especially in the iron ore industry, in Africa and around the world. In some developed countries, Chinese ODI, especially from state-owned companies, has met with suspicion and questions about host security and sovereignty. In reality, Chinese SOEs are undergoing a continuing reform process towards market-oriented operating principles, and Chinese firms also face a steep learning curve in host-country markets. By far the largest proportion of Chinese resource imports are, nonetheless, still bought in open markets from corporations not owned by China.

Despite some controversy, Chinese ODI in Australian resources has been, and will remain, important in ensuring that Australia's mining sector continues to grow. One example of Australia's need for Chinese capital is the nation's budding magnetite industry. The industry could add US\$4.5 billion a year to GDP and 4000 jobs, but it's unlikely to develop without continuing interest from China.

New international resource provinces are opening up as realistic supply alternatives, and this renders Chinese investors' perceptions of bias in the Australian investment screening process increasingly important. Countries in western and central Africa have world-class reserves of iron ore, in similar quantities to Australia, but those resources can't be developed without investing heavily to build infrastructure in politically and economically risky environments.

The scramble to expand iron ore export capacity in Africa and globally has created potential for significant export oversupply over the next five years and could, under a high-risk scenario, cause iron ore prices to drop to around US\$60/t CIF to China by 2018 (the price could soon fall to around US\$80/t even in the low-risk scenario). A fall in price of that magnitude would have serious consequences for marginal producers and Australia's magnetite development plans. Most importantly, a drop in prices would lead to withdrawal and slowdown in the development of projects worldwide.

Any fall in the price of iron ore would have significant knock-on effects for the iron-ore-centric economies of Australia and Brazil. Iron ore is predicted to contribute A\$59.7 billion to Australia's economy in 2011-12, a drop in price could affect the overall terms of trade, the value of the Australian dollar and the real exchange rate.

For some years, the expectation of strong Chinese demand for iron ore and other resources has been a shaping force in the resource trade, but that might not last forever. The exceptionally tight commodity markets and high resource prices in the past decade seem very likely to ease over the next five years as supply in global markets responds to the profit opportunities that high prices have generated.

References

ABARES (Australian Bureau of Agricultural and Resource Economics and Sciences) 2011. *Australian commodities*, March quarter, ABARES, Canberra.

BREE (Bureau of Resource and Energy Economics) 2012. *Resources and energy quarterly*, March quarter, Bureau of Resource and Energy Economics, Canberra.

Buckley PJ, Clegg JL , Cross AR, Xin L, Hinrich Voss H, Ping Z 2007. 'The determinants of Chinese outward foreign direct investment', *Journal of International Business Studies*, 38(4): 499–518.

Burrell A 2011. 'Give us a chance, say magnetite miners', *The Australian*, 7 September, available from <http://www.theaustralian.com.au/business/companies/give-us-a-chance-say-magnetite-miners/story-fn91v9q3-1226130912552>.

Cai, P (2012), 'China takes a tougher line', *Brisbane Times*, <<http://www.brisbanetimes.com.au/business/china-takes-a-tougher-line-20120412-1wwin.html>>, *Brisbane Times*, April 13.

Christie V, Mitchell B, Orsmond D, van Zyl M 2011. 'The iron ore, coal and gas sectors', *RBA Bulletin*, March quarter, 1–8.

Crawford JG, Okita S, Drysdale P, Kojima K (eds) 1978. *Raw materials and Pacific economic integration*, Croom Helm, London.

Dargay J, Gately D, Sommer M 2007. 'Vehicle ownership and income growth, worldwide: 1960–2030', *Energy Journal*, 28(4):163–190.

DFAT (Department of Foreign Affairs and Trade) 2011. *Trade in primary and manufactured products: Australia 2010–11*, DFAT, Canberra.

Donnelly R, Ford B 2009. *Into Africa: how the resource boom is making sub-Saharan Africa more important to Australia*, paper 24, Lowy Institute.

Drysdale P 1970. 'Minerals and metals in Japanese–Australian trade,' *The Developing Economies*, 8(42):198–218.

Drysdale P 1988. *The economics of international economic pluralism: economic policy in East Asia and the Pacific*, Columbia University Press and Allen and Unwin, New York and Sydney.

Drysdale P 2011. 'A new look at Chinese FDI in Australia', *China & World Economy*, 19(4):54–73.

Drysdale P, Findlay C 2009. 'Chinese foreign direct investment in the Australian resource sector', in Garnaut R, Song L, Woo WT (eds), *China's new place in a world in crisis* (349–388), ANU E Press, Canberra.

Duncan, Roderick, 2006, 'Price or Politics? An Investigation of the Causes of Expropriation', *Australian Journal of Agricultural and Resource Economics*, Vol.50, No.1, pp. 85-101.

Edwards N 2012. 'Politics, patchy past hurt China investment hopes,' 19 February, *Reuters*, available from http://www.moneycontrol.com/news/wire-news/politics-patchy-past-hurt-china-investment-hopes_670642.html.

Findlay C 2011. 'Australia–China economic relations', in Golley J, Song L (eds), *Rising China: global challenges and opportunities* (181–201), ANU E Press, Canberra.

Game-Lopata A 2012. 'Oakajee project to go ahead without Murchison', *Supply Chain Review*, 10 January, available from <http://www.supplychainreview.com.au/news/articleid/77576.aspx>.

Garnaut R 2011. *Australia's China resource boom*, available from <http://www.rossgarnaut.com.au/Documents/AJARE%20Australias%20China%20Resources%20Boom%20Garnaut%20final.pdf>.

Garnaut R, Clunies Ross A 1983. *Taxation of mineral rents*, Clarendon Press, Oxford.

Garnaut R, Song L (forthcoming 2012). *China's test of limits of growth*, Oxford University Press, Oxford.

Huang Y (forthcoming 2012). 'Outward direct investment, Chinese style', *East Asia Forum*.

Huang Y, Wang B 2011. 'Chinese outward direct investment: is there a China model?', *China & World Economy*, 19(3):1–21.

Huang Y, Chang J, Yang L 2011. *China: beyond the miracle*, Economic Research, Barclays Capital.

Hunt WH 2004. 'The China factor: aluminium industry impact', *JOM, Journal of the Minerals, Metals and Materials Society*, 56(9):21–24.

Hurst L 2011. 'Comparative analysis of the determinants of China's state-owned outward direct investment in OECD and non-OECD countries', *China & World Economy*, 19(4):74–91.

Hurst L (forthcoming 2012). 'African iron ore: a lesson in the contestability of the iron ore market'.

Hurst L, Wang B 2012. 'Australia's dumb luck and Chinese investment', *East Asia Forum*, 1 April, available from <http://www.eastasiaforum.org/2012/04/01/australias-dumb-luck-and-chinese-investment/>.

IMF (International Monetary Fund) 2005. *World economic outlook*, IMF, Washington DC.

IMF (International Monetary Fund) 2006. *World economic outlook*, IMF, Washington DC.

India Bureau of Mines 2011. *Iron and steel: vision 2020*, Ministry of Mines, Government of India, Nagpur.

Johnston R, Reddy D 2012. 'Guest post: frontier markets up the ante on political risk in mining', 18 January, *beyondbrics*, available from <http://blogs.ft.com/beyond-brics/2012/01/18/guest-post-frontier-markets-up-the-ante-on-political-risk-in-mining/#axzz1k5D0YuoE>.

Kearney AT 2007. *Foreign Direct Investment Confidence Index*, Global Business Policy Council, New York.

Kharas H 2011. 'Asia in the global economy in 2011–2050: the main drivers of the Asian century', in Kohli HS, Sharma A, Sood A (eds.), *Asia 2050: realizing the Asian Century*, SAGE Publications India, New Delhi.

Kharas H, Gertz G 2010. 'The new global middle class: a cross-over from West to East', in Li C (ed), *China's emerging middle class: beyond economic transformation*, Brookings Institute Press, Washington DC.

de Krester A 2012. 'India ore policy to benefit Australia', *Australian Financial Review*, 4 January.

Larum J 2011. *Chinese perceptions on investing in Australia*, Lowy Institute for International Policy, Sydney.

MacDonald A 2011. 'Iron ore prices to stay high until 2015, says London mining chief', *The Australian*, 31 August, available from <http://www.theaustralian.com.au/business/mining-energy/iron-ore-prices-to-stay-high-until-2015-says-london-mining-chief/story-e6frg9df-1226126161119>.

McKay H, Sheng Y, Song L 2010. 'China's metal intensity in comparative perspective', in Garnaut R, Golley J, Song L (eds.) 2010. *China: the next twenty years of reform and development*, ANU E Press, Canberra.

Mackenzie K 2011. 'China's iron ore imports mystery, solved ...', *Financial Times*, 15 December, available from <http://ftalphaville.ft.com/blog/2011/12/15/798571/chinas-iron-ore-imports-mystery-solved/>.

McKinsey & Company 2010. *Lions on the move: the progress and potential of African economies*, McKinsey Global Institute.

Moran TH 2010. 'China's strategy to secure natural resources: risks, dangers, and opportunities', *Policy Analysis in International Economics*, 92, July.

Morck R, Yeung B, Zhao M 2008. 'Perspectives on China's outward foreign direct investment', *Journal of International Business Studies*, 39(3):337–50.

- Mukherjee K, Dutta R 2012. 'India iron ore exports seen plunging after tax rise', *Reuters Online*, 10 December, available from <http://www.reuters.com/article/2012/01/03/india-ironore-idUSL3E8C34V920120103>.
- Novak J, Moran A 2011. *Submissions to the inquiry into the Mineral Resource Rent Tax Bill 2011 and related bills*, Institute of Public Affairs.
- Ocean Equities 2011. 'Differentiating amongst the African juniors and identifying the next serious contenders', *Iron ore sector update*, 7 July.
- RBC Capital Markets 2011. 'African iron ore projects: potential for new supply', *RBC Prospector*, 4 February.
- Ridsdale, M (2011), 'Industry background and analysis', *Resource Capital Research*, <http://www.rcresearch.com.au/pdf/sep11i/RCR_IronOreReview3Q11IndustryBackground.pdf>, September.
- Roberts I, Rush A 2011. *Sources of Chinese demand for resource commodities*, RBA Research discussion paper, Reserve Bank of Australia, No. 2010-08.
- Rosen DH, Hanemann T 2011. *An American open door? Maximizing the benefits of Chinese foreign direct investment*, special report by Center on US–China Relations, Asia Society and Kissinger Institute on China and the United States, Woodrow Wilson International Center for Scholars.
- Scissors D 2011. *China's investment overseas in 2010*, Heritage Foundation, available from <http://www.heritage.org/Research/Reports/2011/02/Chinas-Investment-Overseas-in-2010>.
- Siddique MAB 2011. *Western Australia – Japan mining co-operation: an historical overview*, discussion paper no. 09.11, University of Western Australia.
- Song L 2010. 'China's rapid growth and development: an historical and international context', paper presented at the 2010 Paftad Conference, Peking University, December.
- Song L, McKay H, Liu H (eds) (forthcoming 2012). *The Chinese steel industry transformation: structural change, performance and demand on resources*, Edward Elgar, London.
- Stoeckel A 2008. *Sovereign wealth funds: friend or foe*, Center for International Economics, Canberra.
- Tse P-K 2009. 'The mineral industry of China', *US Geological Survey minerals yearbook: volume II.—area reports: international—2007* (9.1–9.24), US Geological Survey, Washington DC.
- Tse P-K 2012. 'The mineral industry of China', *US Geological Survey Minerals Yearbook: 2010 [Advanced release]*, US Geological Survey, Washington DC.
- UNCTAD (United Nations Conference on Trade and Development) 2007. *World investment report 2007: transnational corporations, extractive industries and*

development, UNCTAD, Geneva, available from <http://www.unctad.org/Templates/webflyer.asp?docid=9001&intItemID=4361&lang=1&mode=downloads><http://www.unctad.org/Templates/webflyer.asp?docid=9001&intItemID=4361&lang=1&mode=downloads>.

UNCTAD (United Nations Conference on Trade and Development) 2011. *Trust fund on iron ore information: iron ore market 2010–2012*, UNCTAD, Geneva.

Wang X 2011. ‘The route of urbanisation in China’, *East Asia Forum*, 23 November, available from <http://www.eastasiaforum.org/2011/11/23/the-route-of-urbanisation-in-china/>.

World Bank 2012, Data, World Bank at <http://data.worldbank.org/> accessed April 2012.

Wright R, Hook L, Leahy J 2011. ‘China allows huge Valemax ship to dock’, FT.com, 29 December, available from <http://www.ft.com/intl/cms/s/0/77a8da68-3219-11e1-b4ba-00144feabdc0.html#axzz1j6SwwPtl>.

van Wyk B 2009. ‘Chinese ODI on the world stage,’ *Pambazuka News*, issue 448.

Yardney M 2012. ‘How Australian property markets will benefit from China’s industrial revolution’, *Property Observer*, 21 February, available from <http://www.propertyobserver.com.au/overseas/how-australian-property-markets-will-benefit-from-chinas-industrial-revolution/2012022153482>.

Acronyms and abbreviations

bt	billion tonnes
FDI	foreign direct investment
FIRB	Foreign Investment Review Board
GDP	gross domestic product
MOFCOM	Ministry of Commerce (China)
mt	million tonnes
ODI	outward FDI
OECD	Organisation for Economic Co-operation and Development
PPP	purchasing power parity
SOE	state-owned enterprise