

IMPACT OF CHINA AND INDIA ON SUB-SAHARAN AFRICAN METALS, ORES AND MINERALS – ISSUES AND CHALLENGES

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1 INTRODUCTION

Sub-Saharan Africa provides a significant share of the mineral resources fuelling the growth of the dynamic Asian economies of India and China. This framework paper examines the current metals, ores and minerals trade between China and India and the attendant issues this poses for producer countries. A range of issues and challenges for further research emerge as businesses, governments and civil society groups witness sub-Saharan mineral producing countries coming to grips with the opportunities for economic development afforded by tight commodity markets while adjusting to the role of China and India as both major markets for minerals as well as sources of direct investment. Risks of distorted growth patterns over-reliant on export receipts from mineral sales are simultaneously part of the challenge facing sub-Saharan mineral producers. Petroleum and gas excluded from the focus of this framework paper, both are the subjects of separate enquiries within a broader Sub-Saharan Africa Asian Drivers research programme that seeks to understand the varied and multifaceted impacts of China and India on trade, investment, governance and the environment.

Africa's direct mineral trade with China and India is presented in the first section. The minerals industry of China and India are examined in the second section to draw out the more important mineral resource requirements that African mineral producers are in a position to supply. After identifying the metals and minerals that China and India are most likely to continue to import the paper identifies countries hosting deposits that may be brought into production as a result of the various impacts of the Asian Drivers. Key policy issues are then raised as candidates for further research that are usefully grouped with reference to their impacts for growth, distribution, governance and the environment. Finally countries that would be instructive for case studies on the impact of the Asian Drivers on SSA mineral producing countries are identified.

2 SCOPE

Minerals discussed in this framework paper cover three principle categories: metals, industrial minerals and energy minerals excluding oil and gas. Minerals comprise all minerals in saleable form as ores, concentrates, metals or alloys as well as processed mineral products transformed into primary dimension products sold by mass, as for example, iron rods, bars and steel coil.

3 AFRICAN MINERAL TRADE

3.1 SUB SAHARAN AFRICAN MINERAL TRADE TO ASIA

China and India currently and are expected to continue to play a significant role in the world demand for metals in the future because both comply with at least two criteria for metals-demand growth (Sohn 2005:6). First, population levels are high, at about 40% of the world's population (Bjorke 2006: 46-50), and are expected to continue to grow. Secondly, income levels (measured as gross domestic product (GDP) or GDP/capita) are high, at 19% of global GDP in purchasing-power parity terms (Bjorke 2006: 46-50), and are expected to grow significantly over time.

Ores and metals make up 20% of Africa's total merchandise exports, second to oil and natural gas at 42%. Data presented by Broadman, H et al. 2007, show exports to Asia are dominated by primary products. Non-petroleum mineral exports to Asia amount to 7.2% of total exports but 28.8% of exports to Asia.² Oil and gas exports to Asia amount to 11.7% of total exports,

² Broadman, H et al define "Asia" to include: Bangladesh, Cambodia, China (including Hong Kong and Macao), India, Indonesia, Japan, the Republic of Korea, Malaysia, Maldives,

but make up 46.8% of exports to Asia. Unsurprisingly trade with the United States is similarly biased in favor of the primary sectors while inter-African trade and trade with the EU are more balanced. On the import side non-petroleum minerals and metals comprise 7% of total imports. Asia supplies 4.1% of Africa's imports in the category of minerals and metals which makes up 12.6% of Asia's exports to the continent. Focusing on China and India, Africa predominantly supplies oil and raw materials to China while supplying mainly ores and metals to India.

Examining the recent data on trade trends measured at 1999 and 2004 presented in Broadman, below, exports of ores to Asia increased 24% pa over the period, where as coal exports declined by 25% pa.

Table 1 Minerals in exports and imports to and from Asia for 1999 and 2004

	Exports				Imports			
	1999	%	2,004	%	1999	%	2004	%
Ores	804	4.2	2,377	6.4	35	0.2	78	0.2
Non-oil mineral manufactures	2	0	3	0	27	0.1	19	0
Basic manufactured metals	4,880	25.5	8,201	22.1	286	1.5	559	1.5
Coal	555	2.9	132	0.4	1,220	6.6	2,586	6.8
Minerals Total	6,241		10,713		1,568		3,242	
Trade total	19,159	32.6	37,141	28.9	18,602	8.4	38,184	8.5

(Source Broadman, 2007 from UN Comtrade)

High growth rates in Asian Economies have contributed to the raising of commodity prices and export diversification for primary producers. This has aided mineral exporting countries by providing new sources of world to replace stagnant demand in the developed world and by tightening commodity markets this effect has also reversed to some extent the declining terms of trade primary commodity exporters have experienced over the 20th century.

Trade with Asia has not contributed to the diversification of African exports by product and origin. Indeed, the patterns of trade established with Asia have increased the concentration of product and source of supply. For mineral products this is a preponderance of ores and metals exported from Southern Africa. Central and Western African countries are predominantly export oil and gas and Eastern Africa is predominantly exporting agricultural products. On the import side trade with Asia is more diversified and concentrated in sectors of primary and secondary manufacturing. Coal is the only significant mineral imported from China in large and volumes, imports that have risen 16% pa between 1999 and 2004.

3.2 MINERALS IN MERCHANDISE TRADE WITH CHINA AND INDIA

Turning to the role of China and India in Africa's merchandise trade specifically, Broadman et. al, provides the following figures about growth at two measurement intervals. Between 1990-1994 and 1999-2004 the annual average growth rate of African exports to China was 20% and 48% respectively. For India these growth rates were 7% and 14%. China and India accounted for 40% and 9% of Africa's merchandise exports to Asia respectively. Primary products dominate trade to the Asian Drivers. Oil and gas make up more than 62% of total exports while ores and metals make up 17% of exports to China. Ores and metals make up 61% and agricultural raw materials make up 19% of exports to India.

Mongolia, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan (China), Thailand, and Vietnam.

Chinese and Indian imports to Africa will not be discussed as a full decomposition of trade is the subject of other enquires into the impact of the Asian Drivers on Sub-Saharan Africa.

3.2.1 MINERAL EXPORTS TO CHINA

Ores, concentrates, metals and gems comprised 13 out of the top 20 exports to China of the 9,171 million USD total value of African exports to China, averaged for the years 2000 to 2004. Iron ore and concentrates headed the rankings with a share of 4.95% of all SSA exports to China. Considerable concentration in the mineral trade with China is observed with South Africa providing more that 90% of Africa's exports in eight of the thirteen categories and all of the categories of metals that have been processed beyond the first stage of beneficiation, that is iron and steel coil, rolled sheets and plates, ferro-alloys and worked and unworked aluminum. See Table 2.

Table 2 Minerals in the top 20 African Exports to China

Rank in top 20	SITC Code and commodity title	Share in Total SSA Exports to China	Exporting Country				
			Share in total value of product from Africa to China				
3	2815: Iron ore and concentrates	4.59%	S. Africa 94.03%	Mauritania 3.54%	Liberia 1.31%	Mozambique 1.21%	
4	6672: Diamonds	3.33%	S. Africa 99.27%				
6	2879: Ores & concentrates other non-ferrous base metals	1.75%	S. Africa 30.95%	R. Congo 26.73%	DR Congo 26.52%	Rwanda 5.90%	Nigeria 4.10%
8	6726: Iron or steel coil	1.38%	S. Africa 100.00%				
9	6812: Platinum	1.34%	S. Africa 100.00%				
10	2877: Manganese ores & concentrates	1.31%	Gabon 46.53%	Ghana 25.87%	S. Africa 25.61%	C. d'Ivoire 1.99%	
11	6821: Copper and copper alloys	1.26%	Zambia 48.36%	S. Africa 29.24%	Namibia 20.41%	R. Congo 1.27%	
12	6747: Sheets and plates, rolled	0.83%	S. Africa 100.00%				

			%				
13	6841: Aluminium and aluminum alloys, unwrought	0.46%	S. Africa 99.80%				
16	6716: Ferro-alloys	0.38%	S. Africa 99.99%				
17	2871: Copper ores and concentrates	0.37%	S. Africa 40.67%	Tanzania 39.74%	R. Congo 13.47%	DR Congo 5.42%	
18	6899: Base metals n.e.s.	0.36%	Zambia 62.88%	S. Africa 26.08%	R. Congo 5.79%	Uganda 3.39%	DR Congo 1.86%
19	6842: Aluminium and aluminum alloys, worked	0.25%	S. Africa 100.00%				

(source: Broadman, et al 2007, based on UN Comtrade)

3.2.2 MINERAL EXPORTS TO INDIA

Non-oil minerals, ores and metals occupy 10 out of the top 20 exports to India in the 3,027 million USD total African exports to India averaged for the years 2000 to 2004 shown in Table 3. Over half of this amount comprises gold exports from South Africa. In contrast to exports to China the only category of further processed metals exported to India is unwrought Aluminum, indeed the third largest category of mineral export is iron and steel scrap. India is the worlds largest fertilizer importer which is reflected in the large share of inorganic acids and phosphates imported.

Table 3 Mineral exports in the top 20 African Exports to India

No. In top 20	SITC Code and commodity title	Share in Total SSA Exports to India	Exporting Country Share in total value of product from Africa to India				
1	9710: Gold	52.67%	S. Africa 99.90%				
3	5222: Inorganic acids and oxygen compounds of non-metals	8.50%	Senegal 55.46%	S. Africa 43.65%			
6	2820: Waste and scrap metal of iron or steel	2.65%	S. Africa 27.07%	Nigeria 15.40%	C. d'Ivoire 6.68%	Benin 5.66%	R. Congo 4.93%
7	3222: Coal	2.05%	S. Africa 99.34%				

8	6673: Precious stones other than diamonds and pearl	1.09%	Zambia 43.75%	Tanzania 34.95%	S. Africa 10.49%	Kenya 6.83%	Madagascar 1.67%
12	2713: Natural calcium Phosphate	0.74%	Togo 72.03%	Senegal 22.53%	S. Africa 5.44%		
13	6841: Aluminium and Aluminium alloys, unwrought	0.61%	S. Africa 83.37%	Nigeria 12.78%	Zambia 1.60%	C. d'Ivoire 1.33%	
14	2871: Copper ores and Concentrates	0.48%	Guinea 72.12%	Ghana 26.40%	R. Congo 1.35%		
17	5232: Metallic salts and peroxy salts of inorganic acids	0.37%	Kenya 99.52%				
19	6831: Nickel and nickel alloys	0.36%	Zimbabwe 53.68%	S. Africa 44.62%			

(source: Broadman, et al 2007, based on UN Comtrade)

Diamond production, processing and trade provides an example of how a global mineral industry may be altered by the growth of the Asian Drivers. India, which does not produce diamonds possesses the world's largest diamond cutting industry, largely distinguished by its ability to cut stones too small for other industries to process. Raw material is currently sourced from traditional channels of diamond production and aggregation dominated by firms based in Belgium, England and Israel.

Table 4 Country of Origin of Diamond Imports to India 2004-2005

Country	2004 - 05	
	2003-04 USD\$ M	(Provision) USD\$ M
Belgium	3,924.97	4,321.28
U.K	1,699.46	1,736.99
Israel	483.33	584.02
U.A.E	369.17	214.96
Hong Kong	397.65	385.21
U.S.A	24.71	36.71
Switzerland	150.58	72.75
Others	91.17	243.37
Total	7,141.04	7,595.31

(Source: Gem and Jewellery Export Promotion Council of India)

First there are data issues. Notably absent from Table 3 based on UN Comtrade data are SSA diamond exports to India. Botswana is the largest global exporter of diamonds by value, Africa produces two thirds of the worlds diamonds. Secondly there are issues in the power of producers versus aggregators and processors. Diamond producers are seeking to shift parts of diamond processing closer to production in their efforts to diversify from only the first mining stage. Thirdly, growing processing centers in India, UAE and Hong Kong are competing to shift production away from the traditional centers in Europe. These factors point to changes in

the world diamond trade that would involve more direct links between diamond processors and traders in China and India and diamond producers in Africa.

3.3 TARIFF PATTERNS ON MINERAL EXPORTS TO CHINA AND INDIA

China has removed tariffs on the raw materials most demanded by its growing economy, so mineral fuels and lubricants are zero rated. Crude minerals are imported at a 15% and 3% tariff for Least Developed Countries and non-LDC countries respectively.

India has overall higher tariff structure for agricultural and manufactured imports from Africa. Crude minerals are imported at an 11% and 10% tariff for LDC and non-LDC countries respectively and gold attracts a 15% tariff for LDC and non-LDC countries. (Broadman, et al. compiled from UNCTAD Trans database).

3.4 INVESTMENT FLOWS INTO THE RESOURCES SECTOR

Examining the country destination of FDI flows it is estimated that over the last 15 years over 70% of FDI has been invested in five of seven oil exporting countries and South Africa. Furthermore, Broadman et. al observe that FDI as a percentage of GDP has been increasing in Africa while it has been decreasing in China, a trend that suggests the multiplier effect in Africa is lower due to the combined effects of lower GDP growth, lower multiplier effects generated by investment in the primary contrasted to the secondary or tertiary sectors and lower complementary domestic investment stimulation.

Chinese FDI in Africa is a small proportion of the overall FDI stock, a mere 2% compared to 75% holding in Asia. Flows during 2004 FDI flows to Africa were 5% against 32% to Latin America and 56% to Asia. Targets for investment have been into the extractive industries, predominantly in oil and gas in Sudan, Nigeria, Guinea, Benin and Republic of Congo. South Africa is ranked as the third largest target for Chinese FDI in Africa. Data on all Chinese outward FDI to 2004 in Broadman reveal that 13% of FDI stock is in the extractive sector, 10% in the secondary sector and 75% in the tertiary sector. Given the low base to start with it unsurprising that the very high rates of growth in FDI into Africa have been observed.

Indian FDI to Africa is focused on manufacturing and services as it the case for the rest of the world, however there is a large involvement in the natural resources sector. Over the period 1995-2005 some 16% of India FDI was directed to Africa. Funds flowed into oil and gas, minerals, gems and agricultural raw material investments. Historical ties between India and Africa influence investment flows.

4 CHINA

4.1 CHINESE MINERALS INDUSTRY

China has large minerals industry with leading positions in the following commodities: aluminium, antimony, bismuth, cement, coal, copper, fluorspar, gold, graphite, iron and steel, lead, magnesium, molybdenum, phosphate rock, rare earths, silver, talc, tin, tungsten, and zinc. Fixed investment above 25% pa. has fuelled by GDP growth rates above 8% pa. In 2004 fixed investment rose by 25.8% to 844 billion USD, some 4% of which into the mining sector. Significant growth has occurred in the mineral processing sector. In 2004, the fixed investment rate in the cement and steel sectors increased by 43.3% and 32.3%, respectively,

compared with 70.1% and 63.9%, respectively, in 2003 (Pui-Kwan Tse, 2005 quoting State Development and Reform Commission, 2005; State Statistics Bureau, 2005).

Metals and energy minerals are mainly located in West and Central China whereas the coastal regions accounted for 60% of industrial production and 50% of fixed investment. China experiences shortages in many metals: bauxite, chromite, copper, iron, manganese, nickel as well as oil. The concentration of production in coastal regions has favored sourcing raw materials from the sea borne minerals trade, however, government incentives and infrastructure investments to develop the central and western regions as well as lower production costs in these less developed areas will increase the contribution of the domestic minerals industry to production.

During the first half of 2006 China moved into top spot as the world's leading exporter of steel mill products. China moved ahead of Japan, Russia and the EU by increasing exports 22% over the comparable first half of 2005 to export a total of 18.9 Mt. The ramp up of steel making capacity in China was evidenced by the 32% decline in imports from 13.8 to 9.4 Mt (International Steel Statistical Bureau 2006).

Physical demand for metals in construction, machinery and transport as China urbanises will continue to drive strong global demand.

China's shortage of mineral raw materials has been stimulated strong growth of imports of ores of chromium, copper, iron, manganese, nickel and alumina. Mineral exporters with significant positions in these resources have directly benefited from the resultant strong demand are Australia, Brazil and Chile.

Chinese imports of selected mineral commodities in 2004 is shown in table Table 6 in the data appendix.

4.2 CHINESE POLICY ON SECURING ACCESS TO RAW MATERIALS

According to the 2003 Mineral Policy of the Chinese government it is the stated intention that "Direct import of mineral products will remain the chief way by which China utilizes foreign mineral resources for a fairly long time to come" but the Chinese government has committed itself to a gradual change in the situation in which the proportion of the spot trade in mineral commodities is large which encourages the signing of long-term supply contracts with foreign companies, and import minerals from diversified sources. With regard to mineral resources in which China has advantages, such as tungsten, tin, antimony, rare earths, fluorspar and barite, the government will improve the export structure, increase the added value of the export products, standardize the order of export business, and actively urge the trade intermediary organizations to improve trade coordination in order to promote the healthy development of the trade in domestic and foreign mineral products.

Importantly, the Chinese government encourages domestic enterprises to take part in international cooperation in the sphere of mineral resources, and in exploration, exploitation and utilization of foreign mineral resources. This will promote and protect investments in mineral resources prospecting and exploitation outside China, and standardize the investment and business operation behaviour in accordance with international practices. It will also develop cooperation with foreign companies in geological survey and mineral resources prospecting and exploitation, and promote bilateral and multilateral exchanges and cooperation in the relevant scientific and technological fields. China's Policy on Mineral Resources(2003)

Three principle strategies have been perused by Chinese state governments, Chinese mineral producers, primary processors and metals traders.

First, steps to provide for security of supply by entering into long term supply contracts with major producers. Notable examples:

- Alumina: Australia, Brazil, India, Jamaica, Kazakhstan, United States, Venezuela
- Bauxite: Brazil, Congo, India, Indonesia, Kazakhstan, Mongolia, Myanmar, Philippines, Russia, Zambia, Vietnam
- Iron Ore: Australia, Brazil, India, Peru, South Africa, United States
- Chromite: South Africa

Secondly, direct investment, usually taking the form of joint ventures with established mining companies with significant positions in the minerals concerned. This has occurred in Australia, Brazil, South Africa, USA, Zambia and elsewhere.

Thirdly, providing infrastructure to less developed countries through aid, concessionary finance or development assistance particularly in with regard to transport infrastructure. Such investment improves access to raw materials and supports recipient countries economic links to china to provide minerals.

5 INDIA

India is Asia's third and world's eleventh largest economy. India's metallurgical and mineral industries provide the basic raw materials for most of their industries. India produces as many as 84 minerals comprising 4 fuel, 11 metallic, 49 non-metallic and 20 minor minerals. India was ranked first in world output of mica and third in the production of barite, chromite, coal, and industrial minerals kyanite, sillimanite, talc and pyrophyllite.

5.1 KNOWN MINERAL COMMODITIES AND PRODUCTION

India's top five mineral commodities in terms of mass production are:

1. Iron ore and concentrate: 126 Mt
2. Cement: 125 Mt
3. Crude steel: 32 Mt
4. Bauxite: 11.3 Mt
5. Chromite: 2.95 Mt

An extensive list of the major commodities produced in India is provided in Table 7 in the data appendix.

5.2 INDIAN MINERAL COMMODITY DEFICIENCIES

According to the Mining, Minerals and Sustainable Development project of the International Institute for Environment and Development, India has a deficient and scarce supply position in several minerals listed hereunder in Table 5

Table 5 Mineral resources that are deficient and scarce in India

Grouping	Deficient	Scarce
Fuel minerals	Coking coal	Crude petroleum
Metallic minerals (Ferrous)	Chromite (refractory grade)	Nickel, tungsten, cobalt, molybdenum, Vanadium
Metallic minerals (non-ferrous)	Bauxite (chemical grade), copper, lead	Antimony, gold PGE's, Tin
Industrial minerals	Apatite, Rock phosphate, kyanite	Sulphur, Potash
Precious stones		Diamond, Emerald, sapphire, ruby

(Breaking New Ground, 2002)

5.3 INDIAN GEOLOGICAL PROSPECTIVITY

Most of the south-eastern part of the country is covered by Archaean granite-gneiss basement, implying potential uranium, rare earth elements and gold mineralization. This also gives the possibility of more deposits of dimension stone.

On the western side of the country, there exists a basic volcanic trap, aged at Cretaceous to Palaeogene, which potentially hosts platinum group elements deposits and associated Nickel deposits. Significant deposits could be found at the contact of the volcanics with Quaternary sediments, where North East – South West trending faults occur.

Industrial minerals are predominantly exploited by small scale mining operators while the coal and metals sector is dominated by state owned companies. Liberalisation of the mining sector is taking place with government encouragement of foreign investment. At the end of 2004 government approval had been given for 73 proposals involving foreign direct investment worth \$900 million and the approval of reconnaissance permits involving an area of 238,000 square kilometres. (Kuo, Chin S 2005). Plans for privatising India's national oil industry mooted in the early 2000s have been withdrawn.

6 DIRECT AND INDIRECT IMPACTS OF ASIAN DRIVERS ON AFRICAN MINERAL SUPPLY AND DEMAND POSITION

Total Chinese production and consumption of steel and aluminium exceeds that for all other national economies and trade blocks. Tight commodity markets have underpinned a run up in commodity prices. Mineral output adjustments lag by the medium term delays in increasing output from existing operations and over the long term by the decade or so required to bring a major mine into full production. These price effects have been easy to observe, however, the more interesting issue is explore the relationships between mineral demand and economic growth rates.

6.1 MINERALS DEMANDED AND ECONOMIC GROWTH PATTERNS

Wilfred Malenbaum posited that the intensity of mineral use was reflected in an inverted U-shaped curve. He hypothesised that poor countries do not use minerals to a significant extent, since their economies are linked to agriculture. As they develop they invest in infrastructure and their intensity of use increases. However, their intensity of use later declines as their economies become more sophisticated, and there is a shift from expenditure on infrastructure to expenditure on education, medical care and other services (Sohn 2005:6).

One would expect to observe this intensity-of-use inverted U-curve when one observes India and China's consumption of minerals, with the big question being, "When do we expect these countries' mineral consumptions to start levelling off or declining?"

Menzie, Tse, Fenton, Jorgenson and Van Oss (2004: slide 3) seem to break down Malenbaum's infrastructure-investing stage further and argue that countries follow a developmental pattern in which they specialise in infrastructure (indicated by their use of cement and construction materials), light manufacture (indicated by their use of copper), heavy manufacture (indicated by their use of aluminium and steel), consumer goods (indicated by their use of industrial minerals) and services (in which consumption is static). The authors suggest, based on the experience of Korea, that each stage takes 20 years and that they begin at 5-year intervals. However, while this further analysis of the stages that an economy goes through are interesting when engaging in forecasting a commodity's use, statistical evidence seems to suggest that China may specialise in a host of manufacturing at the same time and continue to do so for a lengthy time. Malenbaum's inverted U-curve model seems the more appropriate model for mineral consumption, but individual minerals should continue to be investigated to see if they comply with the patterns suggested by Menzie, Tse, Fenton, Jorgenson and Van Oss.

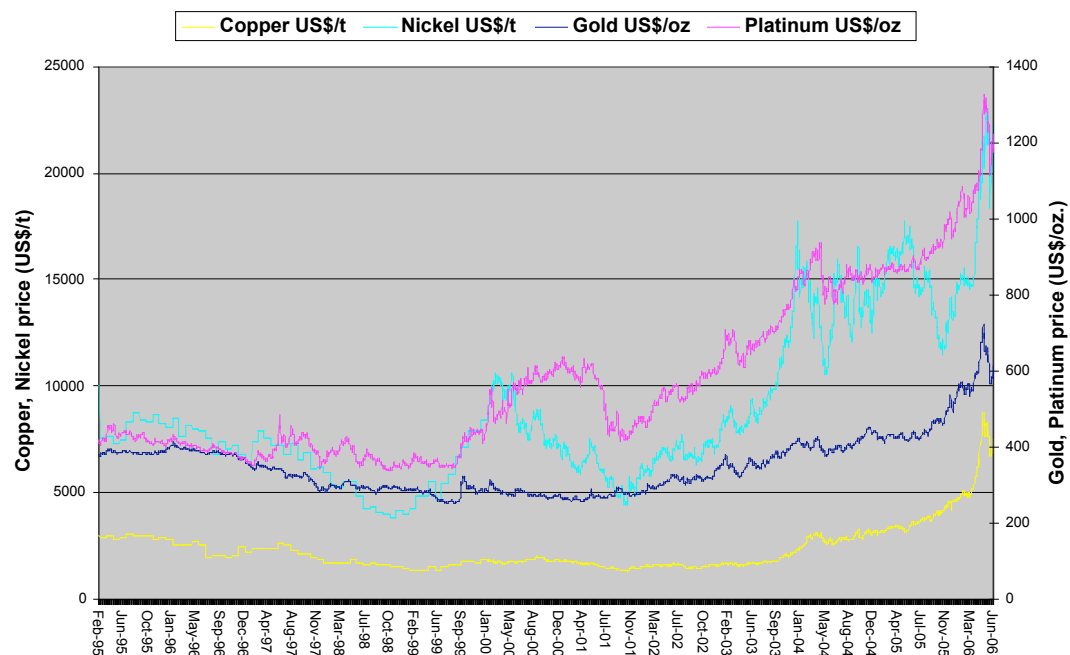
Others, such as Vogely and Tilton, have suggested ways of modifying the Malenbaum inverted U-curve model. Voguely argues that some services could be metals intensive, per dollar of output (Sohn 2005:6). Tilton, meanwhile, argues that there can be shifts in the inverted U-curve as resource-saving technology reduces the use of a particular metal or a particular metal becomes a substitute for another material and is increasingly used (Sohn 2005:7).

This last point is particularly interesting when examining China and India's future mineral needs. One would expect that some minerals, such as iron ore, would continue to be used in a traditional way, such as making steel; these would conform to the traditional Malenbaum U-curve model. Others, such as aluminium, which are sought after as a substitute, would continue to cause the inverted U-curve to shift upwards. As a result, in the case of India and China's metal use, one would expect to see different demand patterns for 'traditional minerals' and for minerals that significantly continue to have different applications. With 'traditional minerals', one would expect that there would eventually be a fall off in demand as per-capita-GDP increased to sufficient levels, while those that take an increasing portion of the composition of products would have increasing demand levels even when per-capita-GDP in India and China started to compare or at least approach levels their Western Europe and North American counterparts.

6.2 INFLUENCE OF THE ASIAN DRIVERS ON COMMODITY PRICES FOR SSA MINERAL PRODUCTS

Attribution of the causes of the movements in commodity prices to demand emanating from China and India is broadly correct, however, other factors need to be taken into account, notably, supply disruptions, positions taken by hedge funds and the stability of Chinese exports from which raw material demand is derived. A comprehensive approach to assessing the influence of the Asian Drivers on commodity prices for African mineral producers needs to examine the workings of the demand and supply position of each commodity in its respective international market.

Figure 1 Metals Prices Boom (1995-2006)



6.3 DIRECT INVESTMENTS BY THE ASIAN DRIVERS INTO THE SSA MINERALS INDUSTRY

A small share of Africa's output of metals and ores destined for China and India are produced by firms under Chinese or Indian ownership. There is a small but growing list of mines and or smelters in which Chinese firms have taken direct positions in. Petroleum and gas by contrast has drawn considerable direct investment from state owned Indian and Chinese oil and gas companies with explicit investment mandates to secure supplies for their domestic economies. Ores, metals and minerals that trade on similar long term supply contracts and through the international mercantile markets are by comparison not seen as necessitating strategic ownership positions. Some examples of investment are listed hereunder.

Chrome ore, charge chrome and ferrochrome is produced by ASA metals, a joint venture started in 1997 between Eastern Asia Metals Investment Co. Ltd from China and a South African provincial government development finance institution.

Copper metal is being recovered by Sino-Metals Leach Zambia Ltd. has started producing copper from tailings at Chambishi on the Zambian copper belt.

Tracking direct investment into the minerals sector of sub Saharan African by Chinese and Indian owned firms and or state owned mineral resources agencies is an important research task requiring ongoing attention to understand the impacts of the Asian Drivers on SSA.

7 RESEARCH QUESTIONS FOR FURTHER INVESTIGATION

Proceeding from the foregoing examination of the minerals trade between the SSA and the Asian Drivers several key issues call for further detailed investigation and analysis. Here some key issues are outlined as points of departure for subsequent research.

7.1 DEVELOPING AN INFORMATION BASE

7.1.1 UNDERSTANDING THE AD PHENOMENON ON WORLD MINERALS MARKETS

Distinguishing the Asian Drivers share of world mineral demand is an important first step to understand the challenges and opportunities for SSA. How long will the tight commodity markets last, is the world in the midst of a commodity super cycle and do the existing models of material consumption in relation to rates of economic growth hold? These questions are of interest a wide range of parties in the developed and developing world: states as regulators of access to resources, companies who extract and process resources and to consumers affected by prices and choices in material characteristics that embrace environmental issues at each stage of the discovery, production, consumption and disposal chain.

Methodologically it is necessary to examine the workings of the demand and supply position of each commodity in its respective international market taking into account technological trends and the influence of substitutes. Noting that the results of such an enquiry would contribute to the work of researchers examining the Asian Driver impacts on developing countries in Latin America and Asia, this is a project that should be conducted via international collaboration.

7.1.2 AD OUTWARD INVESTMENT INTO THE SSA MINERALS SECTOR

Tracking outward investment by Chinese and Indian enterprises into SSA countries minerals sectors is an important task for the observation of the impacts of the direct relationships. A current information base needs to be built up of such linkages to assist researchers to observe the empirical results of development aid and foreign policy relationships between the African mineral producer states and China and India.

Two important sub-themes need to be explored here. First, the provision of development aid to mineral producer countries. Secondly, the appetite from AD commercial and state linked enterprises such as development finance institutions to fund the provision of infrastructure to foster broader economic development.

7.2 POLICY RESEARCH

7.2.1 MACRO-ECONOMIC IMPACTS OF RAPID EXPANSION OF THE RESOURCES SECTOR

Can sub Saharan African mineral producers, as defined here, benefiting from strong foreign exchange earnings from their international minerals sector(s), benefiting from the current commodity boom, avoid the adverse effects of deindustrialisation known as the ‘Dutch disease’?

Given the limited level of secondary industry in most mineral producers economies the aetiology of concern to economists centres around obstacles to economic diversification exacerbated by an appreciating exchange rate rather than the ‘hollowing out’ of existing an manufacturing base.

Posing the question as can Dutch Disease be avoided requires engaging with the core principles of growth, distribution, governance and the environment. In turn it requires engaging with a range of subsidiary questions as follows.

- How sustained will the growth based on tight mineral commodity markets be.
- Will African mineral producing countries be able to manage the growth in their primary sector and avoid the appreciation of their exchange rates.
- How will natural resource rents be apportioned between the state in its capacity of custodian of the natural patrimony for current and future generations, commercial entities exploiting the resources and other stakeholders as making up interested and affected parties. Further, within the range of claimants on resource rents, how will the proceeds be apportioned between current consumption and investment in physical capital for the sustainable exploitation of natural resources on a environmentally sustainable basis.

7.2.2 SAA MINERAL PRODUCERS TERMS OF TRADE WITH MAJOR TRADING BLOCKS

A further set of issues for research are raised by examining the implications of the prima face complementarities between specialisation in primary sector exports by African mineral producers and importation of manufactures from the developed countries who are customers for their raw materials. The issues and challenges raised by this question are not restricted to trade policy matters alone. At the center of this issue lies the question of the economic development path open to African mineral producers.

A specific Asian Driver aspect of the terms of trade question is posed by the work of Kaplinsky, 2006 and others who have questioned whether the long declining terms of trade between the primary and secondary sector will be reversed by the scale of Chinese manufacturing.

7.2.3 VALUE ADDITION MINERALS BASED DEVELOPMENT

Mineral endowments are for many African countries important resource factors to build their economic development upon. A further set of issues for research on the impact of the Asian Drivers speaks to the role that China and India might play in both advancing and retarding further processing of mineral products.

Investigation of these questions would require a commodity specific approach that took into account regional raw material, infrastructure and market factors.

8 AFRICA'S MINERAL INDUSTRY RESOURCE POSITION AND ABILITY TO SUPPLY CHINA AND INDIA'S NEEDS

8.1 ASIA AND AFRICA DEMAND AND SUPPLY POSITION

An examination of China and India's resource requirements within the context of both of these economies development trajectory and their resource position suggests that the following main minerals in which SSA has a significant supply position will be required in volume to sustain industrial development within the Asian Drivers.

- Alumina (chemical grade Bauxite)
- Chromite
- Copper
- Cobalt
- Diamonds
- Iron

- Gold
 - Manganese
 - Molybdenum
 - Platinum Group Metals
 - Nickel
 - Vanadium
 - Titanium
-
- Phosphates (Apatite, Kyanite, Potash)
 - Potassium
-
- Metallurgical coal

Twenty two Sub-Saharan African countries trade directly with China and India in metals, ores and mineral commodity markets. A further twenty countries which are current mineral producers but who do not trade directly with China and India may upgrade to direct trade relations in the near future in response to the demand for raw materials from these two countries.

To usefully trace the overarching themes of the impacts of the Asian drivers on growth, distribution, governance and the environment through an analysis of the sub Saharan minerals industry it will be necessary to combine an appraisal of continent wide features along with specific county experiences. To that end five countries have been identified as candidates for case studies.

8.2 COUNTRY SELECTION

Identified mineral resources for Sub Sahran African have been tabulated for current mineral exporting countries in Table 8 using the Council for Geo Sciences Mineral Reserves of Africa database. As established mineral producers these countries (along with the specific commodity markets that apply) are directly experiencing the impact of the raw material requirements demand flowing from the AD. As a consequence the identified countries represent the universe of countries that form the focus of attention for assessing the impacts of AD on mineral producers at a country level.

In order to establish a universe of countries that may be brought into the category of mineral exporters to the AD, a scan was performed of identified mineral resources in countries that are currently not directly exporting product to China or India. A significant caveat is that this universe has been identified from identified mineral resources, not all of which are proven mineral reserves, that is economically exploitable with available technology and the prevailing prices. Potential mineral exporters and thus targets for mineral development to supply the AD are tabulated in Table 9.

The following criteria³ guided the selection of the countries for case studies:

1. Scope. Oil and petroleum are excluded. Energy minerals, ores, slag, ash, concentrates, metals, alloys, and second stage dimension products are included.
2. Scale. Each country is a significant supplier to China and or and India with respect to the share of mineral trade in own country exports and of top exports of African products to Asia.

³ Note to editors: Consider the overlap with other country case studies in country selection. Richer country experience will be obtained from counties that are selected for AD investigation with respect to trade and investment, environment or governance while undergoing a minerals investigation.

3. Data. Case study selection favours those countries that have good data sets available.

Madagascar has been proposed as a contra-indicator that deviates from the scale and data criteria on the grounds that it is an Indian Ocean country with high and untested geological prospectivity that may develop a significant minerals industry with direct involvement from China and India. The pattern that this development takes would be instructive for testing whether the impacts of minerals extraction influenced by the Asian Drivers is capable of generating balanced economic and social development.

The following are nominated for case study investigations:

1. Congo
2. Ghana
3. Madagascar
4. South Africa
5. Zambia

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DATA APPENDIX

**Table 6 CHINA: IMPORTS OF SELECTED MINERAL COMMODITIES IN 2004
(Metric tons unless otherwise specified)**

Commodity	Quantity	Value (thousands)
METALS		
Aluminum:		
Alumina	5,870,000	\$2,043,563
Metal and alloys, unwrought	1,033,422	1,570,880
Semimanufactures	610,636	1,944,157
Scrap	1,200,008	1,074,771
Chromium, chromite	2,170,000	381,310
Copper:		
Ore and concentrates	2,880,000	2,238,422
Metal and alloys, unwrought	1,381,112	3,812,545
Semimanufactures	1,195,365	3,914,718
Scrap	3,957,604	2,454,969
Iron and steel:		
Iron ore	208,090,000	12,711,952
Steel:		
Bars and rods	1,380,000	922,021
Scrap	10,230,000	2,231,682
Seamless pipe	1,320,000	1,586,354
Shapes and sections	810,000	356,278
Sheets and plates	25,100,000	17,185,992
Manganese ore	4,650,000	585,646
Titanium dioxide	250,989	435,143
INDUSTRIAL MINERALS		
Diamond kilograms	15,268	1,662,353
Fertilizers:		
Compound fertilizers	4,370,000	992,572
Diammonium phosphate	2,290,000	575,654
Potassium chloride	7,180,000	1,158,800
Potassium sulfate	170,000	30,028
Urea	40,000	5,487
Sodium carbonate	197,174	22,746
MINERAL FUELS AND RELATED MATERIALS		
Coal	18,610,000	886,723
Petroleum:		
Crude oil	122,720,000	33,912,468
Refinery products	37,880,000	9,248,352

Source China Mineral Yearbook 2004 (USGS) data obtained from : General Administration of Customs of the People's Republic of China, 2004, China monthly exports and imports, no. 12.

Table 7 India's production of mineral commodities, 2004

Commodity	Production (2004) in tonnes
<i>Metallic minerals</i>	
Bauxite	11 275 000
Alumina	2 600 000
Aluminium metal	861 800
Cadmium metal	489
Chromite	2 948 944
Cobalt metal	545
Copper (ore and refined)	657 800
Gold (kg)	3 800
Iron and steel:	
Ore & concentrate:	
Gross weight	126 000 000
Fe content	80 600 000
Metal:	
Pig iron	25 000 000
Direct reduced iron	5 800 000
Ferroalloys:	
Ferrochromium	527 100
Ferrochromium silicon	10 000
Ferromanganese	170 000
Ferrosilicon	55 000
Silicomanganese	160 000
Other	9 000
Steel, crude	32 000 000
Lead (ore & refined)	106 500
Manganese	
Ore and concentrate	1 700 000
Mn content	630 000
Rare Earth Elements (monazite)	5 000
Selenium (kg)	12 000
Silver (mine & smelter output, in kg)	13 300
Titanium concentrates:	
Ilmenite	520 000
Rutile	19 000
Zinc (content and metal)	773 700
Zirconium concentrate	20 000
<i>Industrial minerals</i>	
Corundum	1 100
Garnet	125 000
Jasper	8 500
Asbestos	18 000
Barite	723 000
Bromine (elemental)	1 500
Cement (hydraulic)	125 000 000
Chalk	115 000
Clays	776 000
Kaolin	805 000
Diamond ('000 carats):	59
Gem	16
Industrial	43
Feldspar	150 000
Fluorspar	10 700
Gemstones:	

Agate	200
Garnet (kg)	850
Graphite	120 000
Gypsum	2 350 000
Kyanite	6 200
Sillimanite	14 500
Lime	900 000
Magnesite	370 000
Mica	3 700
Nitrogen (N content of ammonia)	10 718
Phosphate (incl. apatite)	1 180 000
Pigments	360 000
Salt	15 000
Sand	4 755
Slate	11 000
Soda ash	1 500 000
Stone, sand and gravel	
Calcite	52 000
Dolomite	3 000 000
Limestone	125 000 000
Quartz and quartzite	260 000
Sulfur	12 000
Talc	636 000
Vermiculite	4 400
Wollastonite	115 000
<i>Mineral fuels:</i>	
Coal:	355 000 000
Bituminous	330 000 000
Lignite	25 000 000
Gas (million m ³):	
Gross	28 000
Marketable	26 000
Petroleum ('000 42-gallon barrels):	
Crude	244 000
Refinery products	483 000

Source: USGS (2005)

Table 8 Current SSA Mineral Exporting Countries to China and India by Commodity

Country	Iron Ore	Diamonds	Chrom Nickel Zinc Tin	Iron & Steel	Platinum Group Metals	Manganese	Copper metal & Alloys	Aluminum metal & Alloys	Ferro- chrome	Copper ores & concentrat -es	Cobalt Tungst on Vanadium	Gold	Phosph -ates	Iron Scrap	Coal	Gems	Alumi -nium wroug ht	Nickel ores & Alloy
Benin																	India	
Congo			China				China			C & I	China						India	
D.R.C			China							China								
Gabon						China												
Ghana						China				India								
Guinea										India								
Guinea-Bissau										India								
Ivory Coast						China								India			India	
Kenya																India		
Liberia	China																	
Madagascar																India		
Mauritania	China																	
Mozambique	China																	
Namibia							China											
Nigeria			China											India			India	
Rwanda			China															
Senegal													India					
South Africa	China	China	China	China	China	China	China	China	China	China	China	India	India	India	India	India	India	India
Tanzania										China							India	
Togo													India					
Uganda											China							
Zambia							China									India		
Zimbabwe																		India

(Source: Mineral Data from Council for Geo Sciences mineral reserves of Africa)

Table 9 Potential new suppliers to China and India for SSA Mineral Resources by Country and Commodity

Country	Al	Cr	Cu	Co	Da+Dk	Au	Fe	I&S	Mn	PGE	Ni	Ti	V	P+K+Ky	Mo
Angola					C&I										
Botswana			C&I		C&I						C&I				
Burkina Faso			C&I										C&I		
Burundi											C&I				
Cameroon	C														
D.R.C				C	C&I									I	
Ethiopia														I	
Ghana	C					I		C&I							
Guinea	C						C&I	C&I							
Ivory Coast							C&I				C&I				C&I
Kenya												C&I			
Madagascar	C	C&I										C&I			
Malawi												C&I			
Mozambique								C&I				C&I			
Namibia					I				C						
Niger														I	
Rwanda														I	
Sierre Leone		C						C&I							
Tanzania						I									
Zimbabwe						I				C&I					

(Source: Mineral Data from Council for Geo Sciences mineral reserves of Africa)

