



The mining industry after the boom

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Abstract

The commodity boom of 2004–2012 transformed the fortunes of the mining industry. It also catalysed some important changes in the industry, changes which are likely to have long-lasting effects. These changes include a decisive shift in the customer base of the industry towards emerging economies, particularly those in Asia; a move away from contract pricing towards spot pricing resulting in increased volatility in mineral prices; a growing role in the global industry for emerging economy mining companies; increased operating and capital cost pressures resulting from depletion and tightening environmental standards; and continuing pressures on the resource sector from nationalism and protectionism. These issues collectively represent a challenging backdrop for the establishment of regulatory frameworks for the industry which satisfy the needs of investors while at the same time providing fair and sustainable benefits for mineral host countries.

Keywords Mining · Emerging economies · China · Price volatility · Depletion · Cost pressures · Resource nationalism

Introduction

The commodity boom of 2004–2012 was a dramatic period in the history of the mining industry and brought about some major changes within it (Humphreys 2015). Some of these changes were essentially cyclical and reversed as commodity prices fell, and companies were forced to adjust their behaviour to deal with the problems of lower cash flows and high levels of corporate debt.

However, other changes which took place during these years are likely to prove longer lasting and contribute to shaping the industry over the next 20 to 30 years. In considering trends in the regulation of the mining industry, it is useful to review these changes since they will play a part in providing the context within which such regulations are established in the future.

Amongst the identified changes are these:

- The location of the market will continue to move towards emerging economies and specifically towards Asia;
- Markets will focus on the short term, and prices remain volatile;

- Companies from emerging economies will play an increasing role in the global industry;
- Costs will come under greater pressure from depletion and from tightening environmental standards;
- Investment will remain subject to the forces of nationalism and protectionism.

Market will continue to move towards Asia

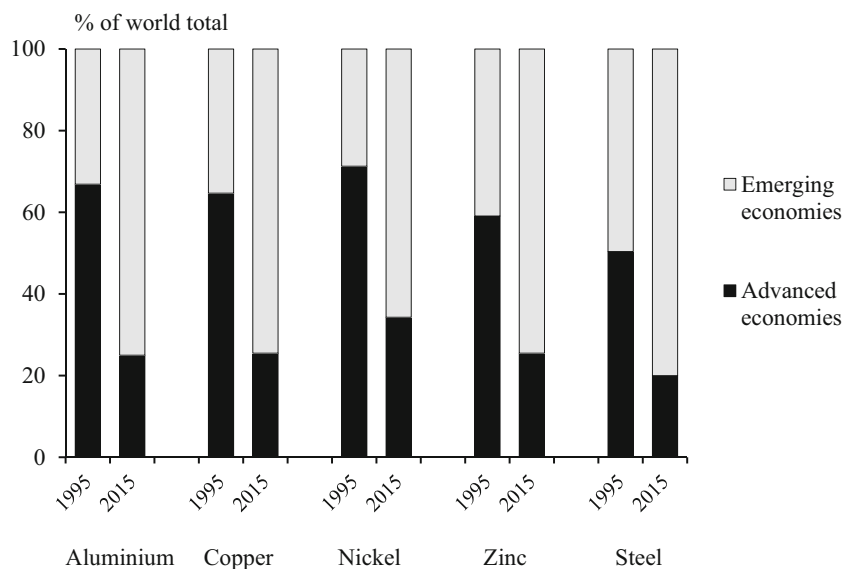
It is well-understood that the commodity boom saw the customer base of the mining industry move decisively towards Asia, although it is perhaps still not fully appreciated just how radical that move was. In a mere 20 years, the industry transitioned from a situation where a half to two-thirds of mineral consumption was in the advanced economy countries to one where three-quarters of mineral consumption was accounted for by emerging economies (Fig. 1). Of course, a large part of this shift was accounted for by China, which currently accounts for around half of world mineral consumption.

We can expect this shift in demand towards emerging economies to continue into the future, albeit at a slower rate. This is because that is where the growth in the global economy is going to be focused in the coming years according to the main forecasting agencies such as the IMF (Fig. 2). It is also

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Fig. 1 Distribution of global mineral consumption. Source: WBMS, WSA. The country classification follows that of the IMF but with developing countries subsumed into the emerging economies grouping for brevity



because these countries are at a material-intensive stage of development, which is to say their growth is heavily concentrated on building, infrastructure and consumer durables like white goods and cars.

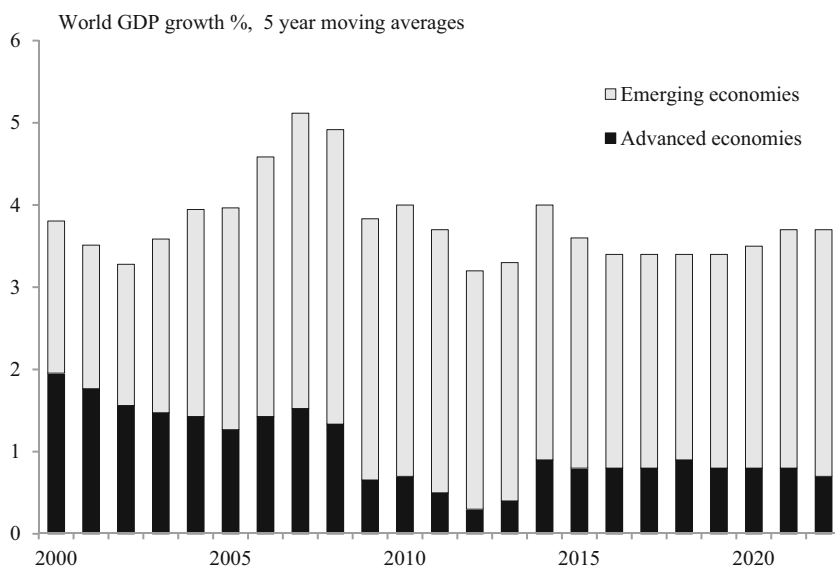
With regard to the specific regions which will contribute to this growth, there are high expectations in particular for South and South East Asia, which is to say the Indian subcontinent and the 10 ASEAN countries, which the IMF expects to be the world's fastest-growing regions in the coming years. These are populous, low-wage regions with good demographics (expanding work forces), growing middle classes and business friendly governments. The Greater Mekong region is currently subject to high levels of inward investment from North Asia. As for India, it is estimated that by 2030, it will have the largest middle-class of any country in the world, a matter of considerable interest to producers of gold amongst

others since those moving into the middle classes (defined by the World Bank as those earning US\$11–110 per day in 2011 PPP terms) have a high propensity to spend their incremental income on consumer durables and luxury goods such as jewellery (WGC 2017).

Prices will be more volatile

The shift in the location of mineral markets has brought with it a change in the way business is conducted, specifically a shift away from long-term contract business towards short-term spot trades. Mineral demand arising in the newly emerging economies during the boom years was not generally from the sort of vast public corporations which had spearheaded the industrialisation of Japan and Korea (the *keiretsu* and

Fig. 2 Emerging economies to dominate global growth. Source: IMF



chaebol), but from smaller, more dispersed, private businesses. These tend not to have the same long-term planning horizons as larger corporations. They are more opportunistic, and the mindset is more of a trading mindset.

The most dramatic impact of this shift was felt in the iron ore business where the long-established, contract-based, benchmark pricing system collapsed in 2009, to be replaced by an essentially spot trading system (Fig. 3). However, the shift towards spot pricing is apparent in other markets too, including coal, copper concentrates, bauxite and potash.

Parallel with this development, more of the world's metal trading is moving to Asia. The LME, which has historically been the hub of global metal trading, saw its share of the trade fall from 87% in 2008 to 71% in 2016 (Thomson Reuters 2017). More trade is taking place in Shanghai, in Singapore and Hong Kong. Asian metal markets, it is probably fair to say, like its stock markets, are more prone to speculation, with investors disposed to see them as much as vehicles for gambling as for efficiently allocating capital or providing services to industry. Significantly, one of China's largest commodity asset managers is called Shanghai Chaos Investment. This has a natural tendency to give rise to greater price volatility.

Another feature of the new customer base is that its behaviour is less transparent and thus less predictable. Partly, this arises because small companies do not have the same reporting requirements as large ones. But, it also arises from the fact that more demand is concentrated in countries which are rather opaque in their nature and where the state plays a more prominent part in economic management. The sudden spike in coal prices in the second half of 2016 did not reflect a surge in demand but was the consequence of production restrictions imposed by the Chinese Government on domestic coal producers (the so-called '276-day rule') the full significance of which had not been appreciated by market watchers outside China.

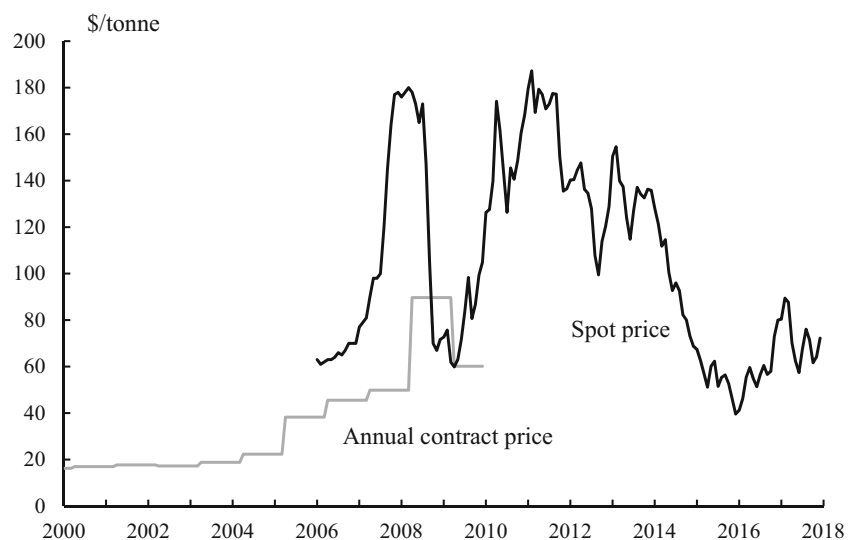
This is a problem for miners in as far as it makes an already difficult task—long-term business planning—even harder. Uncertainty over future prices is one of the biggest uncertainties that those considering large capital-intensive investment projects have to deal with. The development of the iron ore deposits of the Pilbara region in Western Australia in the 1960s and 1970s was only made possible by the preparedness of Japanese steel mills to enter into long-term contractual commitments with would-be producers.

Increased price volatility also has potential implications for miners' costs of capital. The volatility of a company's share relative to the market (its 'beta') is one of the key factors determining the perceived risk of a share and of the return that buyers of a share will expect to compensate them for the assumption of greater risk. Higher price volatility thus passes directly through an increase in a company's weighted average cost of capital.

Growing role of players from emerging markets

One of the key features of the great boom was that it helped give mining companies from emerging economies access to global capital markets, allowing them to strike out onto the world stage and grow. London hosted market listings of mining companies from Russia, Kazakhstan, Ukraine, India, Peru and Mexico. Hong Kong hosted the listing of a number of Chinese companies. By 2008, 10 of the 20 largest miners in the world were from emerging economies (Humphreys 2015). By 2013, according to PwC, companies from emerging economies had risen to account for half the total market capitalisation of the top 40 mining companies, although their share has since slipped back a bit partly

Fig. 3 Price of seaborne iron ore 2000–2017. Source: Industry sources. Contract prices are for Australian iron ore fines sold to Japan. They have been converted from basis FOB dry metric tonne unit to CFR China, US\$/tonne 62% Fe, to make them comparable with quoted spot prices



because of the weak performance of large Chinese coal producers (Fig. 4).

While the passing of the boom has set back the global ambitions of some of these emerging economy companies, China's companies, seeing an opportunity in lower asset valuations, have pushed on with their expansion plans. According to official Chinese sources, in the decade up to 2015, China accumulated around \$140 billion of foreign mining assets (NBS 2016). This equated to 13% of China's total stock of foreign assets. Between the start of 2015 and the middle of 2016, Chinese companies closed 20 cross-border mining acquisitions worth approximately \$8.3 billion, these all around the world (White and Case 2016). As a latecomer to global mining, some of China's earlier overseas acquisitions in mining were of rather indifferent quality. By contrast, some of the more recent acquisitions, such as Las Bambas, Simandou and Tenke-Fungurume, have been truly world class (Table 1).

Growing cost pressures

The issue of increasing costs is perhaps more controversial but needs nonetheless to be addressed.

The boom years unquestionably saw the cost of mining soar spectacularly. This reflected pressure from wages, energy prices, supplies and, in many cases, currency pressures. Some of this was cyclical, of course, and has since reversed. But for some commodities at least, including copper, nickel and gold, costs have remained well above the level they were before the boom, whether measured in nominal (money of the day) or real (constant dollar) terms (Fig. 5). This has, in turn, put upward pressure on prices.

For some commodities, there is evidence of cost pressures arising from depletion. Attention is often drawn in this context to the decline in ore grades in commodities such as copper and gold (Fig. 6). Undoubtedly, it was the case that during the boom years, miners pursued marginal projects that in earlier times would have been considered subeconomic. However, the industry has had to deal with declining ore grades for a very long time and on the whole has managed successfully to compensate for these with productivity gains. Such evidence, as we have suggested, grade declines accounted for only a small part of the cost increases experienced during the boom years.

In addition to grade declines, it seems likely that cost pressures are coming from a range of other, less easily isolatable, factors, for example, from a diminishing capacity to exploit economies of scale (the industry is not finding bigger ore bodies and trucks are unlikely to get much bigger), from the fact that the industry is having to go deeper to mine (both in open pit and underground mines) and from ore quality issues (more complex mineralogy, deleterious elements like arsenic). In the case of nickel, the industry is not finding large new massive sulphide ore deposits of the sort that occur in Norilsk and Sudbury and which have historically furnished the world's lowest cost nickel, with the result that more production is having to come from lower grade, harder-to-process, nickel oxides which tend to occupy the higher reaches of the cost curve.

There is also evidence that the cost of finding ore is rising. According to research conducted by Richard Schodde at MinEx Consulting, the real terms discovery cost for a unit of gold almost doubled between the 1980s and the 2000s, while the discovery costs for base metals more than doubled (BCG 2015).

Fig. 4 Growth of emerging miners' market value. Source: PwC

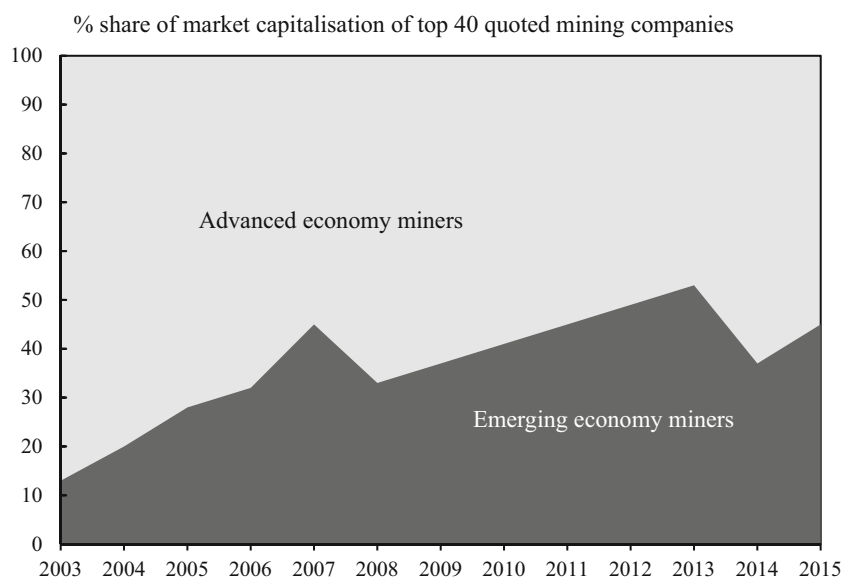


Table 1 Recent mergers and acquisitions involving Chinese companies. Source: Industry sources

Acquirer	Target	Country	Comm	Seller	Price	Status
Tianqi Lithium	Greenbushes (51%)	Australia	Lithium	Talison	\$0.5 bn	Completed May 2014
Minmetals-led consortium	Las Bambas	Peru	Copper	Glencore	\$7.0 bn	Completed August 2014
Shandong Iron & Steel	Tonkolili	Sierra Leone	Iron ore	African Minerals	\$170 m	Completed April 2015
Guangdong Rising	2 mines and several projects	Laos, Papua New Guinea	Gold	PanAus	\$0.9 bn	Completed June 2015
Zijin Mining	Barrick Nuigini (50%)	Papua New Guinea	Gold	Barrick Gold	\$0.3 bn	Completed August 2015
Zijin Mining	Kamoa Project	DR Congo	Copper	Ivanhoe	\$0.4 bn	Completed December 2015
Chinalco	Simandou	Guinea	Iron ore	Rio Tinto	\$1.3 bn	Agreed October 2016
China Molybdenum	Níobio Brasil Fosfatos Brasil	Brazil	Niobium, phosphates	Anglo American	\$1.5 bn	Completed October 2016
China Molybdenum & BHR Partners	Tenke-Fungurume (80%)	DR Congo	Copper, cobalt	Freeport Lundin Mining	\$3.8 bn	Completed January 2017
Yancoal	Coal & Allied	Australia	Coal	Rio Tinto	\$2.69 bn	Agreed January 2017

Less controversial than operating costs perhaps is the fact that the capital cost of mines appears to have taken a significant step up. Again, this may have been partly cyclical (resulting from higher contractor costs, higher raw material costs and so on) but there may also be some important, longer term, factors at work. These might reflect the facts that new mines are in increasingly remote locations requiring the construction of more infrastructure, that they involve longer and more complex permitting processes and more community

expenditures, or that they have higher environmental costs (for example, they have to spend more on waste management systems or water treatment plants).

For many years, which is to say through much of the 1980s and 1990s, the industry used as a rule of thumb a capital cost of copper mine capacity of around \$5000 a tonne. During the boom years, the cost of a tonne of copper mine capacity escalated to over \$20,000, and while it has since slipped back, it has nowhere near fallen to where it started out. Something

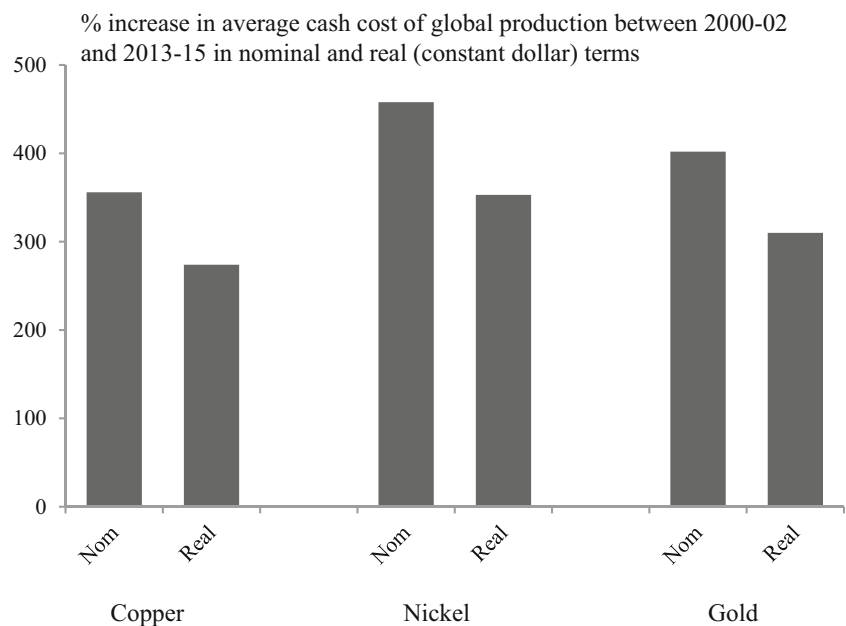
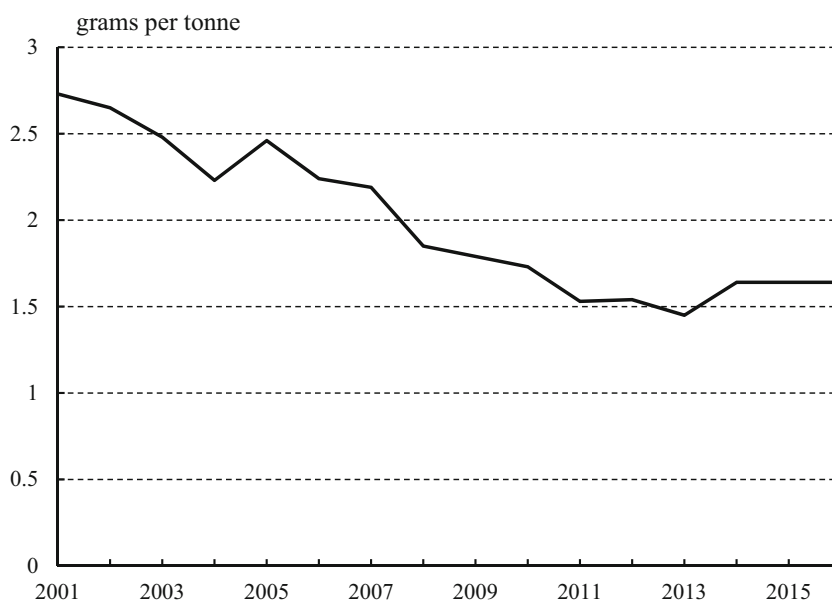
Fig. 5 Cash costs of mine production 2013–2015 vs 2000–2002. Source: Industry sources

Fig. 6 Average gold mine head grade. Source: GFMS



similar appears to have happened with iron ore, where capital costs have spiralled up from under \$50/t of installed mine capacity to \$100/t or even \$200/t.

Testing geopolitics

The final point to make about the future of mining is arguably the most difficult, and that is the growing pressures on the industry arising from geopolitics.

The commodity boom saw a resurgence of resource nationalism and protectionism as mineral-rich countries sought to obtain a greater share of the benefits of the boom for their citizens and greater direct controls over the development of the local industry.

Such resource nationalism took many forms (Table 2). These included widespread increases in taxes and royalties, the review and reopening of existing mining contracts (with a view to imposing more onerous terms), restrictions on foreign ownership, mandated shareholdings in new projects for indigenous investors, the blocking of foreign companies from investment in projects or commodity-deemed strategy; and requirements for local beneficiation and/or export restrictions for unprocessed minerals. Although most of the instances of resource nationalism occurred in emerging economy countries, they were by no means confined to these countries.

There are simply too many examples of these measures to relate, so one will have to suffice, that of Indonesia. Mining is one of Indonesia's most important economic sectors and one of its biggest tax payers. However, much of its exports of minerals historically have gone out unprocessed. In 2009, the government promulgated a new Mining Act determining that the government would take more direct control of

developments in the sector and require more of the minerals produced in Indonesia to be processed there. The key minerals concerned were copper, nickel, bauxite and iron ore.

To give substance to these plans, in 2012, the government passed measures requiring the 'Indonesianisation' of the mining sector (majority Indonesian ownership) over the next 10 years and imposed a 20% export tariff on exports of unprocessed minerals. Export licences would only be available to companies that committed to build smelters in Indonesia to process their minerals in the future. From 2014, the government instituted a total ban on unprocessed mineral exports.

As a result of these changes, and of the uncertainty surrounding them, many foreign investors departed the country, both Newmont Mining and BHP Billiton selling out their interests to local companies in 2016. Freeport-McMoRan, which owns the Grasberg mine in West Papua, the second largest copper mine in the world and a very large tax payer

Table 2 Expressions of resource nationalism in the recent years

- Increased taxes and royalties—increased pretty much everywhere in the boom years, both in advanced and emerging economies.
- Reviews and reopening of mining contracts—Guinea, DR Congo, Liberia, Sierra Leone, Ghana, Kenya, Madagascar, Tanzania, Dominican Republic, Mongolia
- Outright nationalisations—Bolivia, Venezuela, Uzbekistan
- Mandated state or indigenous shareholdings/caps on foreign ownership—DR Congo, Zimbabwe, Kenya, Guinea, Burkina Faso, Madagascar, Sierra Leone, South Africa, Mongolia, Indonesia
- Selected commodities declared 'off limits' to foreigners—Russia, China
- Blocking of foreign takeovers—Canada, Australia, Israel
- Domestic processing requirements/export taxes—DR Congo, Zambia, Zimbabwe, Tanzania, South Africa, Brazil, Indonesia, China, India, Vietnam

in Indonesia, has been in almost continuous dispute with the government over the terms of its operation and the taxation of its exports of copper concentrates. It processes some of its output to metal in Indonesia but does not want to process it all there. Expenditure on exploration in the country has plummeted, and the only investors seemingly prepared to take on the geopolitical risk of investing in Indonesia's mining and metals sector are the Chinese.

There was a view during the boom years that pressures for resource nationalism would ease once the boom subsided. This, after all, was what happened after the 1970s commodity boom which unleashed a similar wave of resource nationalism. However, this seems unlikely.

For one thing, more of the world's minerals come from mineral-driven economies than was the case in the 1970s, and policies in such countries are always going to have their primary focus on what the mining industry can contribute towards national economic development rather than on mining as a source of raw materials for the local economy (Humphreys 2013).

Secondly, global geopolitics is currently wholly different from that of the 1980s and 1990s. The earlier era was characterised by a widespread tendency to privatisation and marketisation, a tendency accelerated by the collapse of the Soviet Union in 1991. Today, by contrast, the prevailing global tendency is towards nationalism, and it is perhaps unsurprising that the resources sector is tapping into this. International trade and cross-border investment flows are slowing, and the forces of economic nationalism and trade mercantilism are in the ascendancy; this even in the country which was once the champion of the free trade system, the USA. So, it would probably not be wise to expect things to change in this regard any time soon.

Whether this is a good thing or a bad thing depends on one's point of view. But, it is undoubtedly going to be a major issue for the mining industry in the coming years, and a major challenge for international investors in the industry who want to go wherever in the world the pursuit of good mineral resources leads them. It is perhaps significant that a number of global miners, including BHP, Rio Tinto and Lundin Mining, have taken in their public briefings to emphasising the share of their assets in OECD countries and, by implication, how they therefore have some protection from the risks of politically less stable areas.

Concluding remarks

This article has reviewed a series of changes to the mining industry which were catalysed by the boom of 2004–2012 and which seem likely to play an important part in shaping its future.

Of course, the mining industry is always moving on. It is a cyclical industry and what companies and countries want to do and the risks they are prepared to take are in significant part shaped by their perception of where they are in the cycle. The collapse of commodity prices which followed the boom has now largely washed through and the cost cutting and rationalisation which this collapse induced have been largely completed. Prices have begun to push up and companies are beginning to think about what happens next and where opportunities might lie. Mineral-rich countries are also beginning once again to consider how a recovery in mineral prices might be best harnessed to the benefit of their national economic development.

The experience of recent years provides much material for those with a preparedness to learn from history, something the industry has not been very good at in the past. What is clear is that the business of mining investment is as tough and complex as ever it was. So, too is the challenge of establishing regulatory frameworks for mining which satisfy the needs of investors while at the same time providing fair and sustainable benefits for mineral host countries.

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References

- BCG (2015) Tackling the crisis in mineral exploration. Boston Consulting Group. Available at www.bcg.com
- GFMS Gold Survey (various years) Thomson Reuters. Available at: <http://financial-risk-solutions.thomsonreuters.info/GFMS>
- Humphreys D (2013) New mercantilism: a perspective on how politics is shaping world metal supply. *Resour Policy* 38(3):341–349
- Humphreys D (2015) The remaking of the mining industry. Palgrave Macmillan, Basingstoke
- IMF World Economic Outlook Database (2017) Available at: www.imf.org
- NBS (2016) China Statistical Yearbook, National Bureau of Statistics. Available at: www.stats.gov.cn/english
- PwC Mine (various editions) PricewaterhouseCoopers. Available at: www.pwc.co.uk
- Reuters T (2017) London metal exchange CEO resigns after difficult year. *Inside Metals*
- WBMS World Metal Statistics Yearbook (various issues) World Bureau of Metal Statistics
- White & Case (2016) Digging deeper: Chinese cross-border mining M&A steals the spotlight
- World Gold Council (2017) India's gold market: evolution and innovation. Available at: www.gold.org
- WSA World Steel Statistical Yearbook (various issues), World Steel Association. Available at: www.worldsteel.org