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Mining's contribution to low- and middle-income economies

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Abstract: In several low- and middle-income countries with important extractive sectors, gross national income has developed favourably. Africa has benefitted most, particularly West Africa. This survey provides an up-to-date statistical analysis of the contribution of non-fuel minerals mining to low- and middle-income economies. Using the detailed data available for the minerals sector, an analysis is carried out of the current situation for 2014, and of trends in mining's contribution to economic development for the years 1996–2014. The contribution of minerals and mining to gross domestic product and exports reached a maximum at the peak of the mining boom in 2011. Although the figures for mining's contribution had declined for most countries by 2014, the levels were still considerably higher than in 1996. The results of this survey contradict the widespread view that mineral resources create a dependency that might not be conducive to economic and social development.

Keywords: mining, development, tax revenue, export, contribution index, employment.

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1 Introduction

This study is designed to provide an up-to-date statistical analysis of the scale of the current dependency of low- and middle-income economies on various extractive resources in dimensions such as production, income (gross domestic product), exports, government revenues, exploration, and employment. The study also attempts to explain and document how country levels of minerals dependency have changed in the past 20 years.

Drawing on the detailed data available for the minerals sector, an analysis is carried out of the current situation for 2014, and of recent trends in mining's contribution to the economic development of low- and middle-income countries for the years 1996–2014. By using data on variables such as production, prices, mineral rents, exploration expenditure, government revenues, and employment, this paper offers answers to questions such as:[1]

- What is the magnitude of the statistical dependency on mining industries in low- and middle-income developing countries today?
- Has that level of statistical dependency changed over time in the past 20 years, from 1996 to 2015?
- Has the level of dependency changed as a result of the sharp drop in prices of most extracted commodities since about 2011, after the end of the so-called super cycle?

The methodology is based on earlier work coordinated by the International Council of Mining and Metals (ICMM), in which the authors participated in 2010 and 2014 (ICMM 2010, 2014).

2 Methodology

2.1 Mining Contribution Index WIDER

One existing approach to assessing the magnitude of the dependency of countries on extractive resources is the Mining Contribution Index (MCI) developed by the ICMM (2010, 2014, 2016). MCI provides data on various measurable aspects of the contribution of mining (but not oil and gas) for every economy in the world. The ICMM released its third edition of 'The Role of Mining in National Economies' (Romine) in November 2016. In the second edition of Romine, MCI combined data for three key indicators: mineral and metal export contribution, increase/decrease in mineral and metal export contribution, and mineral production value expressed as a percentage of gross domestic product (GDP). In the third edition of Romine, another indicator was added: mineral rents as a percentage of GDP (from the World Bank).[2]

[1] This paper complements an earlier paper examining similar questions for both mining and oil and gas (see Roe and Dodd 2016).

[2] One additional source that might enable us to improve the Mining Contribution Index WIDER by adding an estimate for government revenue is the set of Extractive Industries Transparency Initiative (EITI) reports. Countries that have signed up to EITI publish data on government revenues from mining, but such data are only available from the year the country signed up. EITI data typically are only published for periods less than 10 years. Today there are around 20–30 extractives-dependent countries that have signed up to EITI.

In this paper MCI is updated and also further developed. Our revised version is called the Mining Contribution Index WIDER (MCI-W), and is based on four indicators:

1. Exports of minerals including coal as a share of total merchandise exports.

2. The total production value at mine stage of metallic minerals, industrial minerals, and coal, expressed as a percentage of GDP.

3. Mineral rents as a percentage of GDP.

4. Exploration expenditure.

MCI and MCI-W are similar, but use two different ways of combining some measurable indicators. The most notable difference is that MCI uses one factor measuring the *change* in mineral and metal export contribution between two years. MCI-W has no such indicator; we found it difficult to use a relative factor when comparing data over several years.

MCI-W also uses exploration expenditure to give some indication of which countries will be important in the coming years. MCI-W uses GDP purchasing power parity (PPP, real US$ with 2011 as the base year) from the World Bank.

2.2 Indicators

The rationale for including each of our four indicators is as follows:

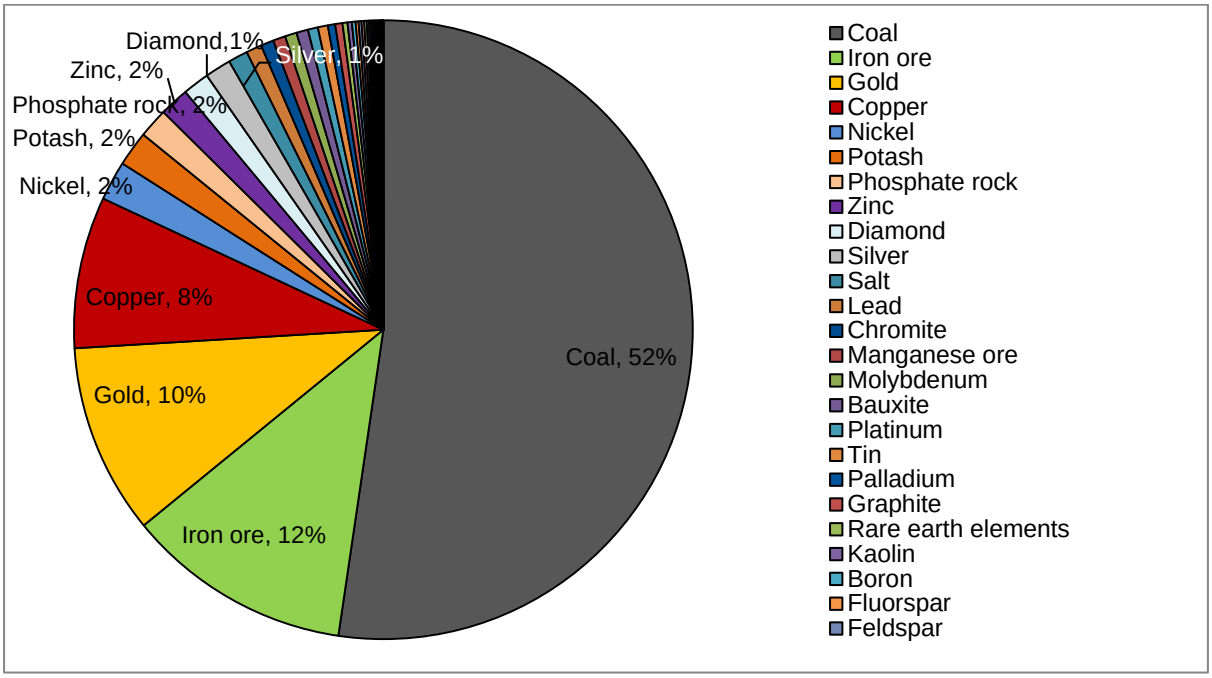
Exports

International trade in metals reflects regional and national advantages and specializations along the value chain (Tercero Espinoza and Soulier 2016). Mineral and metal export contribution in 2014 provides a measure for the scale of mining in relation to other productive activities, in particular for small low- to middle-income countries. The United Nations Conference on Trade and Development (UNCTAD) validates and compiles a wide range of data collected from national and international sources to provide reliable statistics to facilitate analyses of the most urgent and emerging issues. UNCTAD covers international trade and exports of metals and minerals. The specific trade groups used are: non-ferrous metals (Standard International Trade Classification (SITC) 68); other ores and metals (SITC 27 and 28); pearls, precious stones, and non-monetary gold (SITC 667 and 971); coal, whether or not pulverized, not agglomerated (SITC 321); coke and semi-cokes of coal, lignite, or peat, and retort carbon (SITC 325) (UNCTAD 2016).

Value of mine production

This is non-fuel mineral production value expressed as a percentage of GDP (1996–2014). It provides a sense of the scale of value of production relative to the size of the economy. Note that it does not represent the contribution of mining to GDP—on average perhaps only a third of production value represents value addition to the national economy.

Figure 1: Value of mine production by commodity (per cent), 2014



Source: authors' illustration based on data from British Geological Survey, US Geological Survey, World Mineral Statistics, and Raw Materials Data.

The value of mine production is based on figures obtained from Raw Materials Group data until 2013. Figures for 2014 were collected and computed by the authors using the same methodology (Raw Materials Group 1997: 497). A list of minerals and metals included is given in Figure 1. Uranium, aggregates, and limestone are not included.

Mineral rents

Mineral rents are the difference between the value of production for a stock of minerals at world prices and their total costs of production including 'normal' profit. Minerals included in the calculation are tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate. Mineral rent statistics are derived from the World Development Indicators created by the World Bank.

Exploration

The exploration expenditure data produced by SNL Mining & Metals (2016)[3] provides a forward-looking indication of the likelihood of continued mining activity in a country. Without exploration, the mining sector in any country will most likely shrink or even disappear sooner or later, as no new deposits will be found. Exploration expenditure also involves money spent in the country that might generate jobs and add to GDP. However, these effects are not the main reasons for including exploration spend in the index. If we compare mining activities in a country (e.g., production) as a percentage of total mining in the world, and exploration expenditure in the same country measured as a percentage of total expenditure globally, it could be argued that if the relative

[3] SNL Metals & Mining (2016) focuses on corporate spending. In reality, if one adds metals and minerals not included by SNL Mining & Metals, and if one counts exploration undertaken by entities not surveyed, total exploration on either a national or global basis is definitely higher than indicated by SNL for each country. In this study this difference is considered to be of minor importance.

share of exploration is higher than that of mining it is likely that mining will grow into the future, and vice versa.

2.3 Calculation

MCI-W is calculated as follows: countries are ranked in descending order for each of the four MCI indicators. Countries for which data do not exist are omitted from the ranking. As a result, indicator 1 is ranked out of 216 countries, indicator 2 is ranked out of 127 countries, indicator 3 is ranked out of 125, and indicator 4 is ranked out of 122 countries. For each country percentile ranks are calculated based on the four indicators, by dividing the country rank by the maximum rank within that indicator to generate a ranking between 0 and 1. Finally, the four MCI indicators are weighted equally at 1/4, summed up, and multiplied by 100 (ICMM 2014).

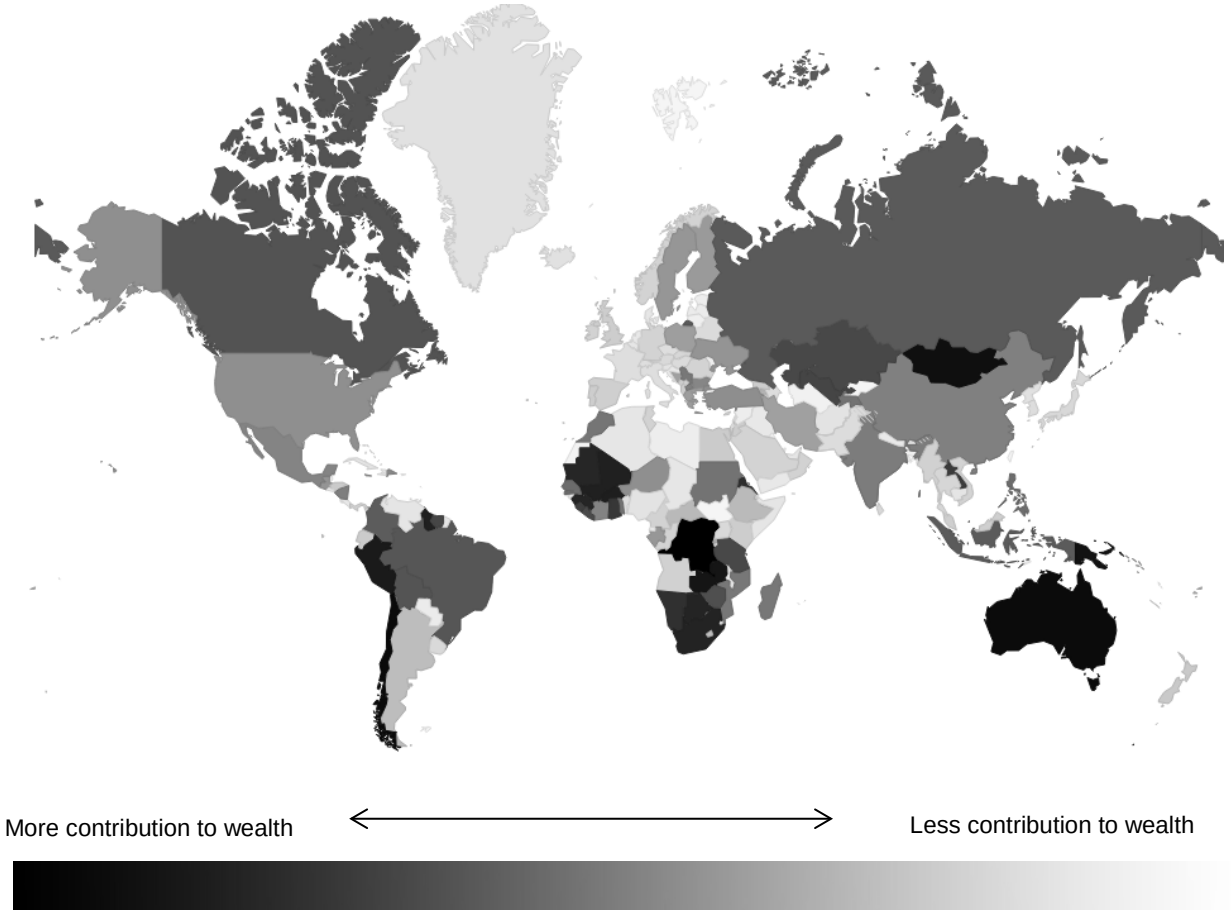
In this study the focus is on the low- and middle-income economies for the years 1996–2014.[4]

3 Current levels of mining contribution to national economies

Our MCI-W results confirm that mining is indeed the backbone of several nations' economies. In some nations, mining contributes a dominant share of the national wealth, with more than 50 per cent of exports and around 10–20 per cent of GDP: many of these countries are low- and middle-income economies. The distinction between different regions is shown graphically in Figure 2, the black areas showing the highest levels of dependency. Regions where mining makes a particularly high contribution are Western, Southern and Central Africa, Oceania, Central Asia, and Latin America. Almost all countries have some, often small-scale, mining activity producing for example coal and aggregates for domestic use. These mineral products are most often not exported, as their low value does not allow transport over longer distances, and hence the combined contribution by production and exports is small. There are some regions or countries where mining contributes less to national wealth: Western Europe, the Middle East and North Africa, Japan, and South-East Asia (lighter areas in Figure 2).

[4] Low-income economies are defined by the World Bank as those with a gross national income (GNI) per capita of US$1,025 or less in 2015; lower-middle-income economies are those with a GNI per capita between US$1,026 and US$4,035; upper-middle-income economies are those with a GNI per capita between US$4,036 and US$12,475; high-income economies are those with a GNI per capita of US$12,476 or more.

Figure 2: MCI-W score by country, 2014



Source: authors' calculations.

3.1 Country rankings

In MCI-W based on the latest available data for 2014, the Democratic Republic of the Congo (DRC) is ranked as the country with the largest contribution of mining to its economy (Table 1). Mineral exports constitute 81 per cent of total exports there, and DRC is ranked the fourth most important country in relation to mineral export contribution. Mineral production value at the mine stage was US$8 billion in 2014, and the mineral production value as a percentage of GDP was 15 per cent: on this indicator, DRC is ranked number three. Exploration expenditure was US$300 million in 2014, placing DRC in tenth place globally. Mineral rents constituted 20 per cent of total GDP, and DRC is ranked number two in 2014. These four variables give the composite score of 97.6 out of 100 in the index for DRC. The top 10 countries in the 2014 MCI-W ranking in descending order are DRC, Chile, Australia, Mongolia, Papua New Guinea, Zambia, Peru, Burkina Faso, Mali, and Guyana (for the top 50 countries, see Table A1 in the Appendix).

Table 1: MCI-W top 20, 2014

Country	Ranking	MCI-W score
DRC	1	97.6
Chile	2	95.2
Australia	3	95.0
Mongolia	4	93.9
Papua New Guinea	5	93.4
Zambia	6	92.6
Peru	7	91.4
Burkina Faso	8	90.5
Mali	9	89.9
Guyana	10	89.9
South Africa	11	89.2
Botswana	12	89.0
Guinea	13	88.6
Mauritania	14	88.5
Eritrea	15	86.4
Namibia	16	86.2
Ghana	17	84.5
Lao PDR	18	83.5
Sierra Leone	19	82.5
Uzbekistan	20	81.2

Source: authors' calculations.

Of the top 50 countries in MCI-W 2014, there are only four high-income economies (HIE), but 16 upper-middle-income economies (UMIE), 18 lower-middle-income economies (LMIE), and 12 low-income economies (LIE) (Table 2).

Table 2: MCI-W top 50 by country classification, 2014

Country classification	Ranking	Percentage
HIE	4	8
UMIE	16	32
LMIE	18	36
LIE	12	24
Total	50	100

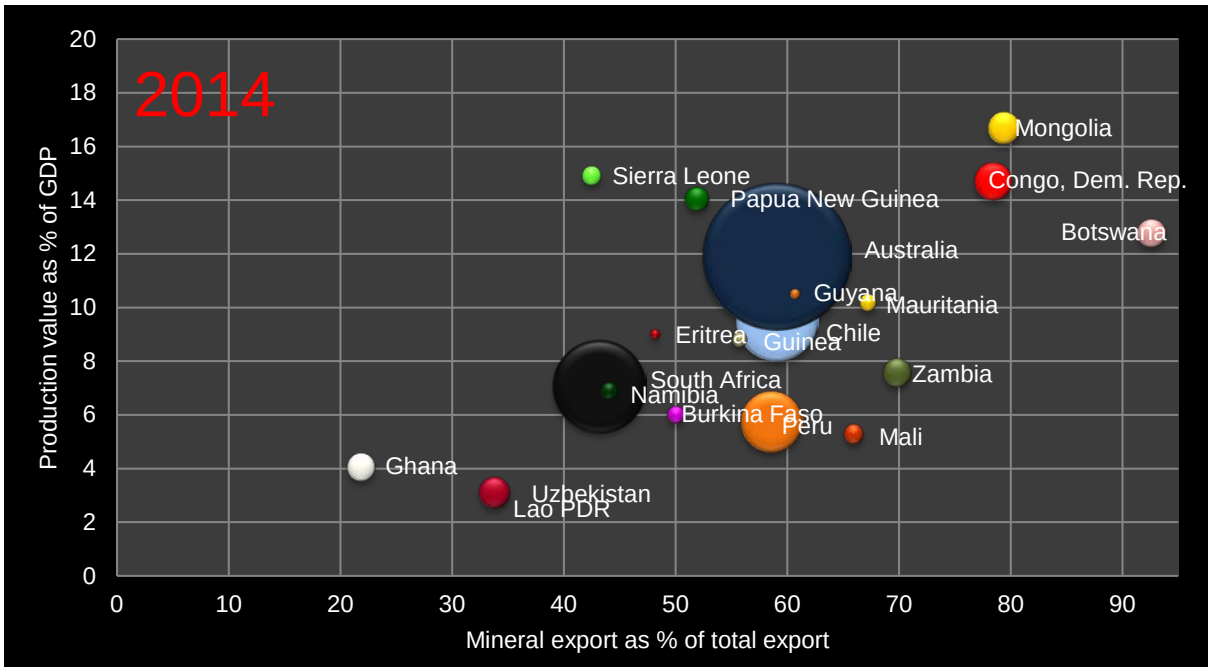
Source: authors' calculations based on World Bank data.

While there are two high-income countries, Chile and Australia, among the five countries with the highest MCI-W scores, there are only two additional high-income countries among the top 50

(Canada and Russian Federation). It should also be noted that all five of the BRICS countries (Brazil, Russian Federation, India, China, and South Africa) are among the MCI-W top 45.

In Figure 3 we present a four-dimensional chart with the export contribution shown on the x-axis and mineral value as percentage of GDP on the y-axis. The size of the circles is proportional to the value of mine production in absolute terms (US dollars). The fourth dimension is time, the data being presented only for 2014 in Figure 3. The chart shows the top 20 MCI-W countries. Australia has by far the largest mining industry by value of production, and the high value is represented by the size of the circle. The export contribution ranking is topped by Mongolia, DRC, and Botswana at levels of 80–90 per cent of total exports, followed by Zambia, Mauritania, and Mali with export contribution levels at around 60–70 per cent. The graphic confirms that the countries with the highest levels of export contribution are mainly LIE or LMIE. Eritrea, with only one mine of industrial scale in operation in 2014, is represented by the small dark red circle.

Figure 3: MCI-W top 20, 2014



Circles are proportional to value of mine production.

Source: authors' calculations.

3.2 Value of mine production

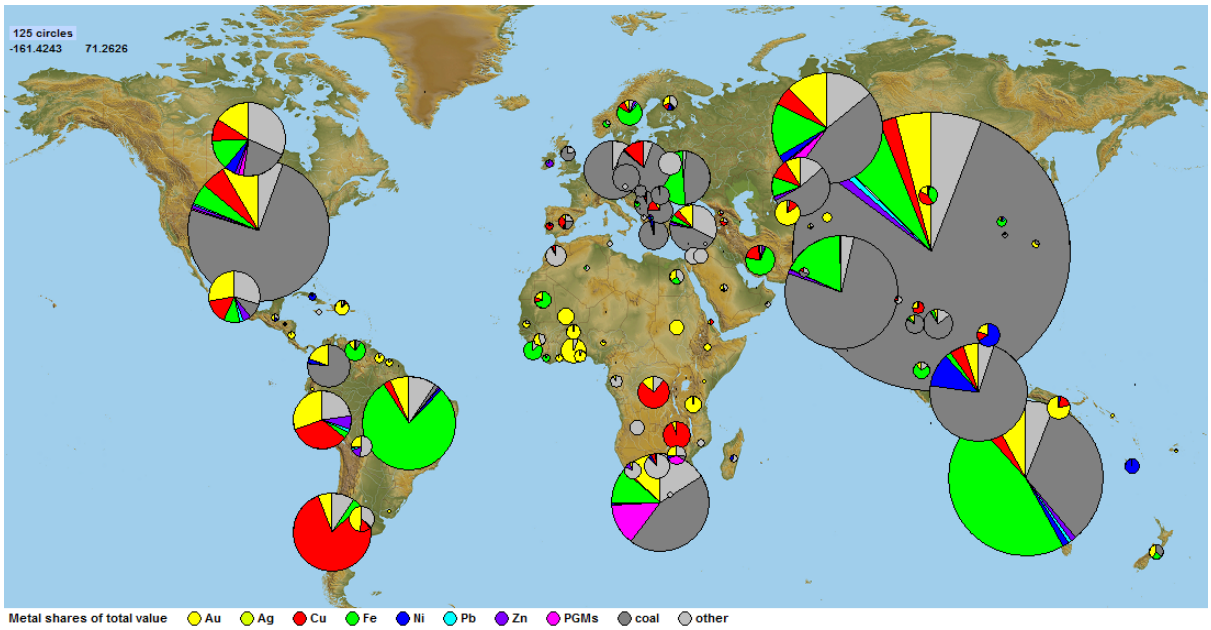
While there are 30 LIE and LMIE among the top 50 MCI-W countries, the HIE and UMIE are substantially more important in terms of production value—for example, China, Australia, United States of America (USA), Canada, Chile, Russian Federation, South Africa, and Brazil (Table 3 and Figure 4). It should be noted that the main engine of metal demand, China, is also by far the most important mining country when coal is included in the production total. If coal is not considered, but only metals and industrial minerals, Australia and China are roughly the same size. The absolute levels of production are relatively small for several of the states in the MCI-W top 50—such as Guyana, Eritrea, and Guinea—but for the economy in the broader sense, mining is an important contributor to all the MCI-W top 50 states.

Table 3: Value of mine production, top 10 countries, 2014

Country	Value billion US$	Percentage
China	405	33
Australia	121	10
USA	107	9
Russian Federation	69	6
India	61	5
South Africa	48	4
Indonesia	41	3
Brazil	41	3
Chile	37	3
Canada	33	3
Top 10	963	78
Others	273	22
Total	1236	100

Source: authors' compilation based on Raw Materials Group data.

Figure 4: Value of mine production by country, 2014



Circles are proportional to value of mine production.

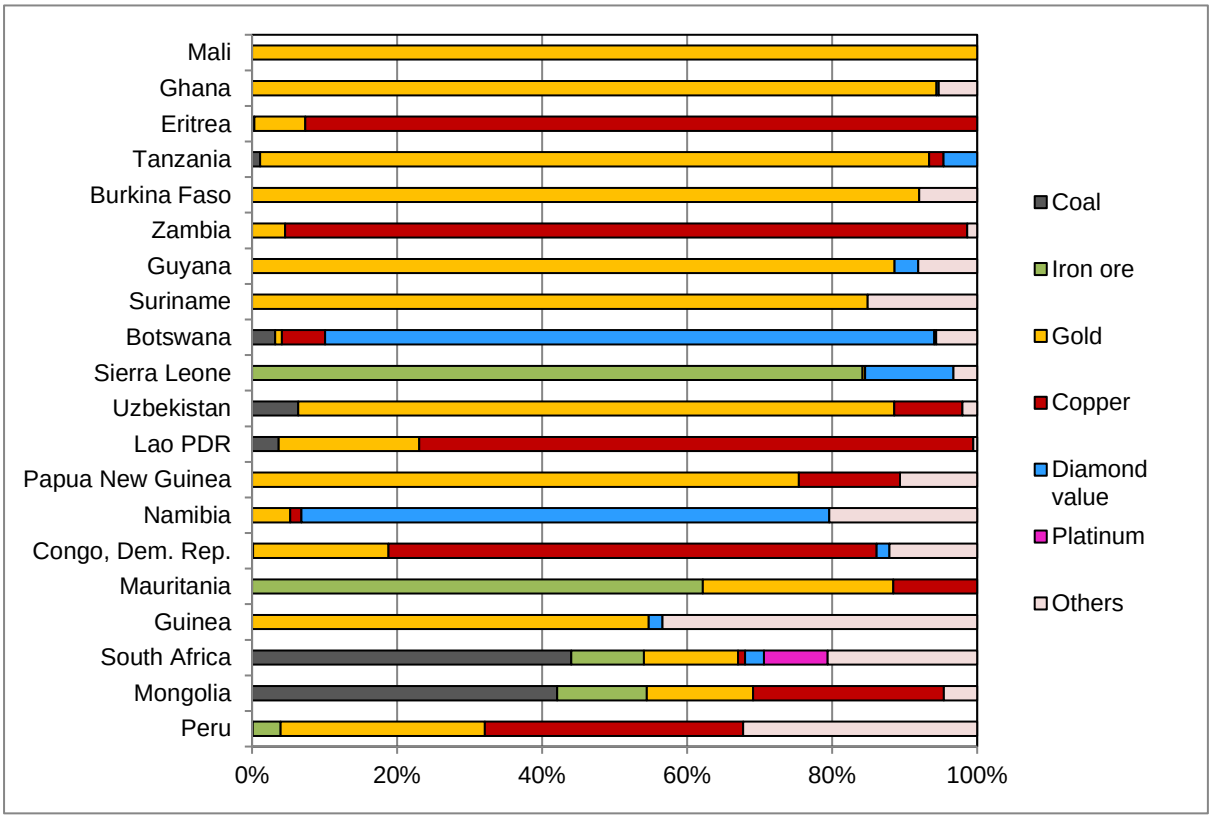
Source: Raw Materials Data.

Figure 4 clearly shows that the total value of mineral production at the mine stage is dominated by coal (the dark grey in the figure). Coal constitutes roughly half of the total value of industry production globally. Iron ore (Fe, green), copper (Cu, red), and gold (Au, yellow) follow next. The industrially important metals nickel and zinc are each roughly an order of magnitude smaller. These metals are of the same value in total global production as the fertilizer minerals—i.e. phosphate and potash—at two to three per cent of the total value of production. Thereafter there are a number of metals and industrial minerals that each contribute less than one per cent of total global value. (See Figure 1 for a complete list of the minerals included in total mine production value.) China is by far the most important country in terms of total production value, followed by Australia

and USA. The top 10 countries in terms of the value of their mine production contribute almost 80 per cent of the total value of non-fuel mineral production at the mine stage globally.

For each of the MCI-W top 20 LIE and middle-income economies (MIE), Figure 5 shows how metals and minerals contributed to the total value of their mine production in 2014. Gold mining is the major mineral contributor in no fewer than nine countries in this top 20. In Mali, gold is the only mineral mined and hence contributes 100 per cent of the total value; in Burkina Faso, Guyana, Ghana, Uzbekistan, Suriname, and Tanzania, gold mining contributes between 75 and 94 per cent. Copper is the most important commodity in Zambia, DRC and Lao PDR. In Namibia and Botswana, diamonds are the main contributor.

Figure 5: Contribution by commodity to MCI-W top 20 LIE and MIE

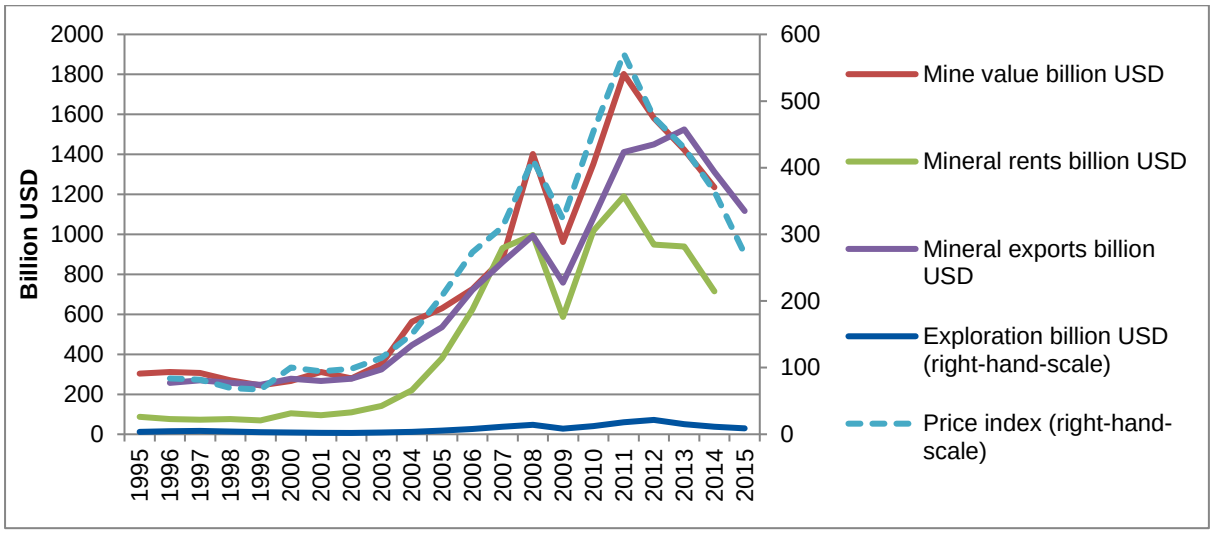


Source: Raw Materials Data.

In 2014, the total global value of mine production at the mine stage including coal was around US$1,200 billion. Coal contributed US$650 billion, and iron ore is estimated at US$145 billion. The change over time in the total global value of mineral production follows the general metal/mineral prices, as seen in Figure 6. However, for some individual countries, the changes in the level of production have also been very important.[5] For example, copper production in DRC has increased tenfold over the last 10 years and is now twice as large as during the previous peak in the 1980s.

[5] See e.g., Eritrea and some other high-ranking MCI-W countries. Annual production data by country for all of the countries covered is not yet available for 2015.

Figure 6: Mining development trends, 1995–2015: prices, exports, exploration, value of mine production, mineral rents



Sources: authors' compilation based on data from Raw Materials Group, World Bank, SNL Metals & Mining, and UNCTAD.

Change of mining contribution over time, 1996–2014

Metal and mineral prices reached a peak in 2011, but have since been in a five-year downturn that is showing some signs of correcting in 2016–17. It should be noted, however, that most metal prices in nominal terms are still higher than they were in the early 2000s. Our price index is made up by a variety of metals/minerals (coal, copper, gold, iron ore, nickel, and zinc). The weighting on the price index was calculated as an average based on the total value of products of the mining industry. The weighting was used to combine the price development of different products into one index.

As Figure 6 shows, the price index has been on a downward trend since 2011, with a flattening beginning in early 2016. It is certain that the global production value will also have dropped for 2015, but we see several important indicators making us believe that the bottom in terms of production value was reached in late 2016 or early 2017. As can also be seen from Figure 6, mineral prices are an important but not the sole determinant of the changing levels of exports, value of mine production, mineral rents, and exploration expenditures.

3.3 Export contribution

Non-fuel minerals and metals are the major contributor to many nations' exports. Among the top 50 countries with the highest mineral exports relative to total exports in 2014, there were 17 nations with a total mineral export of more than 50 per cent of the total. Among the top 50 ranked by export contribution, no fewer than 34 per cent are LIE and 28 per cent are LMIE. Only eight countries or 16 per cent are HIE (Table 4). The export contribution to the MCI-W score in LIE and MIE is the most important factor explaining their high ranks. Sierra Leone is number one with a mineral export contribution of no less than 94 per cent of total exports. Botswana, DRC, Mongolia, and Zambia are all countries where mineral exports contribute more than 70 per cent (Table 5).

Table 4: Top 50 export contribution by country classification, 2014

Country classification	Number of countries	Percentage
HIE	8	16
UMIE	10	20
LMIE	14	28
LIE	17	34
Small island state	1	2
Total	50	100

Source: authors' compilation based on UNCTAD and World Bank data.

Table 5: Top 50 mineral export contributors, 2014

Country	Country classification	Export contribution percentage
Sierra Leone	LIE	93.6
Botswana	UMIE	91.3
Nauru	Small island state	83.3
DRC	LIE	80.9
Mongolia	UMIE	80.4
Zambia	LMIE	75.1
French Polynesia	HIE	68.2
Mali	LIE	65.7
Guyana	LMIE	61.2
Tajikistan	LMIE	59.1
Mauritania	LMIE	58.1
Chile	HIE	57.0
Australia	HIE	56.7
Peru	UMIE	53.8
Guinea	LIE	52.1
Mozambique	LIE	51.1
Namibia	UMIE	50.3
Burkina Faso	LIE	49.6
Democratic People's Republic of Korea	LIE	49.1
Jamaica	UMIE	48.1
Armenia	LMIE	47.3
Rwanda	LIE	44.6
Burundi	LIE	41.6
Liberia	LIE	39.3
Central African Republic	LIE	39.1

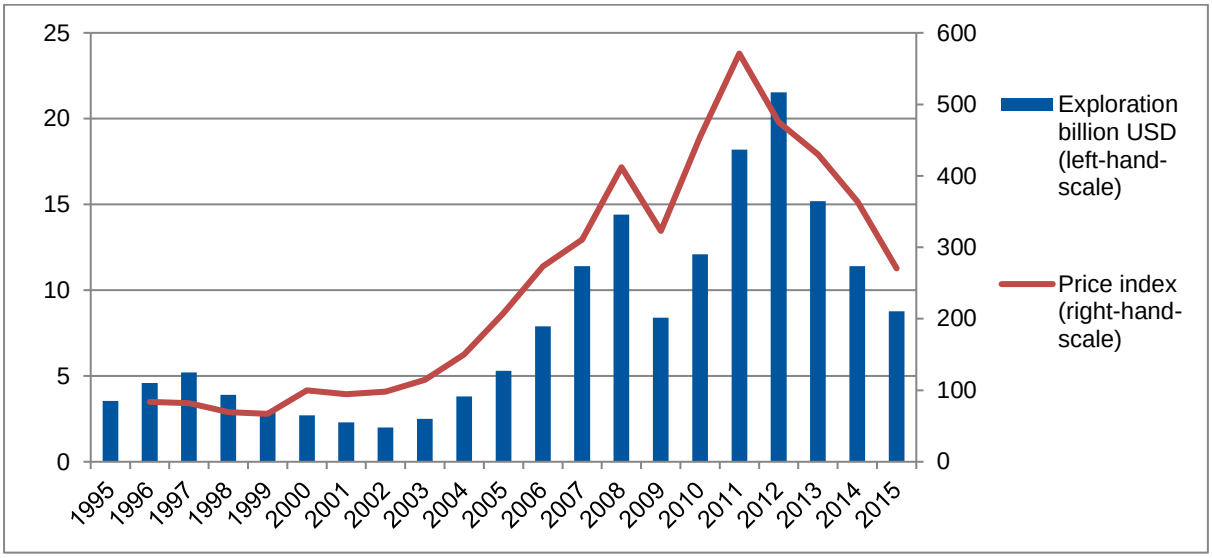
Iceland	HIE	39.0
Eritrea	LIE	38.6
South Africa	UMIE	38.2
Tanzania	LIE	38.1
Papua New Guinea	LMIE	37.9
Madagascar	LIE	37.4
New Caledonia	HIE	36.6
Lao PDR	LMIE	36.5
Suriname	UMIE	33.8
Montenegro	UMIE	32.1
Israel	HIE	31.2
Togo	LIE	30.5
Uzbekistan	LMIE	30.5
Niger	LIE	29.1
Kyrgyzstan	LMIE	28.5
Bolivia	LMIE	27.4
Sudan	LMIE	27.4
Switzerland	HIE	27.0
Lesotho	LMIE	26.4
Bahrain	HIE	24.6
Ghana	LMIE	23.0
Zimbabwe	LIE	20.1
Dominican Republic	UMIE	20.0
Myanmar	LMIE	19.4
Lebanon	UMIE	19.1

Source: authors' compilation based on UNCTAD and World Bank data.

3.4 Exploration

Exploration activity and spending is mainly driven by expectations of future, mostly short-term mineral demand and prices (Figure 7). In reality, exploration expenditure in a given year is closely related to metal prices in the preceding year (Canadian Intergovernmental Working Group on the Mineral Industry 2001: 20–21). This means that future metal demand, which should logically determine levels of exploration, is not a prime driver. This is a failure of the market for this specific service. Some attempts to stimulate exploration have been made in certain countries, with varying success. Examples are financial support to risk-willing investors in Canada and Australia (flow-through shares), and government-funded exploration work in China, India, and Finland.

Figure 7: Corporate exploration expenditure, 1995–2015



Source: author's illustration based on SNL Metals & Mining data.

Exploration expenditure by location is shown in Figure 8. Canada and USA, which together account for 21 per cent of total exploration expenditure, are receiving far more than could be expected from their shares of production (12 per cent).

Figure 8: Corporate exploration expenditure by location

Source: SNL Metals & Mining, an offering of S&P Global Market Intelligence (2016).

3.5 Mineral rents

It is important to note that diamonds are not included in the list of minerals for which the World Bank calculates mineral rent. Thus countries such as Botswana and Namibia, where diamonds are the main mineral contributor to the economy, will get a lower MCI-W score than if diamond rents were also included. Mineral rent is a theoretical approach to calculate some concept of the surplus from the mineral sector. It is difficult to explain why the mineral rents shown by the World Bank data are so high—for some years they are higher than or almost as high as the total value of mine

production. One explanation could be that rents are also calculated on the production of metals and semi-products under way to becoming ore metal (blister copper and the like).

A component part of the mineral rents residual is the revenue that government receives in taxes and fees. Unfortunately, for most countries there are no reliable public data available on government mineral revenues. The International Monetary Fund (IMF) collects data, but only for minerals and oil and gas added together; these cannot be separated, nor are they updated for all countries and the latest years. The IMF currently identifies data for only 12 countries that produce minerals but no oil and gas. Nor does the World Bank separate out the government mineral revenues from other elements of mineral rent.

3.6 Other factors

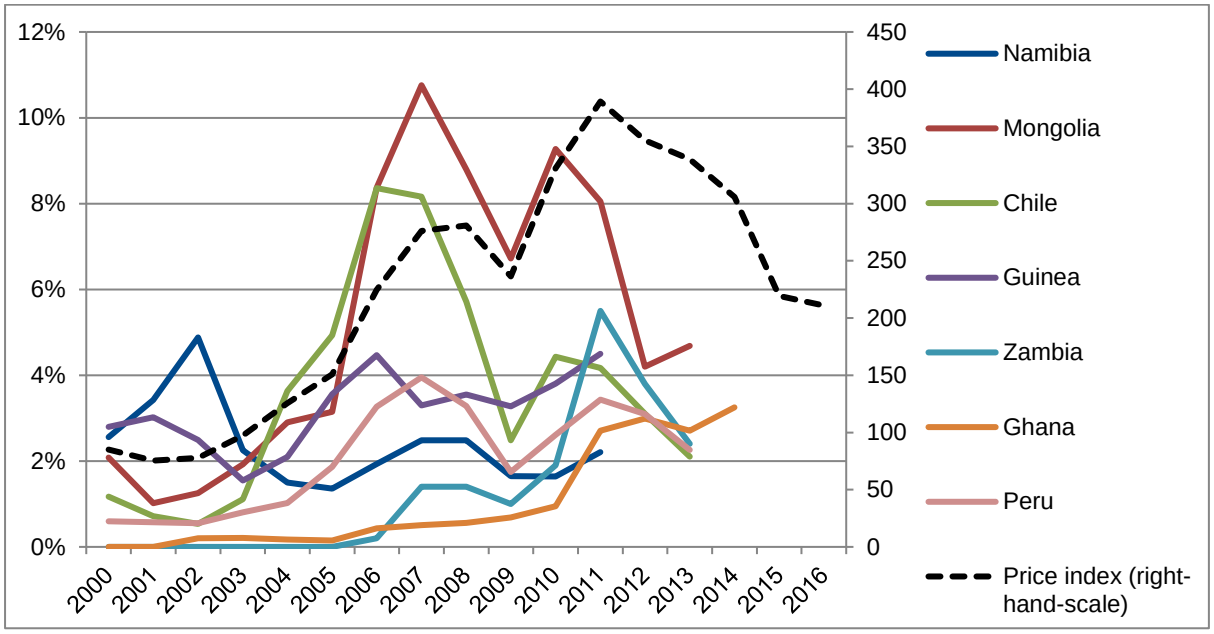
We have studied a number of indicators and combined them to arrive at MCI-W. We have expanded the number of factors compared with the original MCI; however, there are other remaining factors which ideally we would like to measure, but which we have not been able to use in the index because of a lack of comparable data. For two of these, government revenues and employment, there are currently no comparable data available for most countries or for the full length of the period 1996–2014. Nonetheless, we still find it important to give some preliminary results for these two additional components of mining's contribution, in spite of less than complete data sets.[6] Further foreign direct investment and total investments into mining might have been included, but we have chosen not to do so, again mainly due to lack of transparent data.

Government revenues from mining

The capturing by government of some part of total resource revenues as government revenues (mainly taxes and royalties) is crucial to generate development for many reasons, not least that mineral resources are considered non-renewable. From Figure 9 (which uses those IMF data that are available) it is clear that there is a lagged relationship between metal prices and government revenues. Metal prices started upwards in 2002–03, and government revenues increased a year or two later in most countries shown in the graphic. Among the countries in this small sample, government revenues grew until 2011–12 and then fell back sharply, at least for some countries, while continuing upwards for others, such as Ghana. This is probably explained by the fact that Ghana is an important gold producer and the gold price has not fallen as quickly as some of the base metals. The IMF data are not complete for the full period until 2014, and for Zambia and Guinea there are unfortunately no recent figures. The quick growth of mining in Mongolia has resulted in an equally rapid increase of government revenues, but the volatility is also high, making it difficult for mineral-rich countries like Mongolia to plan for their futures.

[6] This approach parallels that of the ICMM in its most recent report on the topic (ICMM 2016).

Figure 9: Government revenues from mining as share of GDP (percentage)



Source: authors' illustration based on IMF Resource Revenue data, 2016.

Employment

The *direct* contribution of mining to the total formal employment of a country is seldom more than one to four per cent in countries with large mining sectors. The number of direct jobs created is normally relatively small, as mining is capital-intensive; but mining also generates *indirect* jobs, which are more difficult to measure. Furthermore, mines are often located in remote areas with limited other opportunities. However, the jobs created by large mining companies are normally well paid compared with other similar jobs in the same country. This means that the mining contribution to the total wage bill of a country is often proportionately larger than its contribution to job numbers. In spite of the lack of easily comparable mining employment figures from any one source—notably the International Labour Organization's LABORSTA database of labour statistics—detailed employment statistics over time are available for a limited number of countries. We provide here information on Peru, Botswana, and Zambia. These available statistics interestingly show that direct employment varies between just above one per cent in Peru and over three per cent of the total number of employees in Botswana. The absolute numbers are nevertheless significant: 60,000 persons in Botswana and Zambia, and almost 200,000 in Peru. Further, it is clear that employment grows with increasing production, and is not as volatile as government revenues, the value of mine production, or the other indicators used in this study. This clearly shows that mining can be successful in generating direct jobs, and hence most probably also indirect ones. Employment multiplier effects can often be significant: perhaps as many as three to five jobs elsewhere in the economy for each direct job in mining (ICMM 2014).[7]

Mining is one of the most important economic sectors in Peru, if not the most important (Figure 10). Copper is the major contributor by commodity to the economy, and copper output has increased year by year, reaching 1.4 million tonnes in 2014. Peru is ranked by MCI-W at number seven. Production value and government revenues from mining have followed the highs and lows

[7] Further detail on this point is provided in Roe and Round (2017).

of metal prices. Employment in the mining sector steadily increased from 2004 to 2014. Direct mining employment as a percentage of total employment has been stable at around one per cent.

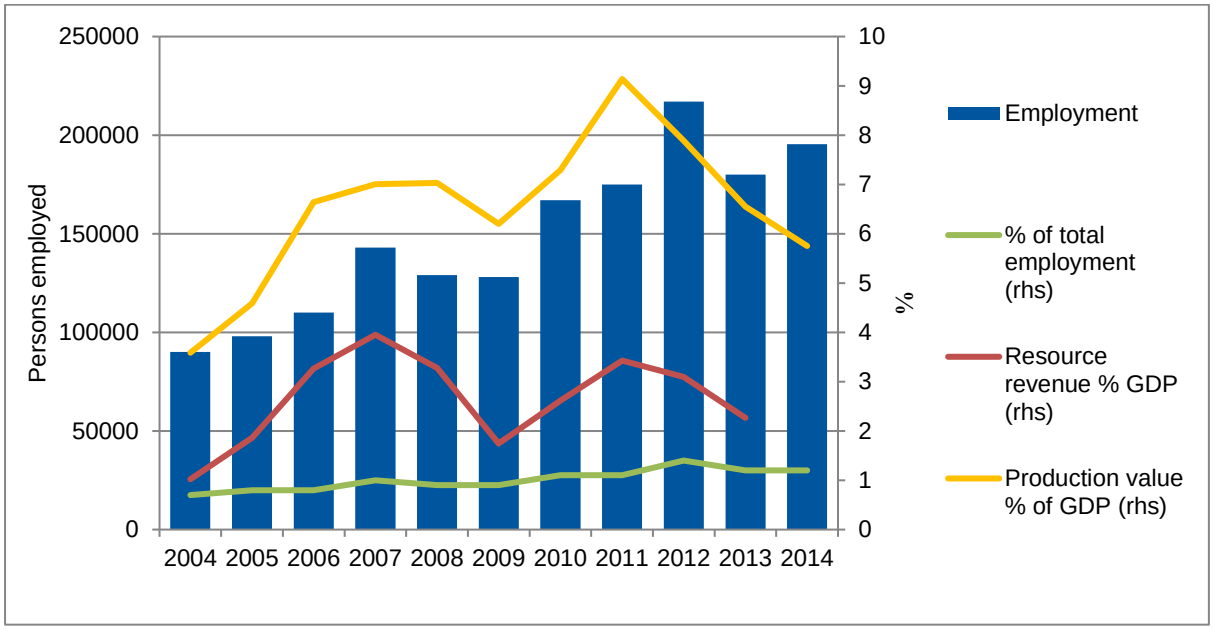
Mining employment in Botswana has been around 10,000–12,000 in the last 10 years, and has slowly increased (Figure 11). Production value as a percentage of GDP has followed the general price trend, but recently has not decreased as much as in countries dependent on base metals. Government revenues from mining as a percentage of GDP decreased from 20 per cent in 2006 to 10 per cent in 2010. Due to a lack of data from the IMF, there are no later figures than 2011. However, mining revenues as a percentage of total government revenues were around 40 per cent in 2015: this had decreased from around 50 per cent in 1998 and before.

In Zambia, the mining sector is a major contributor to the economy. More than 70 per cent of exports are from mining, and the value of mineral production constitutes 7.5 per cent of GDP (Figure 12). Zambia is ranked number four in MCI-W 2014. Mining also accounted for 62 per cent of foreign direct investment in 2014, and mining tax revenues contributed a significant 28 per cent of total government revenues, equivalent to four per cent of GDP in 2014 (World Bank 2016). The mining sector is also a major source of formal employment: eight per cent in 2012. Back in 1996, almost 50,000 people worked in the formal mining industry, and Zambia produced 340,000 tonnes of copper.[8] Employment thereafter was in decline, as indeed was copper production: by the early 2000s, employment and copper output were both at rock bottom. Since then copper production has increased, and so has employment.

To sum up, direct employment in the mining sector most often varies between one and three per cent, but there are examples of much higher levels. This is invariably the case, in particular if informal/artisanal sector employment is also included. Employment is an important stabilizing factor in the contribution of mining in many mineral-rich countries. Employment has also been generally rising in the past 10 years, and has not declined as much recently as the value of mine production, exports, and other factors directly related to commodity prices. Employment is also somewhat less volatile than the other factors under study, and there was for example only a marginal dip during the global financial crisis in 2008–09.

[8] The number of employees was much higher in the 1970s, when production also reached as much as 600,000–700,000 tonnes of copper per year.

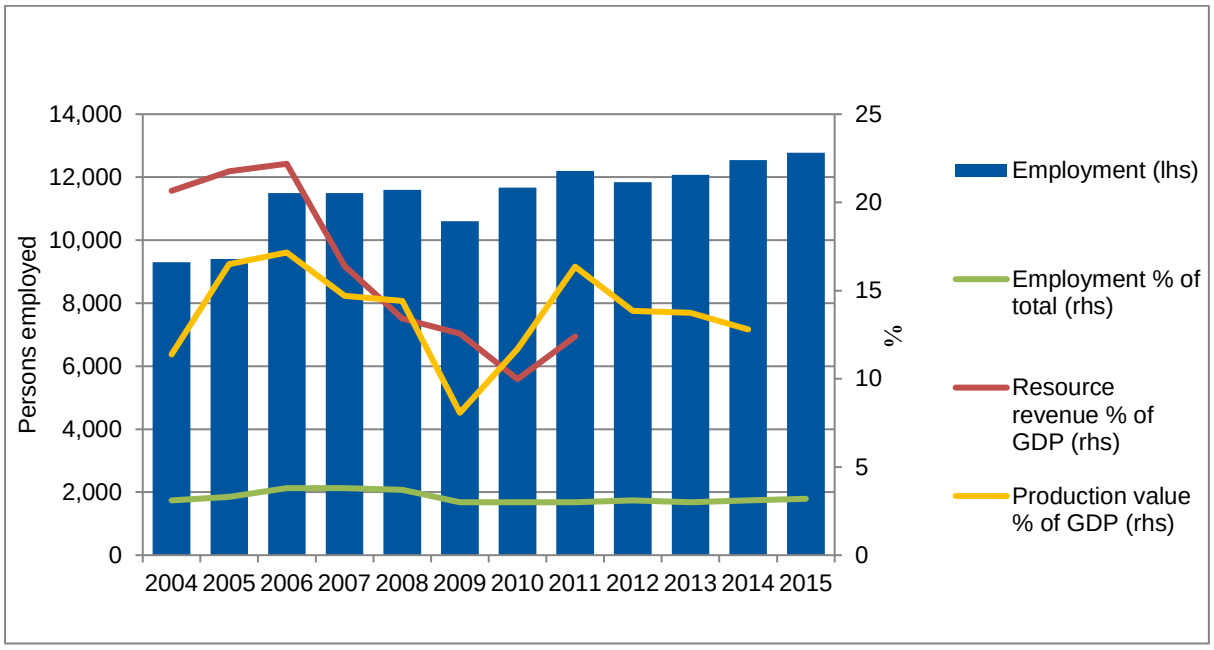
Figure 10: Peru, employment in the mining sector



Rhs: right-hand scale.

Source: authors' compilation based on data from EITI, IMF, and Raw Materials Data.

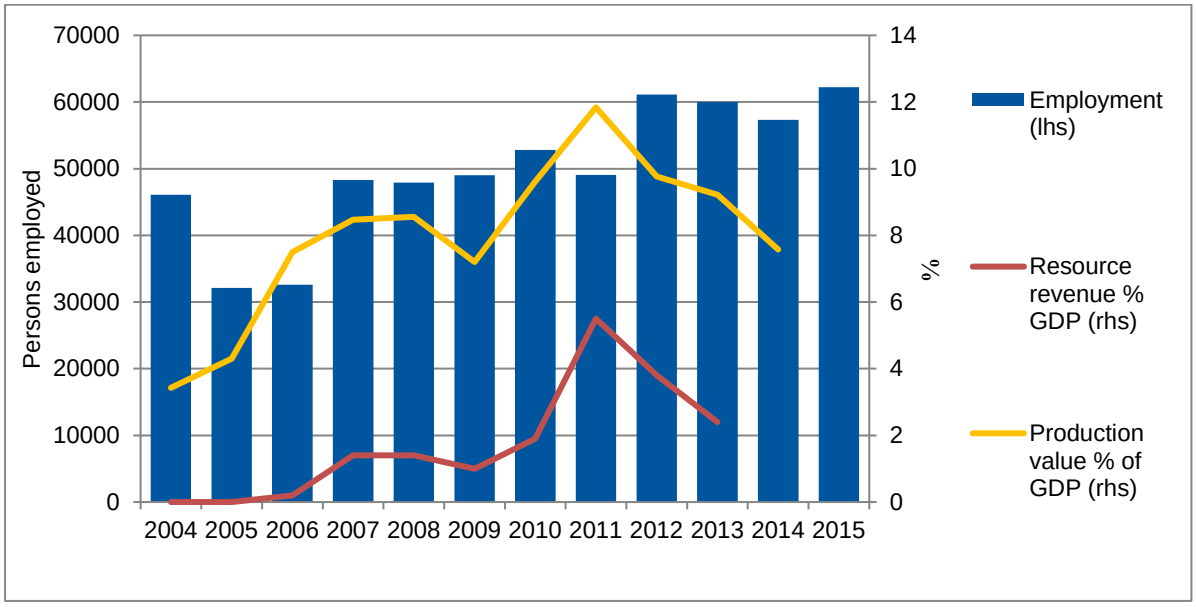
Figure 11: Botswana, employment in the mining sector



Lhs: left-hand scale. Rhs: right-hand scale.

Source: authors' compilation based on data from Government of Botswana, IMF, and Raw Materials Data.

Figure 12: Zambia, employment in the mining sector



Rhs: right-hand scale.

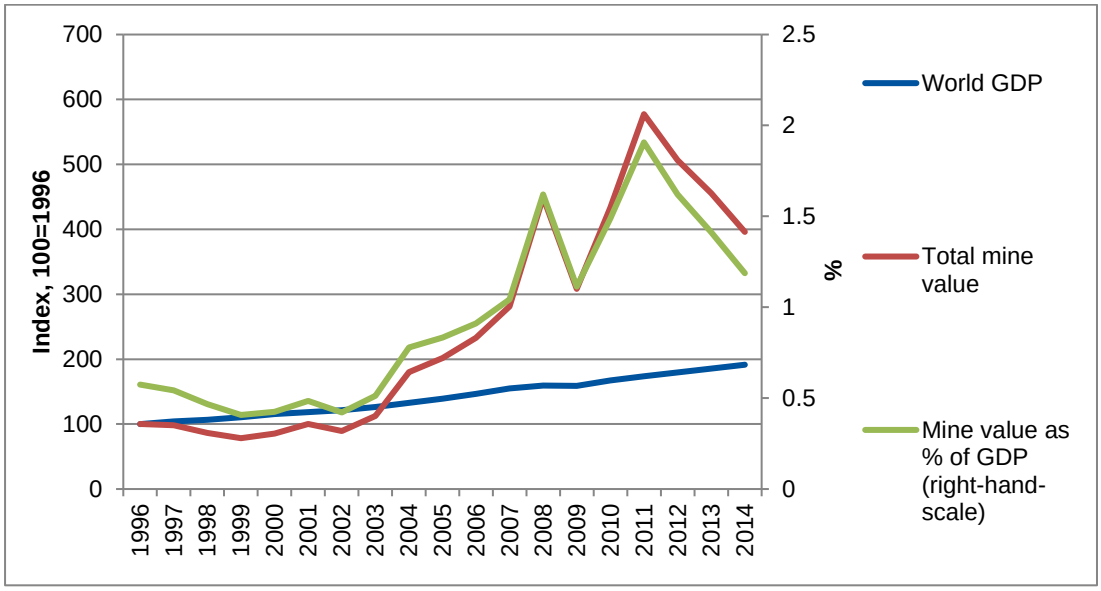
Source: authors' compilation based on data from Zamstats, IMF, and Raw Materials Data.

4 Changes in MCI-W since 1996

The 1996 value of mineral production at the mine stage was US$300 billion (in nominal terms), equivalent to 0.6 per cent of total world GDP PPP (World Bank 2016). In 2011 mine value peaked at US$1,800 billion (1.9 per cent of global GDP); it has since fallen back to US$1,200 billion and 1.2 per cent of world total GDP (Figure 13). The super cycle—the long boom in metal and mineral markets and prices beginning in 2003—made mining a more important part of GDP in almost all mining countries. The share of mining in global GDP doubled in four years, and peaked at three times higher in 2011 than in 1996.

These dramatic changes in the preconditions for mining's contribution to national economies also had strong effects on MCI-W. In 1996 Chile was number one in the MCI-W ranking while DRC, which is number one 2014, was ranked only at number 24.

Figure 13: Value of mine production as a share of world GDP



Source: authors' compilation based on data from World Bank, US Geological Survey, British Geological Survey, World Mineral Statistics, and Raw Materials Data.

Among the 20 LIE and MIE which had the highest MCI-W ranking in 1996, no fewer than 13 economies have climbed up one step in the World Bank's income group classification (Tables 6 and 8). In 1996 the MCI-W top 50 included six HIE, five UMIE, 21 LMIE, and 18 LIE. By contrast, in 2014 the numbers are: four HIE, 16 UMIE, 18 LMIE, and 12 LIE. Zambia, Ghana, Guyana, Mauretania, Mongolia, and Tajikistan were classified as LIE in 1996 but LMIE in 2014. Countries classified as LMIE in 1996 but UMIE in 2014 are: Peru, Kazakhstan, Suriname, Botswana, Namibia, Fiji, Cuba, and Venezuela. Chile and Russian Federation became HIE between 1996 and 2014.[9] There are of course many factors influencing these gradual economic developments, but it seems likely that the contribution of mining and minerals is one important factor.

[9] Russian Federation is among the UMIE again in 2015.

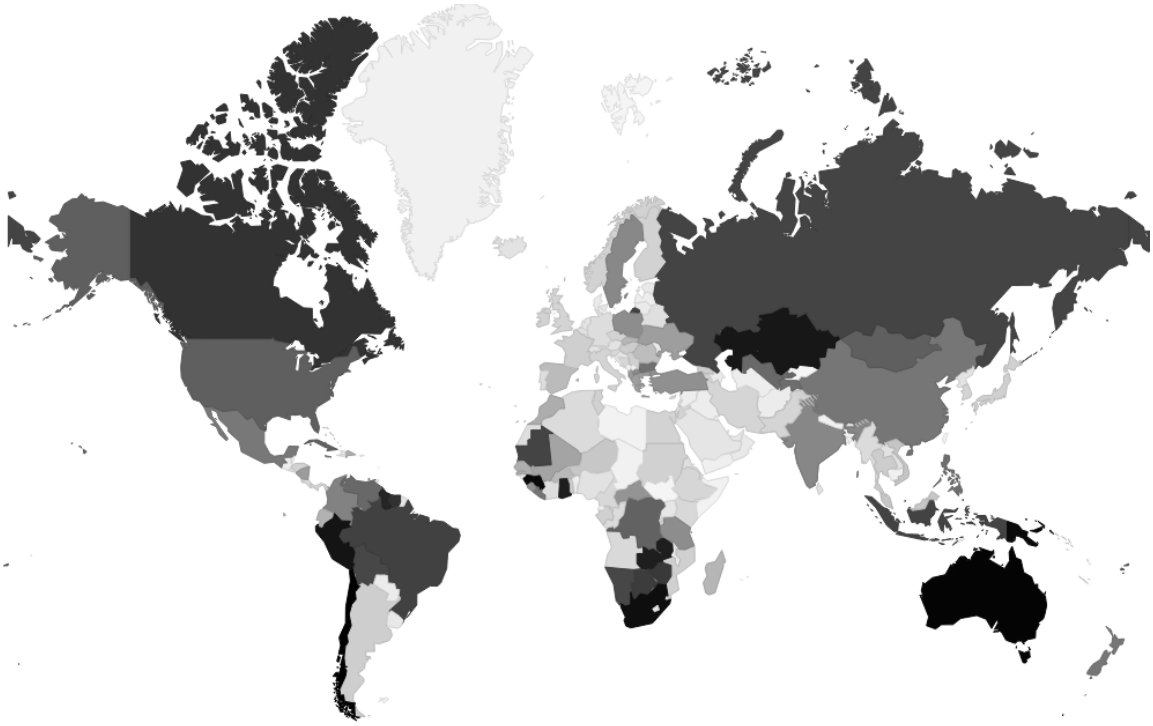
Table 6: Change in country classification, 1996–2014

Country	1996	2014	↑ ↔↓
Chile	UMIE	HIE	↑
Papua New Guinea	LMIE	LMIE	↔
Guinea	LIE	LIE	↔
South Africa	UMIE	UMIE	↔
Peru	LMIE	UMIE	↑
Kazakhstan	LMIE	UMIE	↑
Zambia	LIE	LMIE	↑
Ghana	LIE	LMIE	↑
Guyana	LIE	LMIE	↑
Suriname	LMIE	UMIE	↑
Zimbabwe	LIE	LIE	↔
Botswana	LMIE	UMIE	↑
Brazil	UMIE	UMIE	↔
Indonesia	LMIE	LMIE	↔
Russian Federation	LMIE	HIE	↑
Mauritania	LIE	LMIE	↑
Bolivia	LMIE	LMIE	↔
Namibia	LMIE	UMIE	↑
Fiji	LMIE	UMIE	↑
Mongolia	LIE	UMIE	↑
DRC	LIE	LIE	↔
Cuba	LMIE	UMIE	↑
Venezuela	LMIE	HIE	↑
Uzbekistan	LMIE	LMIE	↔
Tajikistan	LIE	LMIE	↑
Philippines	LMIE	LMIE	↔
Bulgaria	LMIE	UMIE	↑

Source: authors' compilation based on World Bank data.

When comparing the mining contribution to national economies between 1996 and 2014 at the global level, we see a broadly similar picture (compare Figures 2 and 14). There are, however, regions and specific countries that have climbed up the rankings very significantly. West Africa, for example, is a region that has now moved to the top of the MCI-W rankings.

Figure 14: MCI-W score by country, 1996



Source: authors' calculations.

Individual countries which have climbed in the MCI-W rankings can be seen in Table 7. Lao PDR and Eritrea did not have any industrial-scale mining in 1996, so when mining started they went from almost zero to a point today where mining is contributing considerably to their economies. African mining countries in particular have gained an increase in MCI-W score. Among the 16 countries whose MCI-W score increased more than 25 per cent between 1996 and 2014, no fewer than 13 are in Africa.

Table 7: Changes in MCI-W score, 1996–2014

Country	Percentage change
Lao PDR	303.5
Eritrea	255.6
Côte d'Ivoire	154.8
Burkina Faso	74.6
Sudan	68.8
Mozambique	64.5
Serbia	60.9
Togo	59.5
Mali	58.6
DRC	35.7
Sierra Leone	35.0
Senegal	32.7
Madagascar	32.3
Tanzania	29.9
Mongolia	29.3
Morocco	27.9

Source: authors' calculations.

Table 8: Changes in MCI-W score, 1996–2014

Country	Rank 1996	Rank 2014	↑ ↔↓	MCI-W score 1996	MCI-W score 2014	↑ ↔↓
Chile	1	2	↓	94.5	95.2	↑
Papua New Guinea	3	5	↓	92.2	93.4	↑
Guinea	4	13	↓	92.2	88.6	↓
South Africa	5	11	↓	91.3	89.2	↓
Peru	6	7	↓	90.0	91.4	↑
Kazakhstan	7	23	↓	89.1	80.4	↓
Zambia	8	6	↑	87.6	92.6	↑
Ghana	9	17	↓	87.5	84.5	↓
Guyana	10	10	↑	85.9	89.9	↑
Suriname	11	21	↓	83.1	81.0	↓
Zimbabwe	13	25	↓	81.3	78.8	↓
Botswana	14	12	↑	80.5	89.0	↑
Brazil	15	29	↓	79.4	77.0	↓
Indonesia	16	31	↓	79.1	75.9	↓
Russian Federation	17	30	↓	78.8	76.1	↓
Mauritania	18	16	↑	78.7	88.5	↑
Bolivia	19	19	↔	78.1	77.5	↓
Namibia	20	20	↔	78.0	86.2	↑
Fiji	21	65	↓	74.9	56.2	↓
Mongolia	22	4	↑	72.6	93.9	↑
DRC	24	1	↑	71.9	97.6	↑
Cuba	25	83 (2013)	↓	71.8	43.6	↓
Venezuela	26	140	↓	70.3	17.9	↓
Uzbekistan	27	20	↑	70.3	81.2	↑
Tajikistan	28	35	↓	69.2	70.4	↑
Philippines	29	34	↓	68.8	71.6	↑
Bulgaria	30	48	↓	68.6	65.7	↓

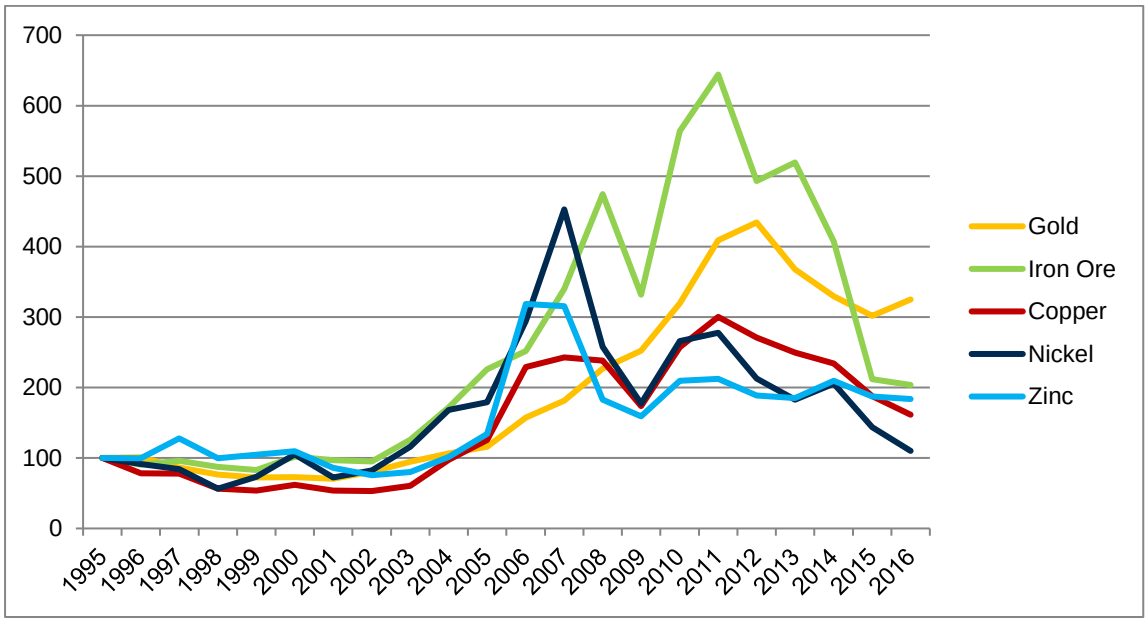
Source: authors' calculations.

In summary, mining quite clearly increased its contribution to economic activity in the low- and middle-income countries between 1996 and 2014. The increase in contribution is higher in LIE than in MIE. Mining's share of GDP tripled during these years for these two categories of country. The share was 3.1 per cent in 2014, compared with 1.1 per cent in 1996. Mineral exports' share of total exports in those countries increased by 50 per cent in the same period. Mineral rents followed the general price developments and reached a peak in 2011, but have declined since, although they are still higher in 2014 than they were in the 1990s. Exploration spending in the countries studied

increased over the period as a whole, but has been declining steeply since 2013. Several LIE and MIE with high MCI-W scores in 1996 have developed successfully and risen in the World Bank GNI classification from LIE to MIE and from LMIE to UMIE. The MCI-W index for individual countries has moved up and down depending on the performance of their mining sector relative to other sectors of the economy. It is difficult to draw any general conclusions from this relative index. There is a need to further develop the contribution index with this in mind.

5 The impact of the end of the super cycle

Figure 15: Price index, yearly averages



Source: authors' illustration based on data from Raw Materials Data and UNCTAD.

Over the first decade of the new millennium, the global mining industry moved from a long period of low prices, unacceptable levels of return, and limited investments to a boom with record high metal prices, improved profitability, and a flurry of new projects. The main driving force behind this change back in 2003–04 was strong demand for metals and minerals, especially from China. This spurred high levels of investment into the extractive industry in order to increase supply to meet growing demand. Since 2011–12 metal prices have dropped, but—excluding nickel—not to pre-boom price levels (Figure 15).

Among the most important metals, gold stands out in that its price has not fallen as precipitously as that of the other minerals, and indeed has already started to move upwards again.

As shown in Figure 5, gold is the single most important metal for the LIE and MIE with the highest MCI-W rankings. Forty-five per cent of their total mine value is from gold mining, and it is the main contributor in nine of these 20 individual countries. Table 9 lists the 18 LIE and MIE in the MCI-W top 50 where gold was the single largest contributor to the value of mine production in 2014. In 17 countries, gold mining contributed more than 50 per cent of the total value of all mineral production. In Côte d'Ivoire, Mali, Nicaragua, and Sudan, gold contributed 100 per cent of total value. Among all the LIE and MIE together, there are a total of 31 nations where gold mining is the main contributor. When small-scale/artisanal gold mining is also considered (such production is not always fully accounted for in the national statistics used), the importance of gold

production and the significance of the relative stability of the gold price are even greater. This is also valid for a number of LIE such as Sudan, Burundi, and Cameroon, where small-scale/artisanal gold production is considerable.

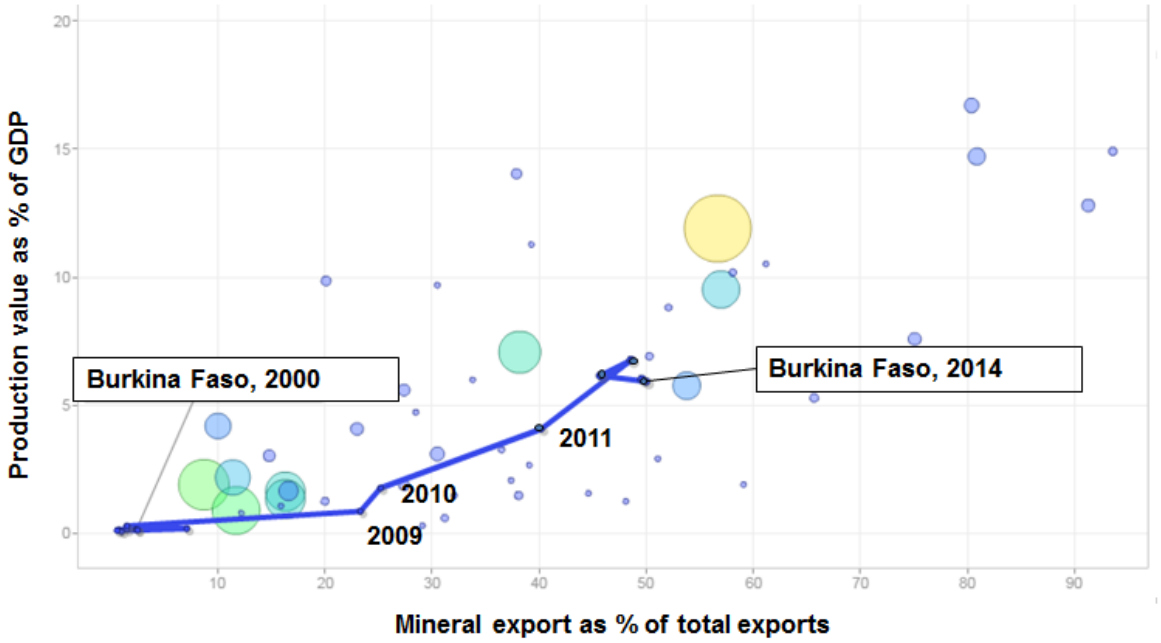
Table 9: Share of total value of mineral production for gold, 2014

Country	Gold contribution	Gold production, tonnes
Côte d'Ivoire	100%	17.0
Mali	100%	48.5
Nicaragua	100%	7.7
Sudan	100%	70.0
Ghana	94%	98.5
Tanzania	92%	40.6
Burkina Faso	92%	37.0
Togo	91%	20.6
Dominican Republic	89%	36.0
Guyana	88%	12.0
Suriname	85%	10.6
Kyrgyzstan	83%	18.0
Uzbekistan	82%	102.0
Senegal	78%	6.6
Papua New Guinea	75%	52.9
Niger	59%	0.7
Guinea	55%	17.0
Bolivia	43%	39.2

Source: authors' compilation based on Raw Materials Data.

One conclusion is that LIE and MIE dependent on gold mining have not been affected as severely by the end of the super cycle as countries producing certain other metals, such as nickel and iron ore. An example is visualized in Figure 16. The figure shows a circle for each year between 2000 and 2014 for Burkina Faso's position on the x-axis (mineral export as percentage of total exports) and y-axis (production value as percentage of GDP). The blue line joins these together in chronological order. Other circles in Figures 16–19 represent other countries and their position in 2014. The colours (blue, green, yellow, and red in order of size) are intended to make it easier to see the size of the circles. In 2000 Burkina Faso had limited mining, the production value as percentage of GDP was close to zero, and exports were just a few per cent. By 2014 production value as a percentage of GDP was around six per cent, and exports as a percentage of total exports were 50 per cent. Gold output in Burkina Faso was fairly constant between 2011 and 2014 at around 30–35 tonnes, while the gold price decreased 24 per cent between 2012 and 2014. However, the levels of mine value as a percentage of GDP and mineral exports were at roughly the same levels in 2012 as in 2014. The example confirms that the impact of the end of the super cycle has been smaller for Burkina Faso and other LIE and MIE where gold mining is important.

Figure 16: Burkina Faso, development in export and production values, 2000–2014

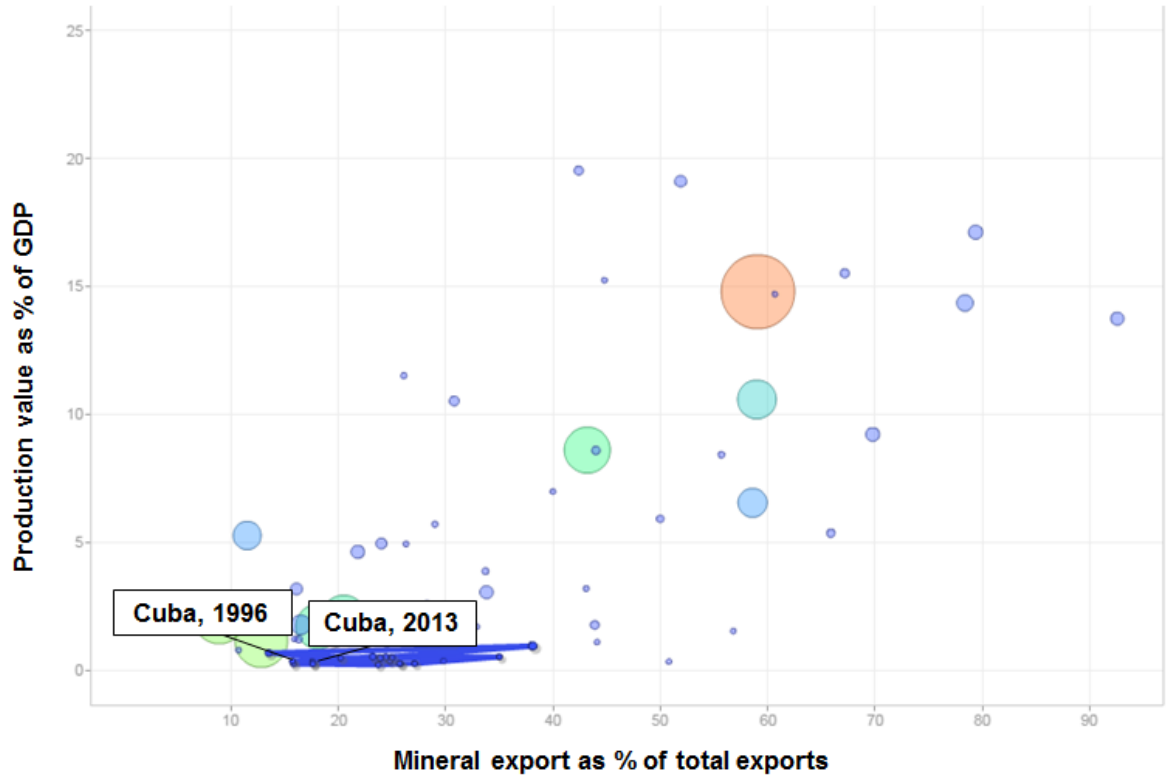


Circles and circle colours are proportional to value of mine production.

Source: authors' calculations.

By contrast, in Cuba, where nickel contributes around 80 per cent of total mine production value, there is a somewhat different picture (Figure 17). The MCI-W ranking for Cuba dropped from 37 in 2007 to 83 in 2013 (no GDP figure for 2014), and minerals' share of exports declined from 38 per cent in 2007 to 15 per cent 2015. However, the share of mining in GDP has remained more or less constant, while minerals' share of exports has swung with the ups and downs of nickel prices.

Figure 17: Cuba, development in export and production values, 1996–2013

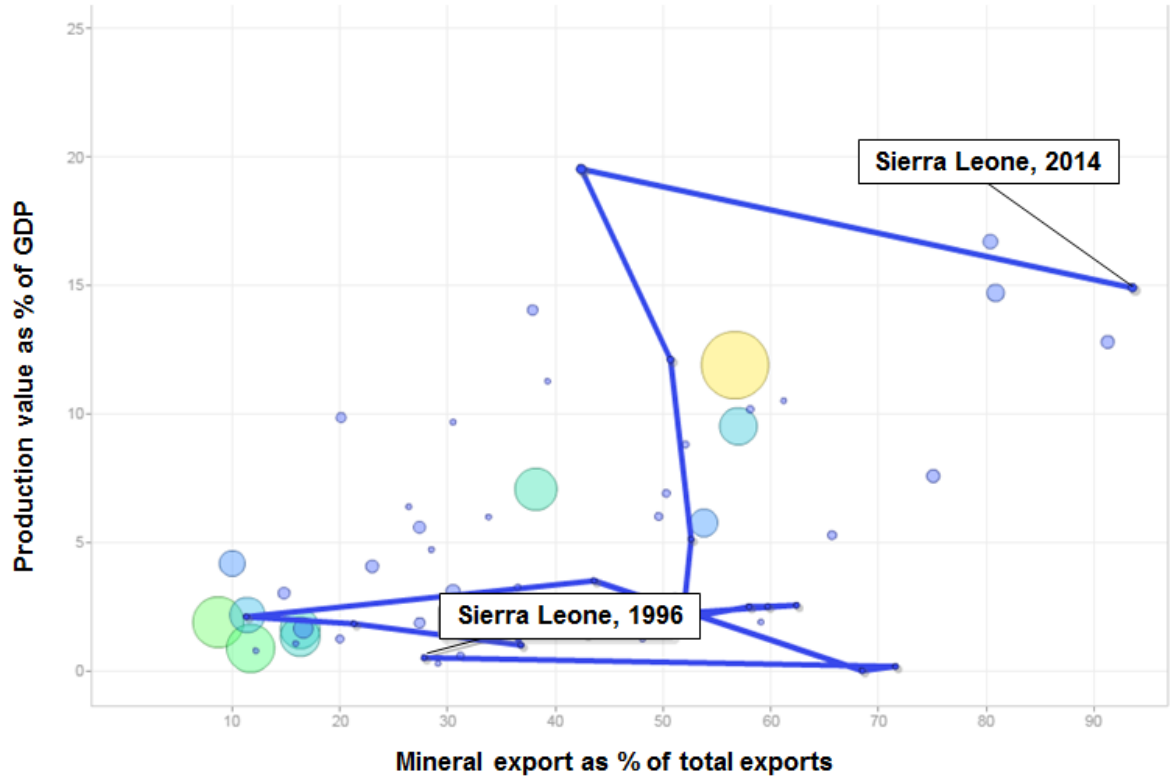


Circles and circle colours are proportional to value of mine production.

Source: authors' calculations.

Another country that benefitted from the price hikes during the super cycle was Sierra Leone, which ranked number 31 in MCI-W in 2011 but number 19 in 2014 (Figure 18). Iron ore is the main mineral commodity. Sierra Leone was hit hard by plummeting iron ore prices after 2011. In 2015 both of the two operating iron ore mines were shut down. One of the mines was later reopened by its Chinese joint venture partner in the second half of the year. Production of iron ore in Sierra Leone was only 2.6 million tonnes in 2015, a drop of 88 per cent compared with 2014 (UNCTAD 2016). In the previous three years, the country had benefited from high iron ore prices, and production also soared from only 1.3 million tonnes in 2011 to a peak of 21.4 million tonnes in 2014. Exports followed suit. However, the falling iron ore prices of the past two years have taken their toll, and the country will definitely fall in the MCI-W ranking for 2015.

Figure 18: Sierra Leone, development in export and production values, 2000–2014

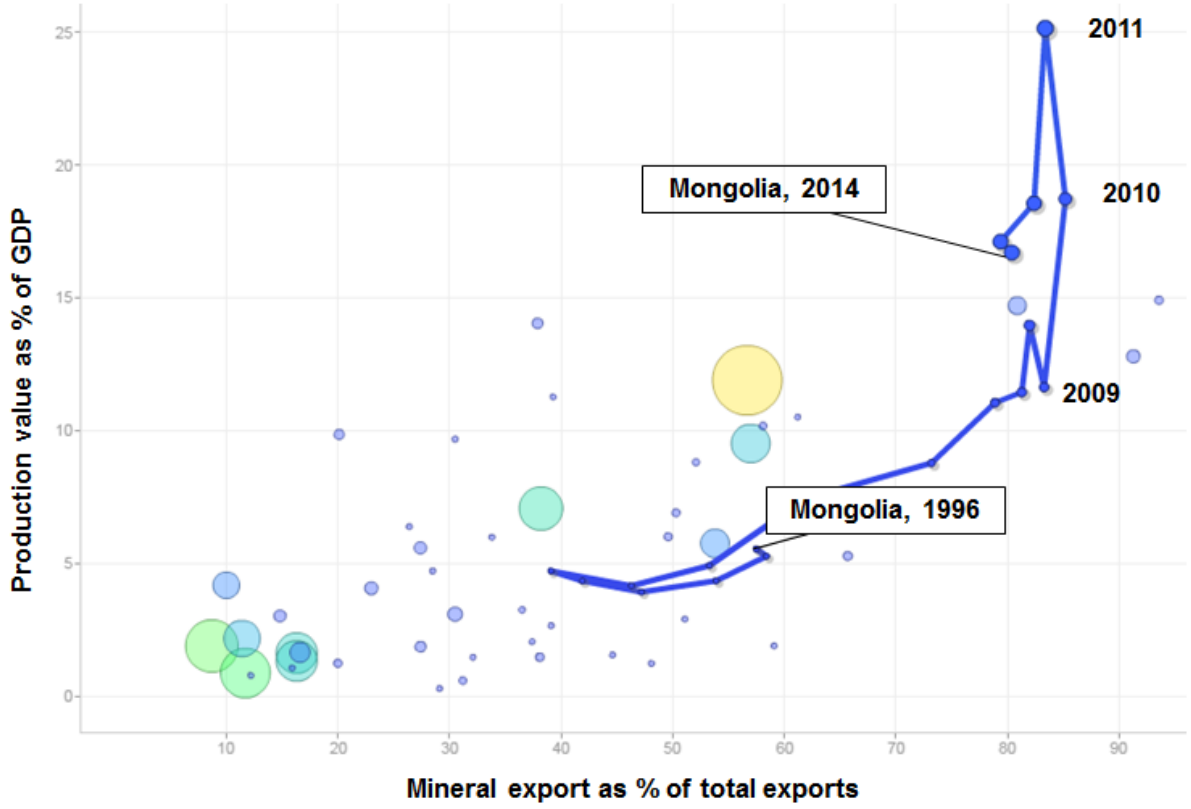


Circles and circle colours are proportional to value of mine production.

Source: authors' calculations.

Mongolia is ranked number four in MCI-W 2014. It is dependent on copper and coal for about 70 per cent of its total mineral output. Despite copper production doubling between 2011 and 2014, mine value as a percentage of GDP fell from 25 per cent in 2011 to about 17 per cent in 2014, a decrease of 30 per cent (Figure 19). The copper price fell by almost 50 per cent in the same period, explaining a part of the decline in mining's contribution. Parts of the decline are probably explained by other sectors of the economy having grown at a higher rate than the economy in general. However, Mongolia is still heavily dependent on mineral exports: around 80–85 per cent in the years 2006–14. It is likely that the contribution of mining to the economy of Mongolia will remain at a high level.

Figure 19: Mongolia, development in export and production values, 2000–14

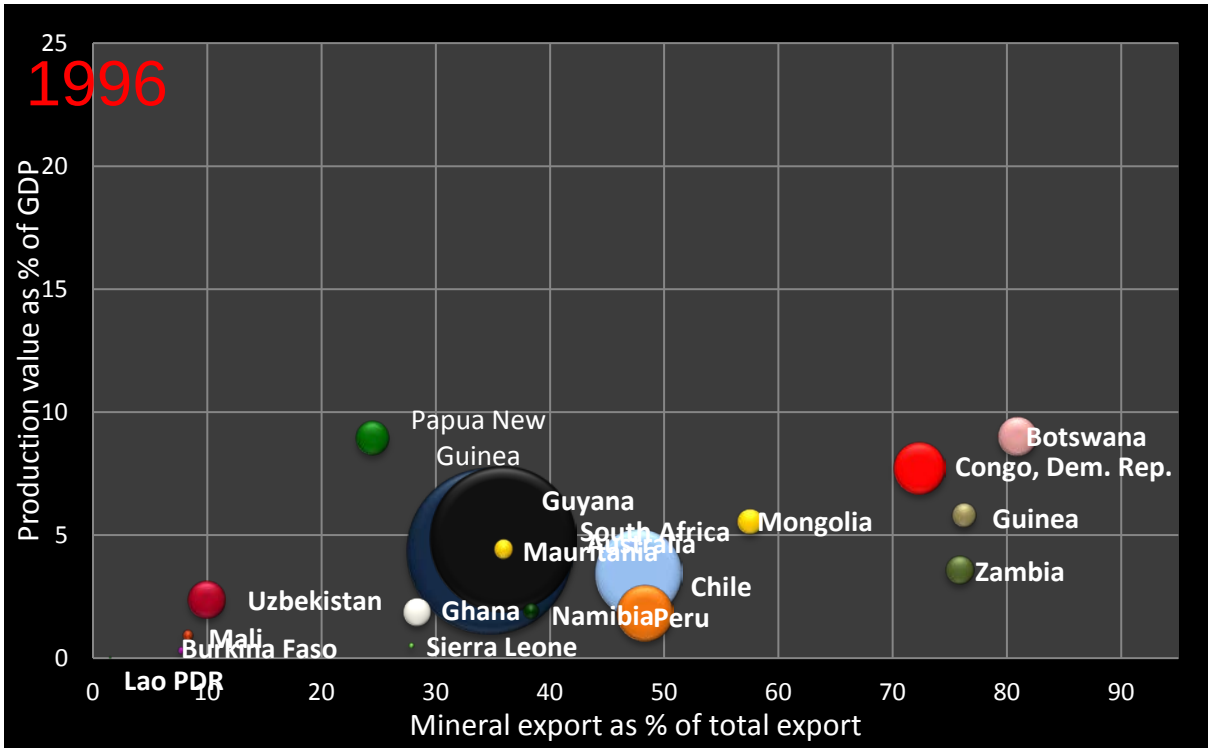


Circles and circle colours are proportional to value of mine production.

Source: authors' calculations.

Figures 3, 20, and 21 allow a comparison of the top 20 MCI-W countries of 2014 with their corresponding positions in two earlier years, 1996 and 2011 (when prices were at their peaks). In this group of countries (of which all but two are LIE and MIE), most moved from the bottom-left corner in 1996 towards the upper-right corner in 2011, but then fell back to somewhere between in 2014. These movements are an indication that mining's contribution is at significantly higher levels in these countries after the commodity price super cycle than was the case in 1996, albeit at somewhat lower levels than at the peak of prices in 2011.

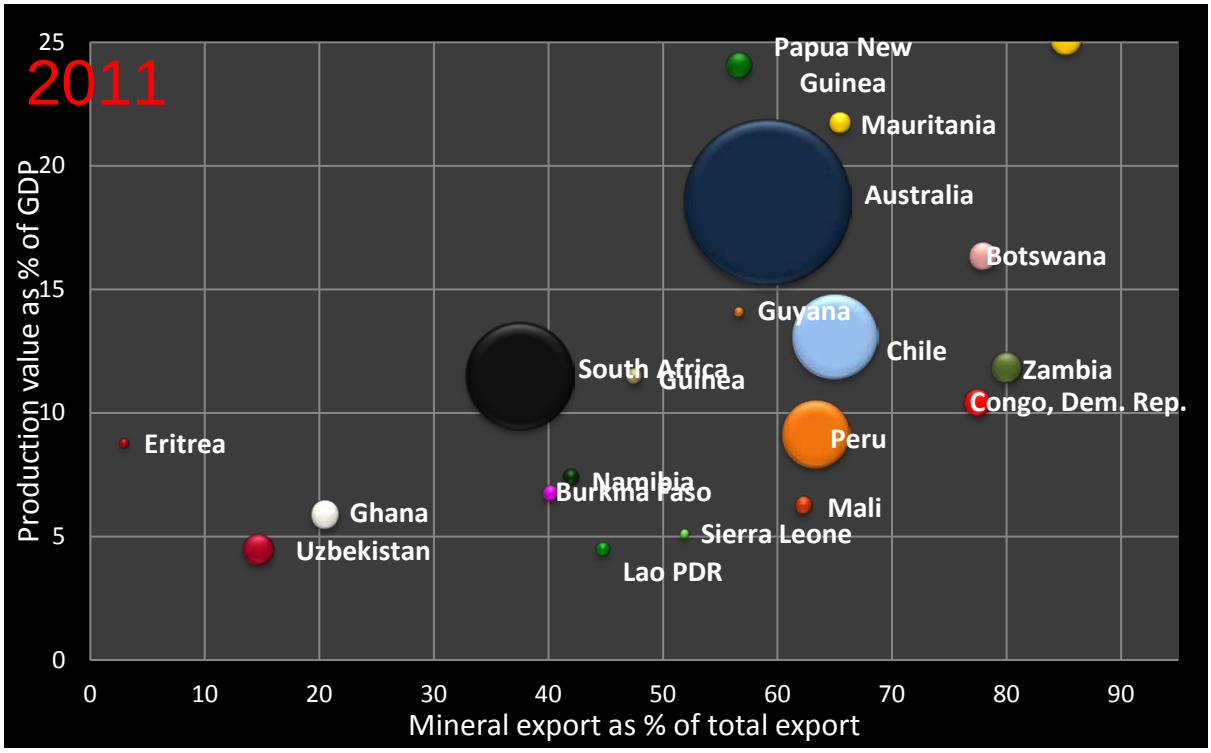
Figure 20: MCI-W top 20 countries, 1996



Circles and circle colours are proportional to value of mine production.

Source: authors' calculations.

Figure 21: MCI-W top 20 countries, 2011



Circles and circle colours are proportional to value of mine production. The yellow semicircle in the upper-right corner without a country label is Mongolia.

Source: authors' calculations.

To sum up, the end of the super cycle has hit countries in different ways, depending on the composition of their mineral production and many other factors. Gold mining countries are experiencing slower but still continuing growth. The level of export dependency and mining's share of GDP reached a maximum at the peak of the mining boom in 2011, when the GDP contribution reached as high as 25 per cent for some countries and export dependency went over 85 per cent. Naturally these figures had declined for some countries by 2014, but the situation for most countries was still a significantly larger contribution of/dependency on mining than in 1996. For some countries, production value as a percentage of GDP and mineral exports are even higher in 2014 after the price peak in 2011, because of a strong growth in production: this is the case for DRC, Sierra Leone, and Eritrea. Countries with a higher share of mineral exports in 2014 compared with 2011 are Burkina Faso, Mali, Guyana, Ghana, Namibia, Mauritania, Guinea, and Botswana.

6 Future implications of extractives dependency

Metal and mineral prices are at present low relative to the peaks of 2011, but still well above the low levels of the early 2000s. Exploration expenditure is also low, and investments into new mines are also at a relatively low level. At the same time, it is clear that demand for metals and minerals in general has not dropped as much as prices have. There are clear indications that the price trough is generated more by an oversupply situation than by a fall in demand (see e.g., Worstall 2015). With the gradual improvement in standards of living, increased life expectancy, and continuing urbanization, which constitute the three major long-term drivers of metal and mineral use, it seems as if there will be a continuing, slow, and gradual increase in metal demand (McKinsey Global Institute 2013). Increased recycling and alternative energy sources might change this situation in the long-term future, but will not affect mid-term scenarios. One of the major reasons for the 2003–11 super cycle was the slow response of the mining industry to increased demand. It takes a minimum of three to five years to increase mine capacity, and this time lag is increasing all the time due to the increasing advantages of scale economies, i.e. bigger mines with larger investments and longer and more difficult permitting processes. In short there are no signs of the lag time decreasing—rather the opposite. In principle, the global mining industry faces a similar situation during the next few years as it did in the early 2000s: slowly increasing demand, but some hesitancy about investing, and hence a low elasticity in mine production in response to demand. There is today less indication of such a strong growth in demand as was seen in the early 2000s. Nevertheless, metal prices might shoot up when supply gets short. The situation might also be exacerbated by the fact that investments into exploration have dropped dramatically in the recent past, and this might be a factor slowing the opening of new mines when new capacity is needed.

In the second half of 2016 (the time of writing) there are some indications that the bottom of the present cycle has been reached. However, the question remains as to how long prices will remain at their present relatively low levels. The possibility of a steeper upturn than expected is not completely unrealistic (see e.g., Keen 2016). Given the long lead times for a mining project to get into production, it is important for mineral-rich countries not to focus too much on present metal prices, but to maintain a long-term approach to their national mineral resources.

As noted earlier, of the 20 LIE and MIE economies with the highest MCI-W scores in 1996, no fewer than 16 have climbed one step on the Word Bank economic development classification. At the other end of the MCI-W rankings, when we compare the World Bank classification of the bottom 20 LIE and MIE in 1996 and 2014, there are only nine countries that moved up one step. There are certainly many reasons why countries have *not* developed in this period, and naturally not only because of lack of mining activity. Nevertheless, a statistical conclusion from this study

is that mining can and has triggered development in several countries. When the analysis is expanded to include how the Gini coefficient has developed in the mineral-rich countries, it further seems as if inequalities have decreased. In this sample of the 20 LIE and MIE with the highest MCI-W scores in 1996, the Gini coefficient has remained constant or decreased, i.e. inequalities have diminished in 14 countries and increased in six countries. Further, in one of the countries exhibiting a higher Gini coefficient in 2014, the increase was marginal.[10]

7 Conclusions

'Contribution' or 'dependency': even the choice of words to describe the relationship between national economies and the extractive sector poses a fundamental choice between good and bad. The traditional perspective in many historically resource-rich countries—such as our own country, Sweden—has been to view mineral resources as fountains from which wealth flows and development grows. To express it poetically, 'Through Swedish history sounds a mighty ringing of iron and copper from medieval times until today' (Furuskog 1935: 65)—clearly an analysis of the *contribution* of minerals to Swedish development.

From the 1990s until just a few years ago, however, the *dependency* approach was the dominant norm. The resource curse paradigm was the starting point for critical analyses in a host of works on mining during the past 20 years. During the super cycle of high metal prices and high oil prices, this a priori negative starting point was sometimes abandoned. There was an increasingly important view based on the hypothesis that the problem might not be the minerals as such, but rather the way the economic results they created were handled. McKinsey Global Institute's (2013) report entitled 'Reverse the Curse' is but one example of this recent turnaround in thinking. Another example is the discussion about mining's potential role as a catalyst for the diversification of national economies (Bastida 2014), the World Bank report on 'The Contribution of the Mining Sector to Socioeconomic and Human Development' (McMahon and Moreira 2014), and the study 'Local Industrial Shocks, Female Empowerment and Infant Health: Evidence from Africa's Gold Mining Industry' (Tolonen 2014).

This study provides backing for this reversal and reorientation by presenting a thorough statistical analysis of almost all countries in the world, including in particular all metal- and industrial mineral-producing countries. We therefore prefer the word 'contribution', as we cannot imagine a world without metals and minerals, and hence mineral resources need not be viewed as a curse if managed carefully.

7.1 Contribution of mining industries in low- and middle-income countries

Among the 50 countries with the highest MCI-W scores, 34 are middle-income countries, 12 low-income countries, and only four high-income countries. Clearly mining plays a particularly important role in many low- and middle-income countries. Among the top 20 countries, DRC has the highest score, followed by Mongolia, Papua New Guinea, Zambia, Peru, and Guyana among the middle-income countries, and by Burkina Faso and Mali among the low-income countries (rankings eight and nine). The high-income countries Chile and Australia are ranked two and three respectively, demonstrating that in high-income countries too, mining can and does remain an

[10] The Gini coefficient is not updated every year for all countries by the World Bank or UNU-WIDER World Income Inequality Database. In cases where the years 1996 and 2014 were not available, the closest year was selected.

important contributor to the national economy. Among the 20 highest-ranking countries, Africa dominates with 12 countries. The vision of minerals as an important part of African economic development is clearly well founded. There are only three countries each from Asia and Latin America, and two from Oceania, in the top 20.

Of the world's 10 largest mineral producers, in order of production value, China ranks 45th in MCI-W, Australia ranks at number three, USA is not even in the top 50, Russian Federation ranks 30, India ranks 42, South Africa ranks 11, Indonesia ranks 31, Brazil ranks 29, Chile ranks two, and Canada ranks 27. This confirms that a high *absolute* value of mine production does not automatically translate into an important contribution to GDP and exports.

7.2 Change in contribution over the past 20 years

Among the 20 low- and middle-income countries with the highest MCI-W score in 1996, no fewer than 13 have climbed up one step on the GNI development classification to the lower-middle-, upper-middle- or high-income category. There are of course many factors contributing to this development, but it seems likely that mining and minerals are one important factor. Geographically, Africa has benefitted most, and in particular West Africa—a region of growing mineral importance—is the prime example of this. Among the 16 countries where the MCI-W score increased by more than 25 per cent between 1996 and 2014, no fewer than 13 are in Africa.

The value of mineral production measured as a percentage of GDP grew from 1.1 per cent in 1996 to 3.1 per cent in 2014: on average, a growth of 200 per cent. In 1996 mineral exports as a percentage of total exports of the LIE and MIE taken together was 12.1 per cent. By 2014 that figure had increased to 17.4 per cent. Furthermore, the figures for both GDP and export share of minerals and mining is considerably higher on average for LIE than for MIE. The levels of GDP and export contribution in 2014 are still at a higher level than in 1996, in spite of the drop in metal prices since the end of the super cycle.

It has not been possible to include employment in the mineral sector as one of the contributing factors to our mining contribution index, because of a lack of data. Nevertheless, the countries for which statistics are available clearly demonstrate that employment is a stabilizing factor, as it does not vary as rapidly as the other factors studied. Further, employment levels in general increased over the period 1996–2014.

7.3 Impact of the end of the super cycle

The contribution of minerals and mining to GDP and exports reached a maximum at the peak of the mining boom in 2011. Naturally, the figures for mining's contribution had declined for most countries by 2014, but importantly the levels were still considerably higher than in 1996.

The results of this survey do not support the widespread view that mineral resources create a difficult dependency which might not be conducive to economic and social development—rather the opposite. Certainly, the indicators on which we base our study only shed light on some aspects of economic and social development. But we think we have enough substance to claim that if additional low- and middle-income countries could locate additional mineral resources, their chances of economic development would be better than they are at present, when only limited mineral resources are known.

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Appendix

Table A1: Top 50 countries in MCI-W

Country	Classification		Percentage of total export		Production value percentage of GDP		Exploration US$ millions		Mineral rents percentage of GDP	
	2014	1996	2014	1995	2014	1996	2014	1996	2014	1996
DRC	LIE	LIE	80.9	75.4	14.7	7.7	306	-	20.1	1
Chile	HIE	UMIE	57	49.5	9.5	3.5	707	156	14.5	6.1
Australia	HIE	HIE	56.7	36.8	11.9	4.4	1254	666	5.1	1
Mongolia	UMIE	LIE	80.4	59.9	16.7	5.5	54.6	-	16.3	8.9
Papua New Guinea	LMIE	LMIE	37.9	36	14	8.9	169	32.6	16.5	12.4
Zambia	LMIE	LIE	75.1	87.3	7.6	3.6	120	10	13.2	3.8
Peru	UMIE	LM	53.8	50.2	5.8	1.8	559	156	6.4	0.5
Burkina Faso	LIE	LIE	49.6	11.4	6	0.3	152	32.4	8.1	-
Mali	LIE	LIE	65.7	17.1	5.3	0.9	79.1	22.6	9.6	-
Guyana	LMIE	LIE	61.2	42.1	10.5	6.3	29.5	8.1	14.4	5.6
South Africa	UMIE	UMIE	38.2	36	7.1	4.8	195	71.7	3.2	0.8
Botswana	UMIE	LMIE	91.3	80.7	12.8	9	48.9	3	1.8	0.2
Guinea	LIE	LIE	52.1	76.7	8.8	5.8	33.4	16.6	9.6	5.2
Mauritania	LMIE	LIE	58.1	38	10.2	4.4	23.2	2.5	28.1	5.8
Eritrea	LIE	LIE	38.6	0	9	-	25.2	-	17.4	-
Namibia	UMIE	LMIE	50.3	38.3	6.9	1.9	60.4	4.3	1.9	0.4
Ghana	LMIE	LIE	23	31.5	4.1	1.9	89.7	42.8	6.5	1.1
Lao PDR	LMIE	LIE	36.5	5.4	3.3	0	32.1	1.3	9	-
Sierra Leone	LIE	LIE	93.6	26.2	14.9	0.5	31.8	1.2	0.2	0
Uzbekistan	LMIE	LMIE	30.5	14.3	3.1	2.4	30.5	1.2	5.6	1.6
Suriname	UMIE	LMIE	33.8	73.5	6	1.8	18.7	7.6	6.4	4.7
Tanzania	LIE	LIE	38.1	3.9	1.5	0.2	96.8	27.3	2.6	0
Kazakh-stan	UMIE	LMIE	10	30.9	4.2	3.2	126	36.5	2.6	1.4
Liberia	LIE	LIE	39.3	81.2	11.3	1.1	18.6	-	0.8	9.3
Zimbabwe	LIE	LIE	20.1	16.2	9.9	2.2	14	9.3	4.2	3.4
Kyrgyzstan	LMIE	LIE	28.5	14.7	4.7	0.8	15.7	4.7	7.2	0.2
Canada	HIE	HIE	11.4	8.7	2.2	1.1	1487	461	0.7	0.3
Bolivia	LMIE	LMIE	27.4	40.1	5.6	1.1	18.1	25.2	2	0
Brazil	UMIE	UMIE	16.3	11.3	1.3	0.4	312	124	1.4	0.3
Russian Federation	HIE	LMIE	8.7	11.2	1.9	1	558	19.3	1.1	0.3
Indonesia	LMIE	LMIE	16.3	8.4	1.6	0.4	178	191	0.8	0.7

Colombia	UMIE	LMIE	16.6	12.6	1.6	0.5	184	2.9	0.6	0.1
Senegal	LMIE	LIE	15.9	12	1.1	0.5	49.5	12.9	1.5	-
Philippines	LMIE	LMIE	7.7	5.4	1	0.2	141	47.8	1.9	0.3
Tajikistan	LMIE	LIE	59.1	37.2	1.9	0.4	4.5	4.1	1.3	0.3
Sudan	LMIE	LIE	27.4	3.1	1.9	0.1	15.4	-	1.1	0.1
Togo	LIE	LIE	30.5	34.3	9.7	1.5	1.3	0.4	1.5	-
Morocco	LMIE	LMIE	7.9	9.8	1.3	0.7	49	-	1.8	0
Mada-gascar	LIE	LIE	37.4	5.2	2.1	0.6	3.6	0.5	3.3	0
Mozam-bique	LIE	LIE	51.1	8.3	2.9	0.2	25.5	0.1	0	0
Serbia	UMIE	No info	5.8	14.8	3	2.8	41.9	-	0.6	-
India	LMIE	LIE	11.7	18.7	0.9	0.7	61.9	1.1	0.6	0.2
Nicaragua	LMIE	LIE	8.3	2.8	1.1	0.2	24	11.7	2.4	0
Macedonia	UMIE	LMIE	5.2	17.9	3	2.3	12.4	-	2.9	0.3
China	UMIE	LIE	1.5	3.6	2.4	2.1	594	4.7	1.2	0.1
Côte d'Ivoire	LMIE	LIE	5.8	0.8	1	0.1	49.6	4.4	1.2	-
Mexico	UMIE	UMIE	4	3.1	0.8	0.2	709	143	0.7	0.1
Bulgaria	UMIE	LMIE	14.8	9.8	3	2.1	3.8	1.1	1.5	1.3
Dominican Republic	UMIE	LMIE	20	2.2	1.2	0.3	6.7	2.8	1.8	0.7
Jamaica	UMIE	LMIE	48.1	49.4	1.2	1.2	3.7	-	1	2.9

Source: authors' calculations.