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ORIGINAL PAPER

Mining's contribution to national economies between 1996 and 2016

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Abstract

In several low- and middle-income countries rich in non-fuel mineral resources, mining makes significant contributions to national economic development as measured by the revised Mining Contribution Index (MCI-Wr). Ten countries among the 20 countries where mining contributes most (highest MCI-Wr score) have moved up one or two steps in the World Bank's country classification between 1996 and 2016. In particular, African countries have benefitted. Socio-economic development indicators also show signs of progress for African mineral-rich countries. This paper provides an update and expansion of an earlier study within the framework of the United Nations University (UNU) World Institute for Development Economics Research (WIDER) initiative Extractives for Development. Based on the detailed data available for the sector, such as production, export, prices, mineral rents, exploration expenditure and government revenues, an analysis is carried out of the current situation for 2016, and trends in mining's contribution to economic development for the years 1996–2016. 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 2016, but importantly 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. In addition, this paper presents an attempt to use already available socio-economic indicators for African mineral-rich countries to measure socio-economic developments. One preliminary conclusion of this survey is that mining countries perform better than oil-producing countries and non-mineral countries in Africa as measured by these indices of human development and governance.

Keywords Extractive industries · Mining contribution · Mineral rent · Africa · "Super cycle" · Mineral export · Exploration · Mine production

Introduction

This paper is an updated and expanded version of a presentation given at the XVth Dundee Mining Seminar held on 5/6 April 2017.[1] The presentation was based on the study *Mining's contribution to national economies* that was initiated by UNU-Wider in Helsinki, which was later developed into a chapter in the book *Extractive Industries: The Management of Resources as a Driver of Sustainable Development.*[2] The UNU-Wider report attempts to explain and document how 'minerals dependency' has changed in the past 20 years on a country-by-country level. In the present paper, the time series is updated to 2016 and a discussion is added of the development of some socio-economic indicators.

Based on available detailed data for the minerals and metals sector in as many countries as possible, an analysis is carried out of the current situation for 2016 compared with 2014, and how the contribution by mining to economic development has changed since 1996. The study covers all non-fuel minerals and coal for short in the text called metals and

[1] 'What are trends in regulating the mining sector? Sharing insights from research and practice', organised by the Centre for Energy, Petroleum and Mineral Law and Policy, Luleå University of Technology and Bundesanstalt für Geowissenschate und Rohstoffe.

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[2] Addison, Tony and Alan R. Roe. 'Extractive Industries: The Management of Resources as a Driver of Sustainable Development', Oxford University Press, 2018.

minerals. Oil and gas are excluded. Economic data have been gathered for production, prices, mineral rents, exploration expenditure and government revenues, and added to this the following socio-economic indicators: Human Development Index, various governance indicators and the Governance and Inequality (the GINI coefficient). The focus is on the following questions:

- How much do the mining industries statistically contribute to national economies?
- Has the level of contribution changed as a result of the sharp drop in the prices of most extracted commodities since about 2011—after the end of the so-called 'super cycle'?
- How has that level of statistical contribution changed over the past 20 years from 1996 to 2016?
- How have socio-economic indicators developed in the same period in African mineral resource rich countries?

The paper covers all countries but low- and middle-income developing economies are given additional attention to follow up on our earlier study.[3] Our intention is to collect and analyse statistical data on a global level over a long period of time and to give an empirical contribution to the discussion about the role of mineral resources in economic and social development of countries. The purpose of the paper is not to provide a full analysis of all the factors behind the observed changes in economic and social contribution by mining. We hope our data and analysis can give inspiration and direction for additional research to perform such analyses.

The paper starts with a methodological discussion and proceeds with the first question raised above: a review of the Mining Contribution Index (MCI-Wr) in 2016 compared with 2014. The four components of the MCI-Wr are the following: value of mine production, mineral exports, exploration and mineral rents. They are presented and analysed together with other factors affecting mining's contribution. A discussion of the second and third question follows: changes in contribution over time both since 2014 and over the entire period under study. The socio-economic issues are dealt with in the subsequent section. Finally, our conclusions are presented.

Methodology

In recent years, several approaches to assess the magnitude of the contribution/dependence of countries on extractive resources have been presented.[4] This study is based on the Mining Contribution Index (MCI) that was developed by the ICMM.[5] A later version called Mining Contribution Index WIDER[6] (or MCI-W for short) was presented. In this study, the following four economic indicators are used:

- The total production value at mine stage of metallic minerals, industrial minerals and coal expressed as a percentage of GDP (sourced from USGS, BGS, Raw Materials Data, RMG Consulting).
- Exports of minerals including coal as a share of total merchandise exports (sourced from UN Comtrade).
- Exploration expenditure as a percentage of production value at mine stage (sourced from SNL Metals & Mining, the data was previously presented by Metals Economic Group and lately by S&P Global but is one continuous time series).
- Mineral rents as a percentage of GDP (sourced from World Bank Data).

The first two indicators have been used in previous studies of mining's contribution to national economies and their inclusion in the index is easily understood. The third and fourth (exploration and mineral rents) warrant some explanation.

Data on exploration expenditure[7] provides an indication of the likelihood of continued mining activity in a country and hence about the long-term viability and continuity of mining. Without exploration, the mining sector will most likely shrink or even disappear sooner or later, as no new deposits will be found. With exploration, it is more likely that new deposits will be found and the mining sector will grow and hence its contribution will increase. If the mine production in a country, expressed as a percentage of total mine production in the world, is compared with exploration expenditure in the same country also measured relative to global exploration expenditure, it is reasonable to assume that if the relative share of exploration is higher than that of mining, it is likely that mining will grow in the future, and vice versa. In the present version (MCI-Wr), we have chosen to relate the exploration expenditure to the mine production of each country and not as earlier use the absolute size of exploration as the indicator. Our previous model of calculation lead to an overemphasis of this indicator as in all countries exploration expenditures are small compared with the size of mining itself and its economic impact. Exploration expenditure certainly also involves money spent in the country that might generate jobs and add to GDP,

[3] Ericsson, M. and Löf, O., *Mining's contribution to low- and middle-income economies*, WIDER Working Paper 2017/148, June 2017.

[4] Hailo, D. and Kipgen, C. 'The Extractive Dependence Index (EDI)', Resources Policy 51, pp. 251–264, 2017.

[5] ICMM, *The role of mining in national economies*, 3rd edition 2016.

[6] Ericsson, Löf, op.cit.

[7] SNL Metals & Mining's World Exploration Trends focus on corporate spending. In reality, if all metals and minerals would be included, and if all exploration undertaken by all types of entities, not only corporates but also governments, total exploration on both a national or global basis is definitely higher than indicated by SNL. Further, the SNL figures are based on budgeted expenditure and not actual figures. In this study, however, these discrepancies are considered to be of minor importance.

but even if exploration in some regions of a country can provide considerable additions to GDP, this effect is an additional reason for including this indicator in the MCI-Wr. Thirdly, exploration generates additional knowledge of a country's geological potential and thereby adds to its mineral balance sheet.

Mineral rent is the difference between the value of production of a mineral at world prices and the total cost of production including in costs an estimate of the 'normal' return on capital. Minerals for which this indicator is calculated by the World Bank are tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite and phosphate.[8] Countries where other minerals and metals (coal being the most important one) are produced will get a lower MCI-Wr score as these rents are not included in the calculation. In order to make the mineral rent indicator more useful and get a wider coverage, we have calculated diamond rents using the same formula as the World Bank has done for the other metals. We have not calculated mineral rents for any other minerals or metals than for diamonds. The reason for this single addition to the mineral rent indicator is that among the low- and middle-income countries with high MCI-Wr scores, Angola, Botswana and Namibia are countries where diamond mining is particularly important. Further, we have noticed a second issue with the rent calculations by the World Bank. The mineral rents for some countries are for some years higher or almost as high as the total value of mine production. Could one explanation be that rents are also calculated on the production of metals and semi-products under way to become metal (blister copper and the like)? It is impossible from the statistics to ascertain what the reasons are for these figures. We find however the mineral rent aspect of mining's contribution to be important and chose to include these data in spite of the difficulties mentioned. The effect of these shortcomings in the available statistics is that for some countries, the economic contribution of mining is underestimated.

A number of additional indicators could be used to quantify the economic contribution of mining to national economies such as taxes paid, employment created, investments made and value added by the sector.[9] All or any of these are important and would shed more light on the issue of mining's contribution to national economies. However, it has not been possible to include these variables for lack of statistics either the geographical coverage has not been sufficient or only a few years of the period under study (1996–2016) are covered.[10] Our intention is to study a majority of the countries in the world and not only a selection, which has been the most common approach in previous work. Employment is one key factor for which statistics are not available. The Laborsta statistics by the International Labour Office (ILO) is unfortunately not up-to-date and is not covering all important mining countries. In some cases, it is further difficult to separate between employment in the mining sector from oil and gas industries. The Geneva office of the ILO has been reorganised and is lacking resources, which has created additional problems. We have tried to contact national statistical offices in the most important countries with limited success. Other potential global sources of statistics such as the EITI, ICMM and the IndustriAll, the global federation of mining trade unions, have been consulted with only limited success. This area should clearly be one priority in continued research into the contribution of mining to national economies. In 2017, an Extractive Dependence Index (EDI) was developed by UNDP using three variables of which the extractives industry's value added is included as a factor previously not extensively studied.[11]

In addition to mining activities covered by the statistics used in this study, 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 any longer distances and hence the contribution to exports is small. They may however contribute considerably to GDP and have important employment effects but due to lack of statistics their contribution is not included in this study. If this production of construction materials and coal for local use and also small-scale production of other minerals and metals, in particular gold and precious and semi-precious stones, not systematically covered in the statistics we have used, is included the contribution of mining to national economies would increase. It is impossible to say how much, but clearly the figures presented show a floor from which the full contribution could grow if better statistics would be available.

The Revised Mining Contribution Index WIDER (MCI-Wr) is calculated as follows: countries are ranked in descending order for each of the four indicators. Countries for which data do not exist are omitted from the ranking. 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 zero and one. Finally, the four MCI indicators are weighted equally at 1/4, summed up, and multiplied by 100.[12]

[8] World Bank https://data.worldbank.org/indicator/NY.GDP.MINR.RT.ZS

[9] For an extended discussion see: Hailo, D. and Kipgen, C., op. cit.

[10] The search for employment statistics could serve as but one example of the problems encountered when collecting the necessary statistics.

[11] Hailo and Kipgen, op. cit.

[12] ICMM, *The role of mining in national economies* 2nd edition 2014.

Fig. 1 Mining contribution index (MCI-Wr) score by country 2016. Source: Own calculations

MCI-Wr 2016—current levels of mining's contribution to national economies

The 2016 update of the MCI-Wr index confirms that mining is an important part of many nations' economies, and of these countries, a majority is low- and middle-income economies. The map in Fig. 1 shows the countries with the highest levels of contribution in black and those where mining contributes less are in more pale grey towards white indicating no contribution at all. Regions where the contribution of mining is particularly high include Western, Southern and Central Africa, Oceania, Central Asia and Latin America. The regions where mining contributes less to national wealth are Western Europe, the Middle East and North Africa, Japan and some countries in South Asia. Figure 2 shows the MCI-Wr index by country in 1996.

In the present MCI-Wr based on the latest available data for 2016,[13] the Democratic Republic of Congo (DRC) is ranked as the country with the largest contribution of mining to its economy, see Table 1. Mineral exports constitute 86% of total exports and the DRC is ranked as the second most important country in relation to mineral export contribution. Mineral production value at the mine stage was 6.8 billion USD in 2016 and the mineral production value as per cent of GDP was 12%: on this indicator, the DRC is ranked as number two. Exploration expenditure was 143 MUSD in 2016 and expressed as a share of production value is 2%, and DRC is in 37th place globally. Mineral rents constituted 13% out of total GDP and DRC is ranked at number six in 2016. These four variables give the composite score of 93.0 out of 100 in the index for DRC. The top 20 countries in the 2016 MCI-Wr ranking compared with 2014 are shown in Table 1. All countries with an MCI-Wr index are given in Appendix 1.

There are only three high-income economies (HIE) among the top 50 countries in the 2016 MCI-Wr, but 17 upper-middle-income economies (UMIEs), 16 lower-middle-income economies (LMIE) and 14 low-income economies (LIEs) (see Table 2). Among the 20 countries with highest MCI-Wr, there are two high-income counties (Australia and Chile) while among the next 30 countries, Canada is the only additional HIE. Clearly, it is a great challenge for emerging economies with a high MCI-Wr index to make sure that they have sound policies, legislation and regulations in place and

[13] When updating the index, we have recalculated also the 2014 and earlier figures. For some countries, they have changed mainly due to the revision of export figures, which is done continuously by the UCTAD. It should also be noted that for some countries, there is no GDP figures for a certain year. We have estimated these figures by using data from another year, either before or after.

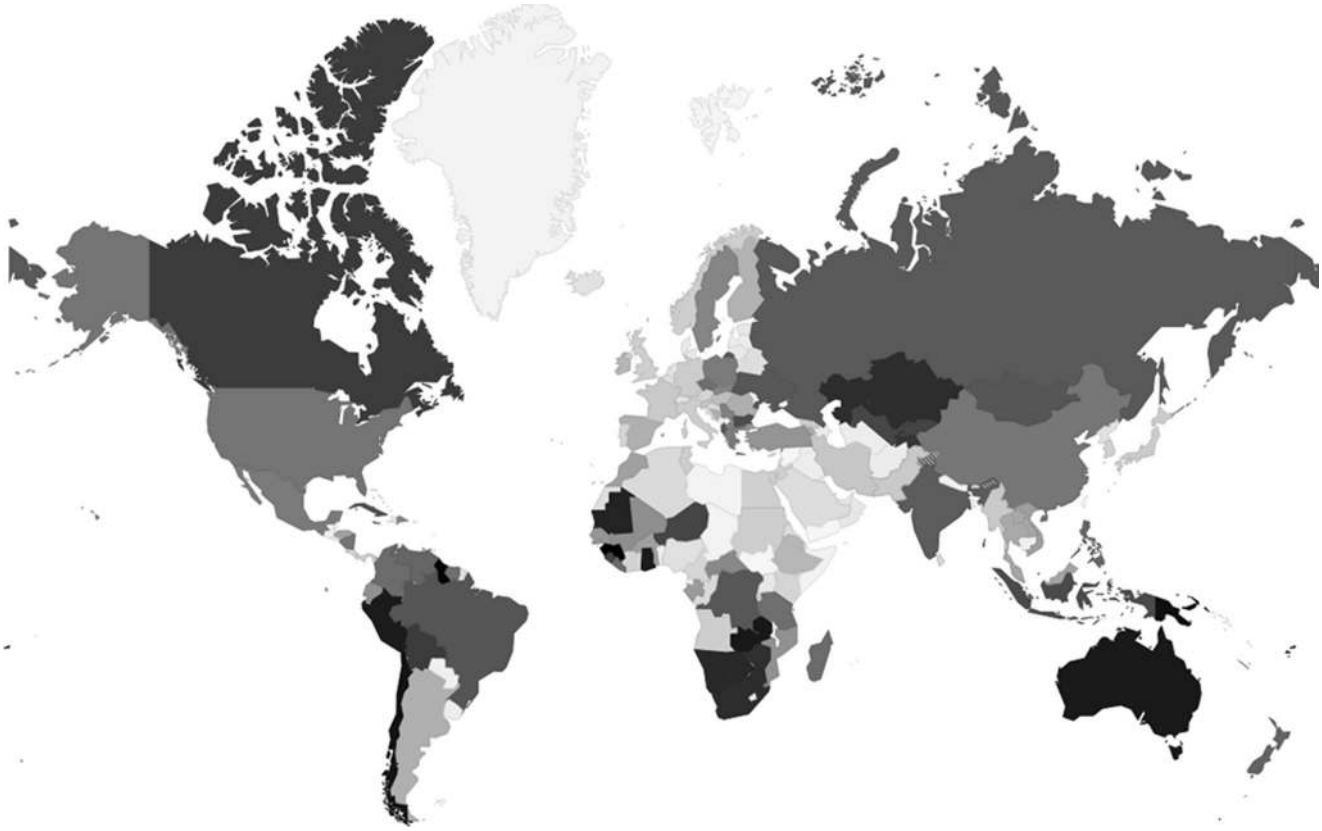

Fig. 2 Mining contribution index (MCI-Wr) score by country 1996
Source: Own calculations.

Table 1 Top 20 revised Mining Contribution Index WIDER (MCI-Wr)

Country	Rank 1996	MCI-Wr score 1996	Rank 2016	MCI-Wr score 2016	Change in rank
Congo, Dem. Rep.	29	72.2	1	93.0	↑
Burkina Faso	64	55.6	2	92.9	↑
Mali	57	59.4	3	91.6	↑
Papua New Guinea	3	89.5	4	91.1	↓
Eritrea	119	24.4	5	90.3	↑
Namibia	11	83.5	6	90.1	↑
Mauritania	9	84.9	7	89.5	↑
Suriname	42	66.5	8	89.3	↑
Peru	8	86.7	9	88.3	↓
Liberia	37	67.6	10	88.2	↑
Botswana	10	83.8	11	88.2	↓
Chile	4	88.6	12	87.8	↓
Zambia	5	87.5	13	87.3	↓
Guyana	2	90.8	14	87.2	↓
Sierra Leone	19	77.2	15	87.1	↑
Mongolia	27	72.8	16	86.0	↑
Australia	6	87.4	17	84.6	↓
Guinea	1	91.7	18	84.3	↓
Tanzania	41	66.9	19	83.4	↑
Kyrgyz Republic	20	77.0	20	83.2	↔

Source: Own calculations

Table 2 MCI-Wr Top 50 by country classification

Country classification	2016 number	2014 number
HIE	3	4
UMIE	17	14
LMIE	16	19
LIE	14	13
Total	50	50

Russia was a high-income country in 2014 but is an upper-middle-income economy in 2016

Source: World Bank

competent staff implement them in order to make sure that benefits continue to flow from the mining sector and that they are used in a sustainable way.

Figure 3 is 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 (USD). The fourth dimension is time: the data presented in the printed graph is just for 2016 for obvious reasons. Figure 3 shows the top 30 MCI-Wr countries. Australia has the largest mining industry by value of production as indicated by the size of the circle. The export contribution of mining is highest in Botswana, Sierra Leone, DR Congo and Mongolia at levels of 80–90% of total exports, followed by, Mali, Burkina Faso and Zambia with export contribution levels at around 70–80%. The figure confirms that the countries with the highest levels of export contribution are mainly low- or lower-middle-income economies. Guyana is the country with the highest contribution of mining as share of GDP at 18% of the value of all non-fuel minerals at the mine stage. Mongolia and the DR Congo follow next at 12–15%. Eritrea with only one mine (Bisha, gold) of industrial scale in operation in 2014 and two in 2016 (Zara copper/gold was gradually taken into operation in 2015/16) is represented by a small light blue circle. It is the country with the smallest value of its mining production included in the figure.

Indicators in MCI-Wr

Value of mine production

Coal constitutes roughly half of the total value of industrial mine production globally. Iron ore, copper and gold follow next. Nickel and zinc are each roughly an order of magnitude smaller and approximately the same level as the fertilizer minerals phosphate and potash: 2–3% of the total value of production at the mine stage. A number of metals and industrial minerals follow, which each contributes less than 1 % of total global value of mine production (see Fig. 4). In 2016, the total global value of mine production at the mine stage including coal was around 1000 billion USD. Coal contributed 470 billion USD, and iron ore 125 billion USD. The change over time in the total global value of mineral production follows the general metal/mineral prices developments. For individual countries, however, changes in production volumes, start of entirely new mines, expansion of existing ones or closure of depleted operations are equally or more important. 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.

The value of metal and mineral production at the mine stage is expressed as a percentage of GDP. This figure provides a sense of the scale of value of production relative to the size of the economy.[14]

While there are 30 low- and lower-middle-income economies among the top 50 MCI-Wr countries, the high-income and upper-middle-income economies are substantially more important in terms of metal and mineral production value, for example China, Australia, USA, Canada, Chile, Russia, South Africa and Brazil (see Fig. 5 and Table 3). It should be noted that the main engine of metal and mineral demand—China—is also by far the most important mining country when coal is included. If coal is not considered, only metals and industrial minerals of Australia and China are roughly of the same size by this measure. The top ten countries in terms of the value of their mine production contribute 75% of the total value of non-fuel mineral production at the mine stage globally. The absolute levels of production are relatively small for several of the states in the MCI-Wr, such as Guyana, Eritrea and Guinea but for the economy in a broader sense mining is an important contributor to all the states in the top 50.

Among the 20 countries with the highest production values in Table 3, only Australia, Chile, Peru and the DRC are among the highest-scoring MCI-Wr countries in 2016. Except Australia and Chile, no other country among the highest ranked MCI-Wr countries account for more than 0.7% of the total value of mine production in 2016. All the countries in the MCI-Wr top 20 together account for 19.1% of total world production value, but Chile and Australia together, the only high-income countries, stand for 13.3%.

For each of the MCI-Wr top 20 low- and middle-income economies, Fig. 6 shows how metals and minerals contributed to the total value of their mine production in 2016. Gold mining is the major contributor in no less than nine countries in this top 20. In Mali and Suriname, gold is the only metal mined and hence contributes 100% of the total value, and in Burkina Faso, Guyana, Ghana, Uzbekistan and Tanzania gold mining contributes between 84 and 94%. Copper is the most important commodity in Zambia, DR Congo and Laos. Diamonds are the

[14] This figure 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 compare, ICMM 2014.

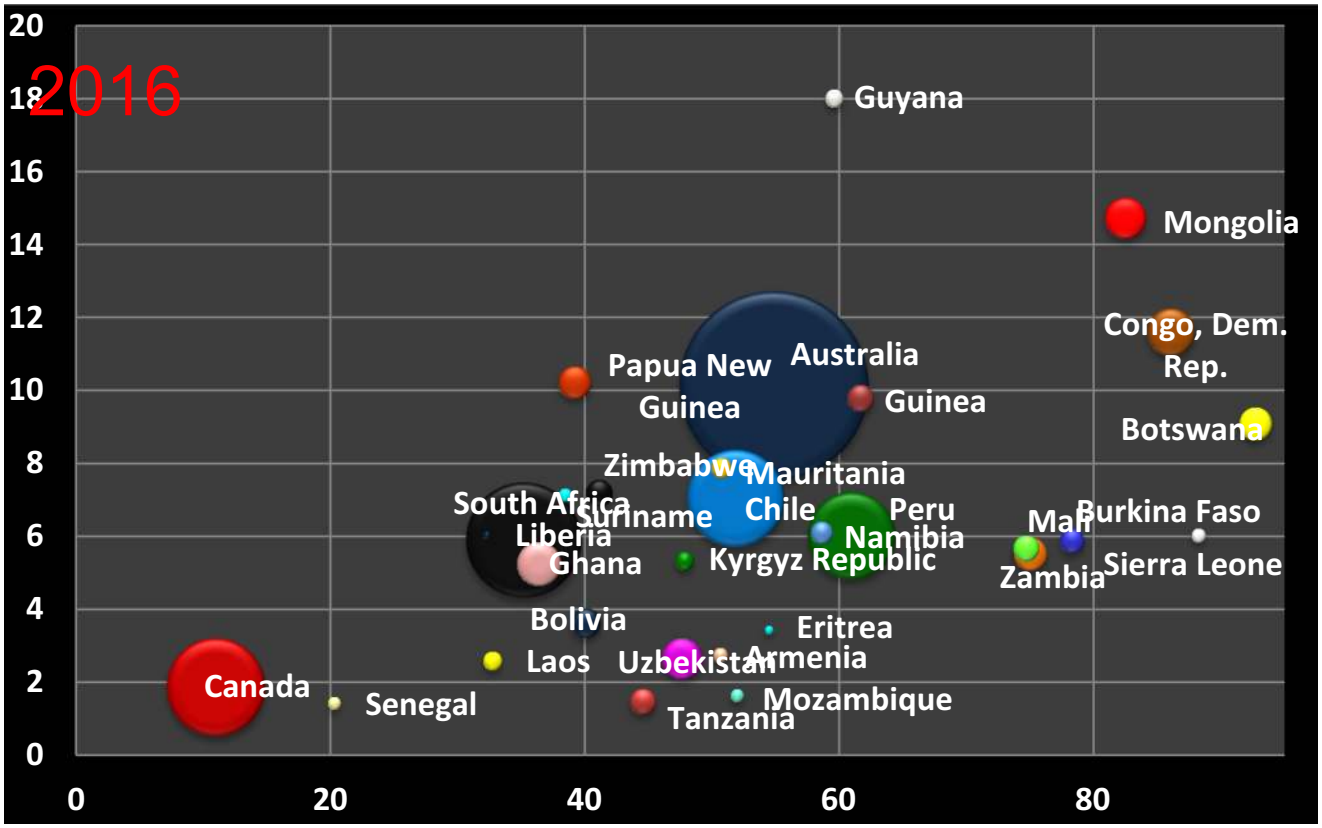

Fig. 3 2016 MCI-Wr Top 30 countries (circles are proportional to value of total mine production)
Source: Own calculations.

main contributor in Namibia and Botswana. Figure 6 also illustrates the vulnerability of many countries to metal price volatility be it gold or copper, iron ore or coal. The situation is slightly different for the diamond-producing countries because the oligopolistic situation in the diamond market probably has a stabilizing effect.

Export of minerals and metals

International trade in minerals and metals reflects regional and national advantages and specializations along the value chain. (Tercero 2016) The export contribution of metals and minerals provides a measure of the scale of mining in relation to other

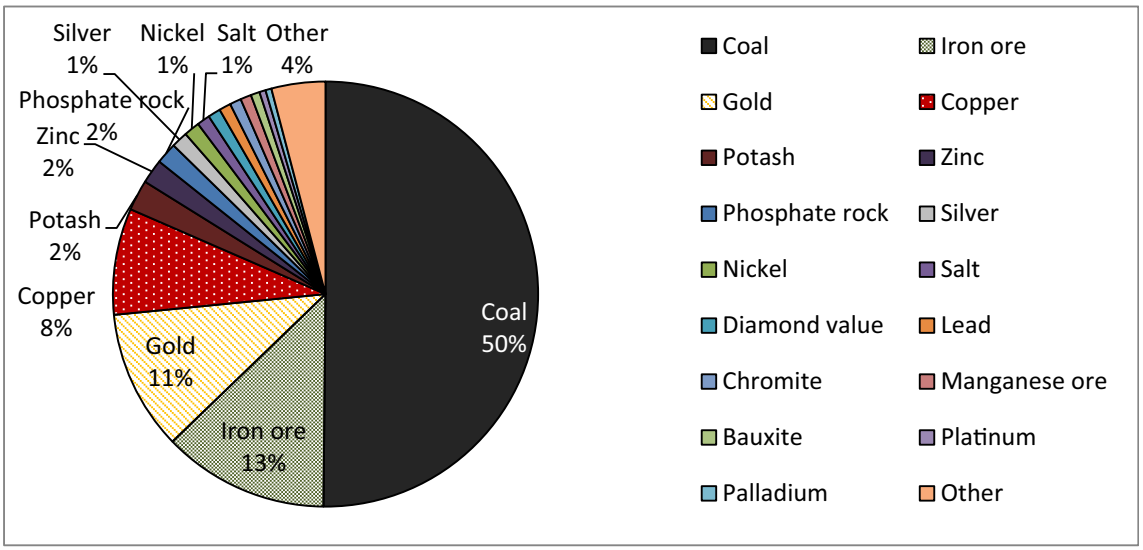

Fig. 4 Total value at the mine stage of metals and minerals 2016 (%) Source: RMG Consulting based on World Mining Data, British Geological Survey, UNCTAD 2016, and US Geological Survey

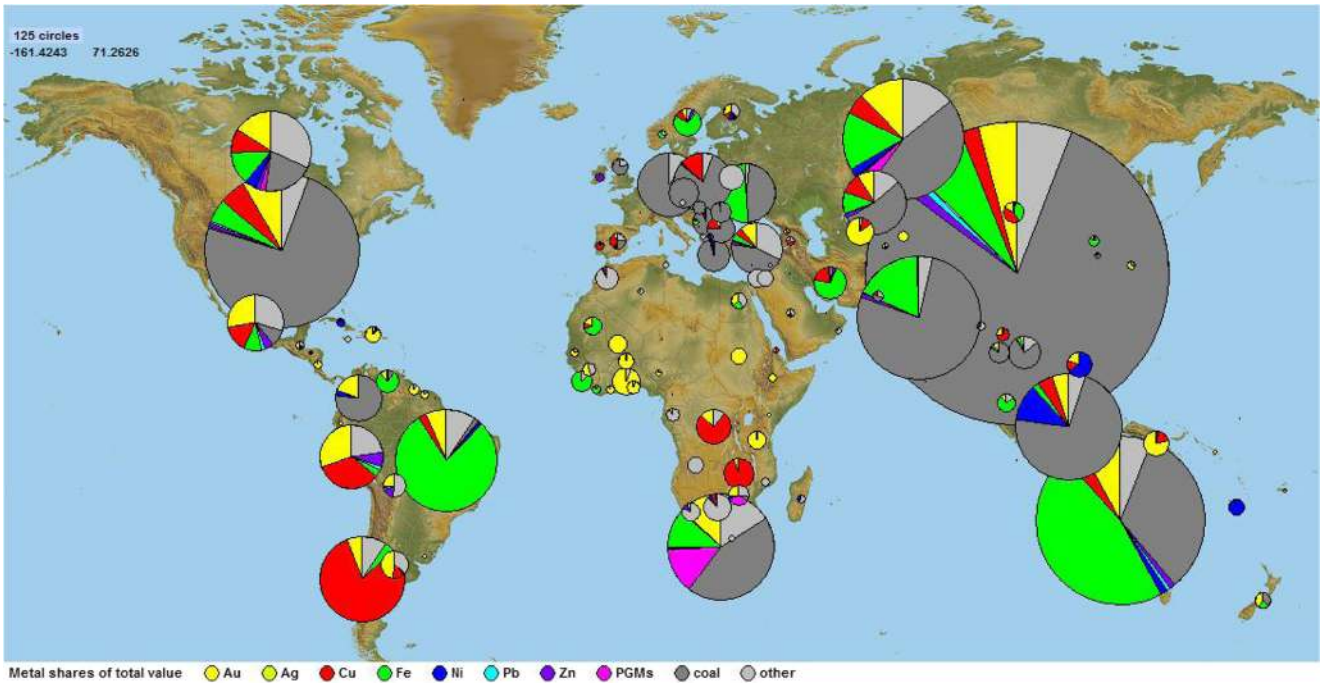

Fig. 5 Value of mine production by country mid-2010s (circles are proportional to value of mine production) Source: Raw Materials Data

Table 3 Value of mine production Top 20 countries

Country	Mine value 2016 billion USD	2016 (%)	Mine value 1996 billion USD	1996 (%)	Income group 2016	Income group 1996
China	304.3	29.6	69.8	22.4	UM	L
Australia	108.5	10.5	24.9	8.0	H	H
United States	72.2	7.0	53.4	17.1	H	H
India	62.2	6.0	15.3	4.9	LM	L
Russian Federation	61.0	5.9	18.5	5.9	UM	LM
South Africa	40.4	3.9	19.2	6.1	UM	UM
Indonesia	38.6	3.8	4.6	1.5	LM	LM
Brazil	36.5	3.5	7.2	2.3	UM	UM
Canada	29.2	2.8	10.8	3.5	H	H
Chile	28.6	2.8	6.8	2.2	H	UM
Peru	23.1	2.2	2.8	0.9	UM	LM
Kazakhstan	17.5	1.7	4.4	1.4	UM	LM
Mexico	16.4	1.6	3.0	1.0	UM	UM
Germany	14.2	1.4	10.2	3.3	H	H
Poland	11.2	1.1	9.2	3.0	H	UM
Turkey	10.6	1.0	3.3	1.1	UM	LM
Colombia	8.8	0.9	1.6	0.5	UM	LM
Congo, Dem. Rep.	6.8	0.7	2.3	0.7	L	L
Ukraine	6.6	0.6	4.6	1.5	LM	LM
Ghana	5.9	0.6	0.7	0.2	LM	L
Total top 20	903	87.7	273	87.4	–	–
Total	1029	100	311.9	100	–	–

Source: Raw Materials Data and RMG Consulting

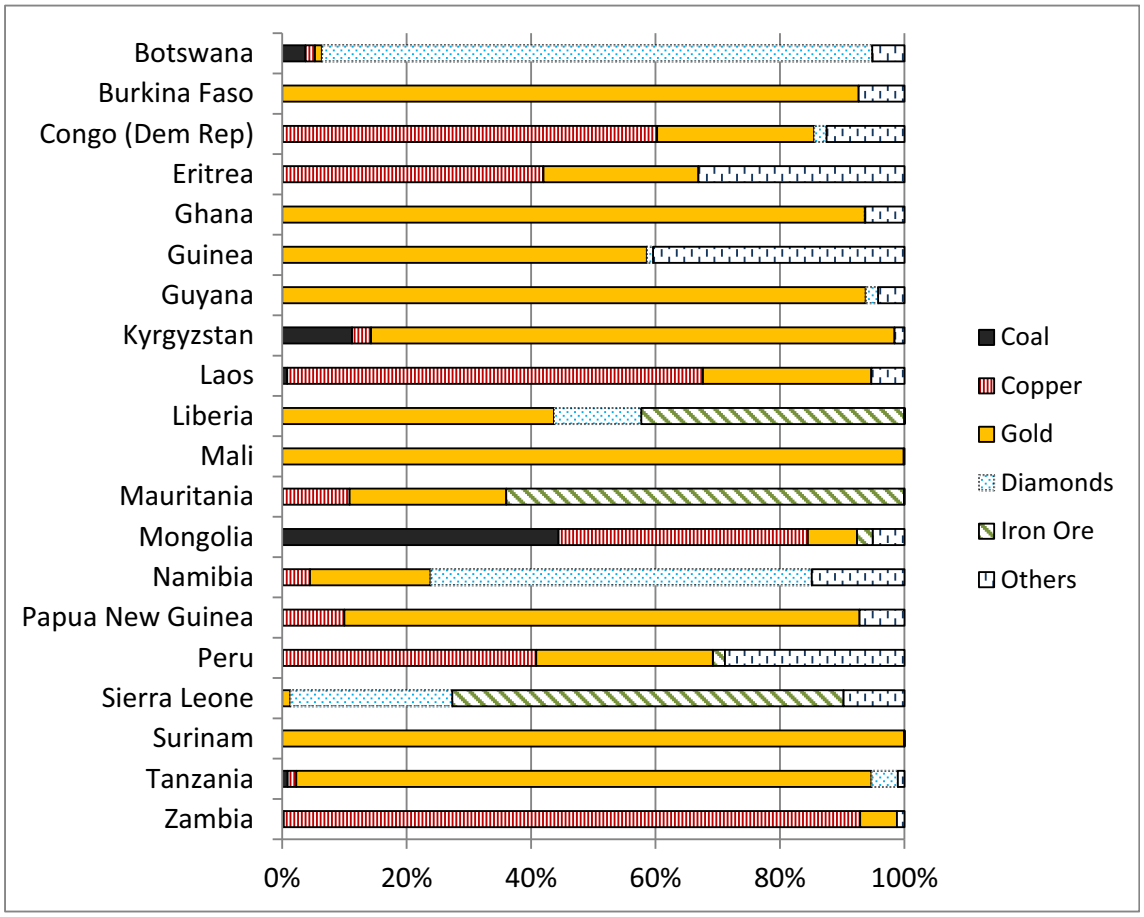

Fig. 6 Contribution by commodity to MCI-Wr for Top 20 low- and middle income economies (%) Source: RMG Consulting

export activities, in particular for small low- and middle-income countries.

Non-fuel minerals are major contributors to many nations' exports. Among the top 50 countries with the highest non-fuel mineral exports relative to total exports in 2016, there are 21 with a total mineral export of more than 50% of the total. Among the top 50 countries, ranked by export contribution, 18 are low-income economies and 14 are lower-middle-income economies. Only 9 countries are high-income economies (see Tables 4 and 5). The export contribution to the MCI-Wr score in low- and middle-income economies is the single most important factor explaining their high ranks. Botswana has the highest share of minerals in its exports of 93% of total exports. Sierra Leone, DR Congo and Mongolia are all countries where non-fuel mineral exports account for more than 80% of total exports.

Exploration

Global exploration is more volatile than mine production and varies, with a time lag, with metal prices.[15] In 1996, global exploration expenditure was just below 5 billion USD. Activities dwindled in the early 2000s and reached a trough in 2002 at around 2 billion USD. At the height of the 'super cycle', exploration peaked above 21 billion USD only to be reduced to around just a third of that amount in 2016. Since then, exploration has been expanding slowly again. These figures are published by SNL Metals & Mining and include most metal exploration except iron ore and further not coal. As mentioned earlier, there are other shortcomings in these figures but none of them are considered serious enough not to include exploration in the MCI-Wr index. Exploration expenditure figures for individual countries vary in a similar way as global figures do and sometimes are even more volatile. Exploration

Table 4 Top 50 export contribution by country classification

Country classification	2014 number	2016 number
HIE	9	9
UMIE	9	9
LMIE	15	14
LIE	17	18
Total	50	50

Sources: UNCTAD, World Bank

[15] Overview of trends in Canadian mineral exploration 2000, Canadian Intergovernmental Working Group on the Mineral Industry, pp. 20–21, Natural Resources Canada 2001.

Table 5 Top 20 mineral export contributors 2016

Country	Country classification	Export contribution 2014	Export contribution 2016	Change export contribution 16/14 (%)
Botswana	UM	91.3	92.7	1.5
Sierra Leone	L	93.6	88.2	− 5.7
Congo, Dem. Rep.	L	80.9	86.0	6.4
Mongolia	LM	80.4	82.5	2.6
Burkina Faso	L	49.6	78.3	57.7
Zambia	LM	75.1	75.0	− 0.1
Mali	L	65.7	74.7	13.6
Nauru	UM	83.3	72.1	− 13.4
French Polynesia	H	68.2	64.9	− 4.8
Guinea	L	52.1	61.6	18.4
Peru	UM	53.8	61.0	13.4
Guyana	UM	61.2	59.6	− 2.6
Namibia	UM	50.3	58.6	16.6
Australia	H	56.7	54.9	− 3.3
Tajikistan	LM	59.1	54.7	− 7.4
Eritrea	L	38.6	54.5	41.0
Korea, DPR.	L	49.1	52.7	7.5
Mozambique	L	51.1	51.9	1.6
Chile	H	57.0	51.9	− 9.1
Mauritania	LM	58.1	50.7	− 12.6

Sources: UNCTAD, World Bank

figures give a dynamic aspect of mining activities in the sense that high exploration expenditures and activities could, if successful, lay the foundation for increased mine production 10–15 years later. Over the period since 1996, the ratio of global exploration expenditure to the value of total global mine production has varied between 1.7% in 1996 and 0.7% in 2016 with two peaks above 1% in between. For some of the countries with high MCI-Wr scores in 2016, this ratio has been much higher in periods, for example Burkina Faso had ratios around 100% during a couple of years between 1996 and 2007. These exploration efforts have made it possible to start and expand mine production in the country in later years and the concomitant increase in the MCI-Wr index. Mali, Eritrea, Papua New Guinea, Liberia and Tanzania are other countries where exploration during periods since 1996 has been on much higher levels than the global average, albeit not reaching the figures of Burkina Faso. Some of the other countries in the MCI-Wr top 30, such as Mauritania, Peru, Botswana, Chile and Australia have had lower exploration ratios possibly indicating lower probability of quick future expansions of their mine production. In 2016, the highest ratio is calculated for Senegal 8.5%, Eritrea 4.69, Burkina Faso 4.04, Mali 3.49 and Canada 3.32% respectively. At the low end are Zimbabwe and Uzbekistan both 0.43%, Mongolia 0.48%, Guinea 0.56, Guyana 0.81% and Australia 0.83%. The differences in actual spending are of course big, most funds are spent in Canada at 0.99 billion USD, and Australia is number two at 0.90 billion. Exploration expenditure is down to 151 million USD for DRC, 73 Burkina Faso, Mali 70 and Papua New Guinea 101, all million USD. For the countries with lower MCI-Wr scores, the absolute amounts spent on exploration in 2016 were a couple of tens of million USD (see Table 6).

Exploration expenditure depends on a range of factors including geological prospectivity, the potential to make a discovery and later the likelihood to take this deposit into an operating mine. Other drivers are mining and environmental legislation, security of tenure, tax system, availability of infra structure and competent and trained staff.[16] All these factors are directly or indirectly influenced by national and local political decisions. Even geological potential can be influenced by geological mapping and research into processes of ore formation etc.

Mineral rents

Mineral rents vary considerably over time and between countries. Among the countries with the highest MCI-Wr score in 2016, Suriname, Mauritania, and Mongolia had mineral rent figures over 20% of GDP (24.0, 22.3

[16] James Otto, *The competitive position of countries seeking exploration and development investment*, Journal of the Society of Economic Geologist, Special Publication 12, pp. 1–17, 2006.

Table 6 Top 20 MCI-Wr countries and exploration

Country	MCI-Wr rank 2016	Exploration rank 2016
Congo, Dem. Rep.	1	10
Burkina Faso	2	13
Mali	3	18
Papua New Guinea	4	20
Eritrea	5	75
Namibia	6	38
Mauritania	7	43
Suriname	8	41
Peru	9	5
Liberia	10	70
Botswana	11	32
Chile	12	4
Zambia	13	29
Guyana	14	51
Sierra Leone	15	83
Mongolia	16	45
Australia	17	2
Guinea	18	33
Tanzania	19	15
Kyrgyz Republic	20	25

Source: SNL Metals & Mining World exploration trends, various years

and 21.5 respectively). A second group of countries including Liberia, DRC, Guyana and PNG has mineral rents between 10 and 20% (17.6, 13.2, 11.8 and 11.3 respectively). For all these countries except Papua New Guinea, the contribution to GDP by mineral rents increased with 10 times (DRC) and two times for Guyana and Liberia. Mineral rents as a percentage of GDP decreased from 12.4–11.3% for PNG. Given the uncertainties discussed in the Methodology section above, it seems as if a careful recalculation of the mineral rents would be useful in order to determine more precisely their contribution to national economies or perhaps the replacement of this indicator by using value added in the sector. Among countries with low mineral rents (less than 5%) are Australia (5.0%), South Africa (4.6), Tanzania (3.0), Bolivia (2.8), Mozambique (2.3) and Senegal (1.8%). Also among these countries, there had been an increase since 1996. Australia and South Africa would have considerably higher mineral rents if also coal would have been included as both these counties are important coal producers.

Other factors

In addition to the four indicators studied, there are other remaining ones, which ideally should be measured but are not because there is a lack of comparable data. Two of the most import ones not included in the calculations are government revenues and employment. In spite of this, it is important to present at least a brief discussion, based on some data not coherent and not covering all countries for all years but still giving some indications to the importance of these indicators.[17] Additional indicators, which could also be important to include are foreign direct and total investments into mining, and mineral wealth created. There is however not sufficient annual data over the entire period to make any further calculations for investments meaningful. Mineral wealth developments are treated in increasing detail by the World Bank in the study The Changing Wealth of Nations 2108. Non-fuel mineral resources grew very rapidly between 1995 and 2014, more than 10 times from 997 to 10.154 billion USD. This is by far the largest increase of all asset types measured in this study. It would be interesting to include also wealth developments into a future mining contribution index.

Government revenues[18]

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 the mineral resources are considered non-renewable. From Fig. 7, (which uses those IMF data that are available), it is clear that there is lagged relationship between metal prices and government revenues. Metal prices started upwards in 2002/2003 and government revenues increased a year or two later in most counties that are shown in the graphic. Among the countries in this limited sample, government revenues grew until 2011/2012 and then fell back sharply at least for some countries while continuing upwards for others (e.g. 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 such as Mongolia to plan for their futures.

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

[18] This section and the following on employment are cited directly (with minor additions) out of the UNU Wider Working Paper 2017/148. In this working paper there is also a more detailed discussion of employment in some mining countries.

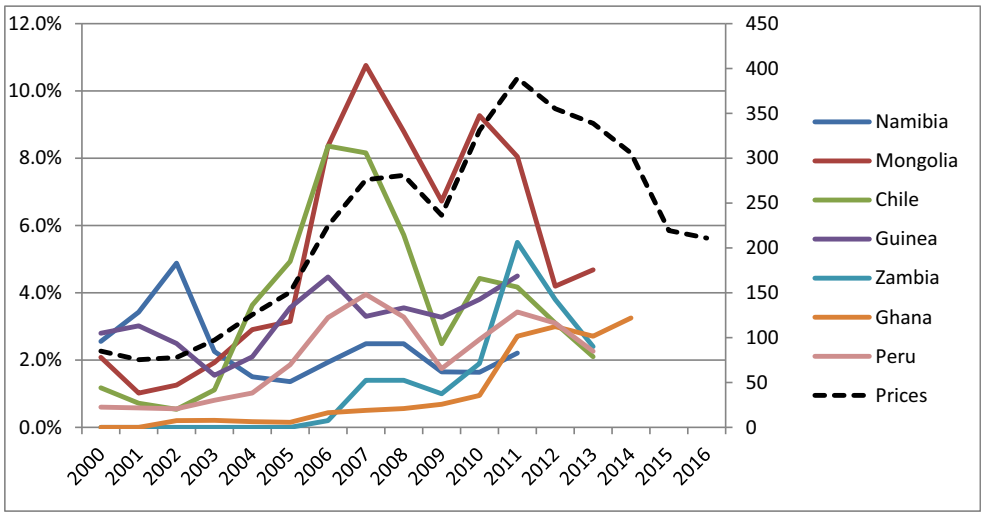

Fig. 7 Government revenues from mining as a share of GDP (%)Source: IMF Resource Revenue Data, 2016. Note: For details on the price index please see note of Fig. 14

Employment

It has not been possible to include employment in the mineral sector as one of the contributing factors to the MCI-Wr mining contribution index because of lack of data.

Direct employment in the mining sector most often varies between 1 and 3 %, but there are examples of much higher levels.[19] This is invariably the case, if informal/artisanal sector employment is also included. Employment is an important stabilising 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 further somewhat less volatile than the other factors under study, and there was for example only a marginal dip during the global financial crisis in 2008–2009.

The employment effects of mining, directly and indirectly, is a key area for further research.

Impact of the end of the 'super cycle'

The global mining industry experienced a period of unprecedented change during the first 15 years of the new millennium. Metal and mineral prices had been on low levels for an extended period in the 1990s and into the new millennium. A period with low profitability and limited investments very quickly turned into a situation with record high metal prices, improved profitability and a plethora of new investment projects. It was mainly the strong demand for metals and minerals in China which drove these developments. Metal prices have dropped since the peak in 2011/2012, but not to pre-boom levels, and in 2017, there was a turn-around in the market, which seems to be lasting. Gold stands out in that its price did not fall as precipitously as several other metals.

Gold is the single most important metal for the highest MCI-Wr ranking LIEs and MIEs. Forty-one percent of the total value of their mine output comes from gold. Gold is the main contributor in nine out of these 20 countries. Table 7 lists those 20 LIE and MIEs in the top 50 MCI-Wr counties where gold was the single largest contributor to the value of mine production in 2016. In all 20 countries, gold mining contributed more than 50% of the total value of all metal and mineral production. In Surinam, Mali and the Sudan, gold contributed 100% of total value. Among all the LIEs and MIEs together there is a total of 24 nations where gold mining is the main contributor. When also small-scale/artisanal gold mining is considered (such production is often 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 particularly important for a number of LIEs like Sudan, Burundi and Cameroon where small-scale/artisanal gold production is considerable.

Two examples are demonstrated in Figs. 8 and 9. The figures show the total value of metal and mineral production relative to GDP on the vertical axis and the metal and mineral export as a percentage of total exports on the horizontal for every year since 1996. The line joins these annual readings together in chronological order. Burkina Faso had only limited mining in early 2000s and the production value as percentage of GDP was close to zero and exports were accordingly very low. By 2016, the production value as a percentage of GDP was around 6% and exports as percentage of total exports were growing continuously. In 2016 the contribution to exports by gold had increased to almost 80%. Gold output in Burkina Faso was expanded less rapidly from 2012 onwards and remained around 35 t, while the average annual gold price

[19] ICMM 2014.

Table 7 Share of total value of mineral production for gold

Country	Gold production 2016 (tonnes)	Gold contribution	MCI-Wr rank 2016
Suriname	13	100	8
Mali	47	100	3
Sudan	93	100	41
Cote d'Ivoire	24	95	33
Guyana	22	94	14
Ghana	129	94	21
Burkina Faso	39	93	2
Ecuador	7	93	66
Tanzania	44	92	19
Togo	14	90	46
Azerbaijan	2	86	79
Ethiopia	7	86	112
Kyrgyz Republic	21	84	20
Uzbekistan	100	84	28
Papua New Guinea	62	83	4
Honduras	3	73	54
Niger	1	69	36
Dominican Republic	38	67	43
Argentina	56	62	50
Guinea	30	59	18

Source:RMG Consulting

had decreased 12% between 2012 and 2016. The value of mine production as a percentage of GDP remained at the same levels from 2012 and onwards. This example of Burkina Faso confirms that the impact of the end of the 'super cycle' has been smaller for countries where gold mining is important than for countries mining other metals and minerals such as copper in Mongolia.

Mongolia is ranked as number 16 on the MCI-Wr 2016. It is dependent on copper and coal for about 70% of its total mineral output. Copper production doubled between 2011 and 2016 but in spite of that mine value as percentage of GDP decreased from 25% in 2011 to about 17% in 2016, there is a decrease of 30% (see Fig. 9). The copper price fell by almost 50% in the same period explaining a part of the decline in mining's contribution. Other sectors of the economy having grown at a higher rate than the economy in general have probably offset the negative effect of declining copper prices Mongolia is however still heavily dependent on mineral exports, around 80–85% in the years 2006–2016. The contribution of mining to the economy of Mongolia will most probably remain on a high level.

Countries have been hit by the end of the 'super cycle' in different ways depending on many factors such as the composition and size of their mineral production. Gold mining countries are experiencing a slower but still continuing growth. The level of exports and mining's share of GDP reached a maximum at the peak of the 'super cycle' in 2011. At that time, GDP contribution reached as high as 25% for some countries and mining exports went over 85%. These figures have declined for some counties but the situation for most countries is still a significantly larger contribution of mining in 2016 than in 1996. For some countries, production value as percentage

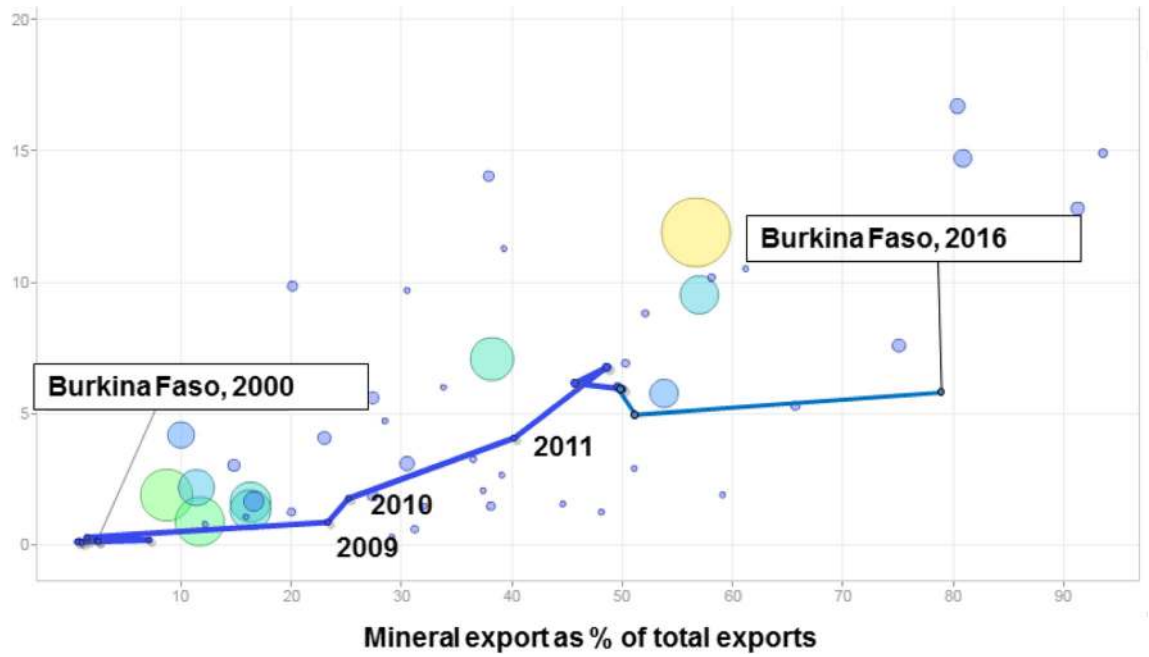

Fig. 8 Burkina Faso, development in export and production values 2000–2016 (circles and circle colours are proportional to value of mine production). Note: Other circles indicate other countries and their position in 2014. Source: Own calculations

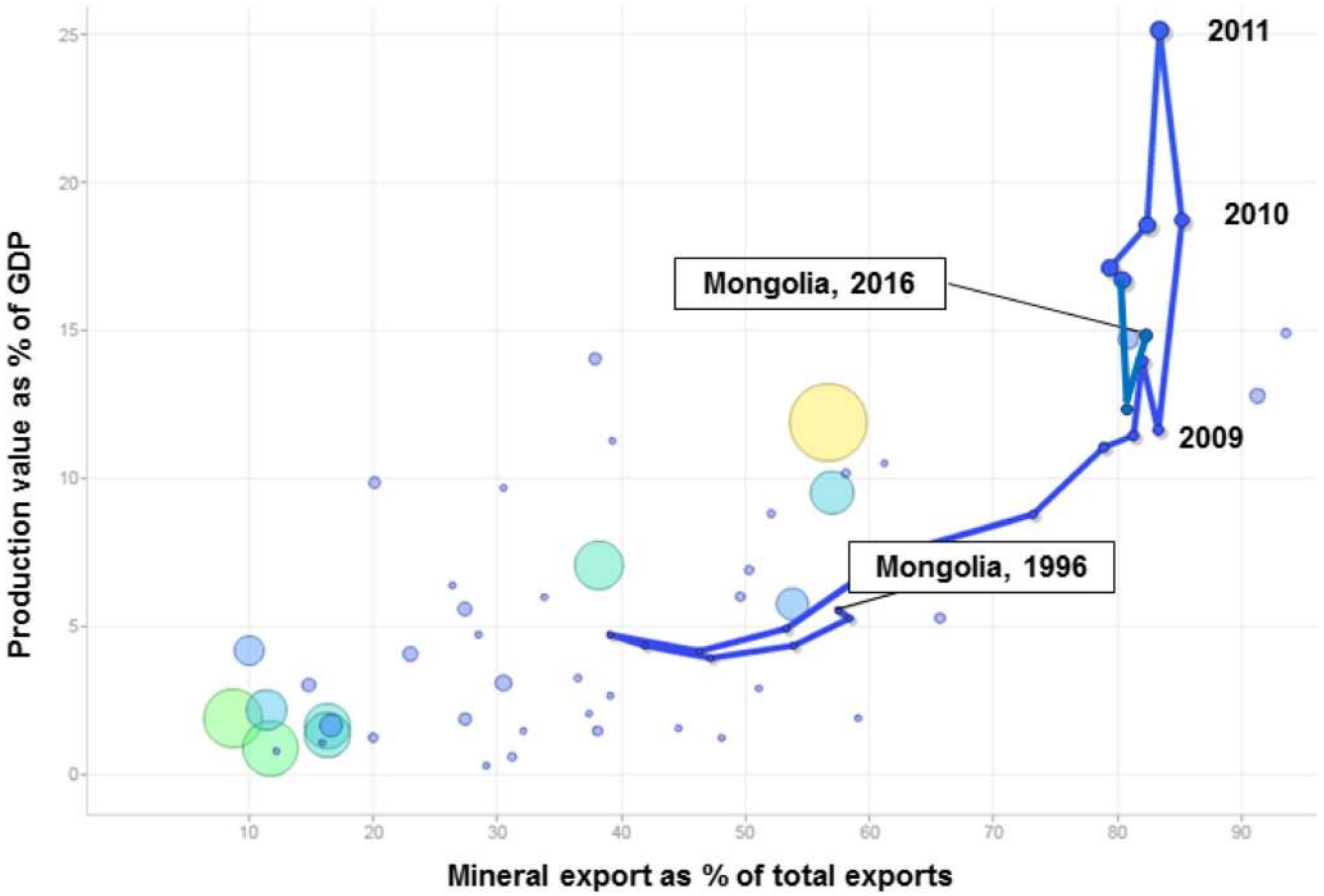

Fig. 9 Mongolia, development in export and production values 2000–2016 (circles and circle colours are proportional to value of mine production). Note: Other circles are other countries and their position in 2014. Source: Own calculations

of GDP and mineral exports is even higher in 2016 because of a strong growth in production offsetting the decline in prices. This is the case for example for the DRC, Sierra Leone and Eritrea. Some of the countries with a higher share of mineral exports in 2016 compared with 2011 are Burkina Faso, Mali, Guyana, Ghana, Namibia, Mauritania, Guinea and Botswana.

Changes in the MCI-Wr between 1996 and 2016

The value of mineral production at the mine stage was 300 billion USD (in nominal terms) in 1996, equivalent to 0.6% of total world GDP PPP (World Bank 2016). In 2011, the value of metal and mineral production peaked at 1800 billion USD (1.9% of global GDP). It has since fallen to 1200 billion USD (2016), which is 1.2% of world total GDP (Fig. 14). The extraordinarily 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. Mining's share of global GDP doubled in 4 years, and was three times higher in 2011 than it was in 1996. In 2016, there was a trough at only 50% of the 2011 level, but still 40% higher than in 1996. This rapid growth and later equally quick decline in value of metal and mineral production naturally had strong effects on MCI-Wr. The 20 countries with the highest MCI-Wr score in 2016 are shown in Table 8. Of these, ten economies have climbed up one level between 1996 and 2016 in the World Bank income group classification (low (L), lower-middle (LM), upper-middle (UM) and high-income (H) countries). Mauritania, Zambia, Mongolia and Kyrgyzstan were classified as low-income countries in 1996 and in 2016 are classified as lower-middle-income countries. Namibia, Suriname, Peru and Botswana were classified as lower-middle-income countries in 1996 and upper-middle-income countries in 2016. Chile moved from the upper-middle level to become a high-income country in the period. Certainly, there are a host of factors influencing these gradual economic developments, but the contribution of mining is most probably one of the more important ones.

The contribution of mining to national economies in 1996 compared with the situation in 2016 is illustrated in the two

maps in Figs. 1 and 2. The contribution of mining (the darker coloured countries) has increased for several countries in Latin America and Africa, both West Africa and South and Central Africa. The importance of mining for some countries in Europe, North America and China has decreased in the same period.

Of the 20 countries with the highest MCI-Wr score in 1996, 11 have moved up one or more levels in the World Bank country classification. In addition to the countries mentioned above, Kazakhstan and Russia have moved from the lower-middle to the upper-middle group. Another seven countries fell out of the group of 20 countries with the highest MCI-Wr score from 1996 to 2016: Canada (HI), South Africa and Brazil (UM), Ghana, Bolivia and Indonesia (LM) and Zimbabwe (L). They were replaced in the top 20 group with the highest MCI-Wr score in 2016 by two LM countries (Mongolia and Kyrgyz Republic) together with seven low-income countries (DRC, Burkina Faso, Mali, Eritrea, Liberia, Sierra Leone and Tanzania). Most of these newcomers showed a quick increase in MCI-Wr score, while for Sierra Leone, Mongolia and Tanzania, it grew at a slower pace.

We cannot determine if the declining MCI-Wr score means that the economies of these countries have diversified or simply that the mining sector has contracted. It also remains to be seen if the newcomers in the top 20 group of countries in 2016 such DRC, Burkina Faso, Mali, Eritrea and Liberia will benefit from their quickly developing mining sector and consequently MCI-Wr score and move up in the World Bank country classification as many in the 1996 top 20 group did during the past 20 years.

Certain countries have climbed quickly up the rankings: West African countries including Burkina Faso, Mali, Liberia and Sierra Leone have for example moved to the top of the MCI-Wr rankings (see Table 8). Most countries, which show the largest increase in MCI-Wr, had no or only limited industrial mining in 1996 but investments were made during the first decade of the twenty-first century. The exploration expenditures in the early part of the period under study were also high as discussed above. African mining countries in particular have increased their MCI-Wr score. Among the 20 countries for which the MCI-Wr score has increased most between 1996 and 2016, no less than 14 are in Africa (see Table 9).

Mining's contribution to economic activity in the low- and middle-income countries clearly increased between 1996 and 2016. The increase is higher in LIE than in MIE. Mining's share of GDP increased with 43% during these years for these two categories of country. The share was 1.2% in 2016, compared with 0.8% in 1996. The

Table 8 Change in country classification 1996–2016

Country	1996	2014	2016	2016/1996 ↑ ↔↓
Congo, Dem. Rep.	L	L	L	↔
Burkina Faso	L	L	L	↔
Mali	L	L	L	↔
Papua New Guinea	LM	LM	LM	↔
Eritrea	L	L	L	↔
Namibia	LM	UM	UM	↑
Mauritania	L	LM	LM	↑
Suriname	LM	UM	UM	↑
Peru	LM	UM	UM	↑
Liberia	L	L	L	↔
Botswana	LM	UM	UM	↑
Chile	UM	H	H	↑
Zambia	L	LM	LM	↑
Guyana	L	LM	UM	↑
Sierra Leone	L	L	L	↔
Mongolia	L	UM	LM	↑
Australia	H	H	H	↔
Guinea	L	L	L	↔
Tanzania	L	L	L	↔
Kyrgyz Republic	L	LM	LM	↑

Source: World Bank Data

Table 9 Change in MCI-Wr score 1996–2016

Country	Change in MCI-Wr score 2016/1996 (%)
Lesotho	398
Eritrea	269
Solomon Islands	265
Cote d'Ivoire	105
Burkina Faso	67
Sudan	64
Mali	54
Armenia	52
Lao PDR	51
Senegal	40
Suriname	34
Mozambique	33
Liberia	30
Argentina	29
Congo, Dem. Rep.	29
Tanzania	25
Togo	23
Gabon	20
Mongolia	18
Sierra Leone	13

Source: Own calculations

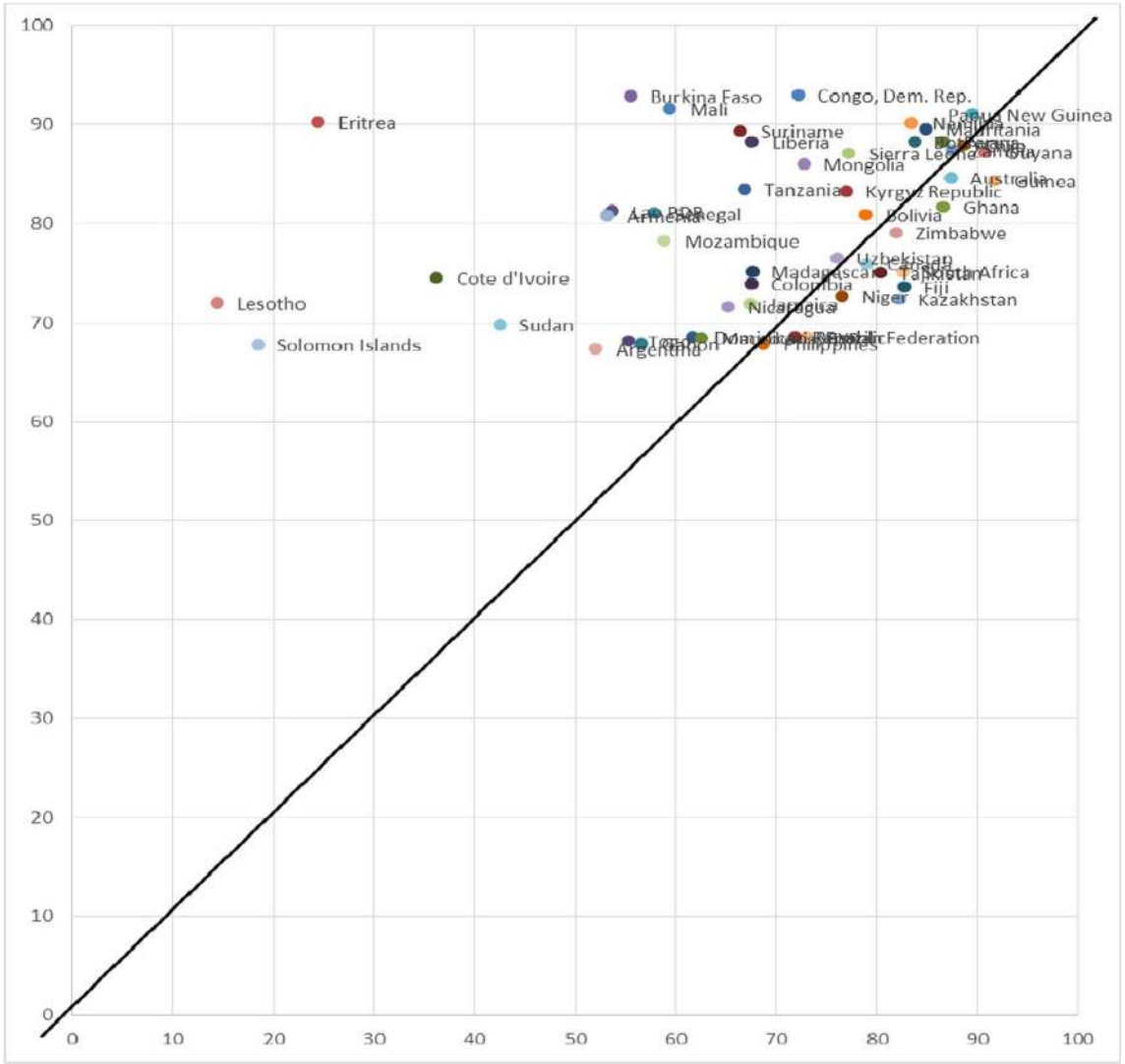

Fig. 10 MCI-Wr for Top 50 countries 2016 (vertical) and 1996 (horizontal). Source: Own calculations

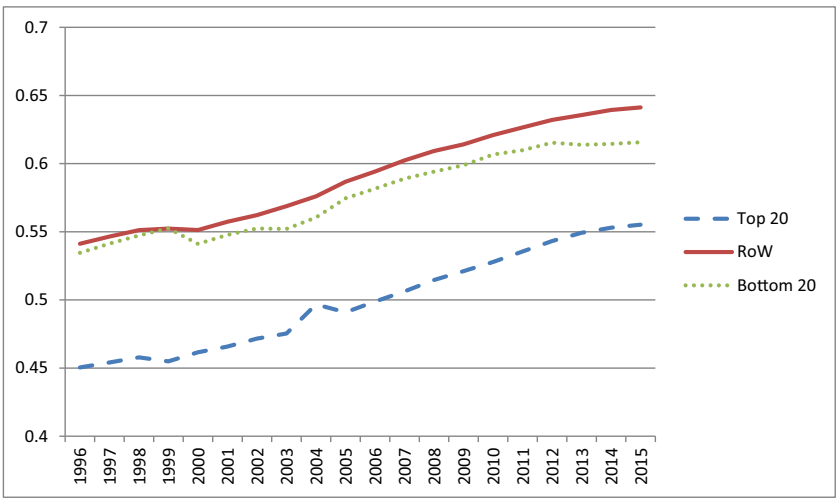

Fig. 11 Human development index development 1996–2015 Source: UNDP. Note: RoW, rest of World

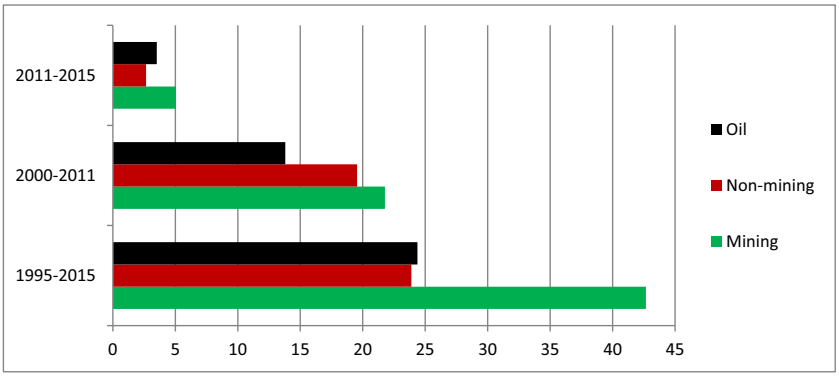

Fig. 12 Percentage change in Human Development Index in low- and lower middle Sub-Saharan African economies Source: McMahon and Moreira

share of mineral exports in total exports of those countries increased by 50% in the same period. Exploration spending in the countries studied increased over the period as a whole, but has been declining steeply since 2013. Mineral rents followed the general metal price developments and reached a peak in 2011, but have declined since, although they are still higher in 2016 than they were in the 1990s. Several LIE and MIE countries with high MCI-Wr scores in 1996 have developed successfully and risen in the World Bank classification from LIE to MIE, from LMIE to UMIE and from UMIE to HIE.

Figure 10 shows the MCI-Wr scores of the top 50 countries in 2016 relative to the situation in 1996. In countries above the line, mining's contribution to national economies has increased and below the line they have decreased. The quick growth in Eritrea, Lesotho and Cote d'Ivoire is clearly visible. A range of other countries has also seen mining's contribution to their national economic development increase.

As can be seen from the graph for those countries where mining's contribution has dropped between 1996 and 2016, the decline has been much smaller (closer to the line) than the growth countries which are scattered further away from the line. Among the countries below the line, where mining's contribution has dropped two groups is identifiable: former centrally planned economies such as Russia, Kazakhstan and Tajikistan and some of the largest mining countries such as Brazil, Australia, Canada and South Africa. Even Botswana and Chile, two countries which have been considered to be successful in using mining as a lever for economic development, are above the line i.e. mining's contribution to their national economies has increased during the period.[20]

Social development and mining

The analysis of the contribution of mining to national economies and to development can be taken a step further to include a number of indicators of social development:

- Human Development Index (HDI).
- Governance including: corruption, political stability, rule of law, government effectiveness, regulatory quality, voice and accountability.
- Inequality, the Gini coefficient.[21]

Human development index

Human development index (HDI) as defined by the United Nations measures several aspects of social development such as health, life expectancy, standard of living, education. The top 20 economies in the MCI-Wr index have increased their HDI on average from 0.45 to about 0.55, an increase with 27%. It is notable that the top 20 MCI-Wr group of countries has managed to develop at the same pace in this period as have the rest of world group (RoW) including most high-income countries. By contrast, the bottom 20 economies in the MCI-Wr index have increased slightly less, 18% between the years 1996–2015 (Fig. 11).

To get a closer look into the social development the analysis has focused on Sub-Saharan Africa, which has been chosen for a first more detailed analysis of social developments in mining countries using existing indicators over the 20-year period from 1996 to 2015. The countries of sub-Saharan Africa were divided into three groups (see Figs. 12 and 13) oil producing countries, mining countries and non-mining countries (countries with neither minerals nor oil production) and the development of Human Development Index and some indicators of governance where compared. In both figures mining countries are

[20] Lange G.-M., Wodon Q. and Carey K. 'The Changing Wealth of Nations 2018', World Bank 2018, pp. 11 and 75.

[21] The Gini coefficient is not updated every year for all countries in World Bank or UNU WIDER World Income Inequality Database and in those cases, the years 1996 and 2014 were not available, closest year has been selected.

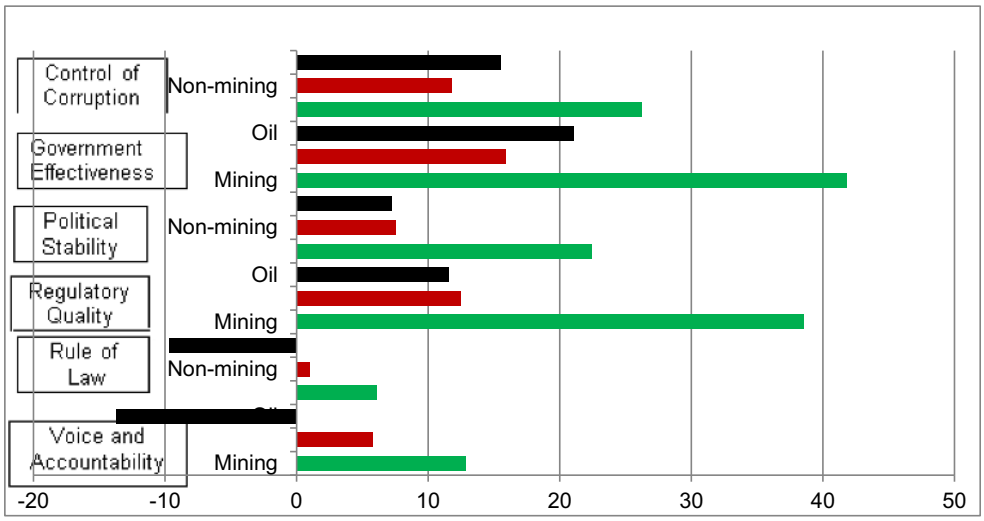

Fig. 13 Percentage change in Governance indicators in low- and lower middle sub-Sahara Africa economies 1996–2015 Source: McMahon and Moreira

shown in green, oil producing countries in black and non-mining countries in red. In mining countries in the region, HDI has risen by 43%, while in non-mining countries with only 24% and the same figure in oil producing countries.

Mining countries: Burkina Faso, DRC, Cote d'Ivoire, Eritrea, Ghana, Guinea, Liberia, Madagascar, Mali, Mauritania, Mozambique, Namibia, Niger, Rwanda, Senegal, Sierra Leone, Tanzania, Togo, Zambia, Zimbabwe. Non-mining countries: Central African Rep., Ethiopia, Lesotho, Benin, Burundi, Cabo Verde, Djibouti, Gambia, Guinea-Bissau, Kenya, Malawi, Somalia, Swaziland, Uganda. Oil countries: Angola, Sudan, Cameroon, Congo, Rep. Equatorial Guinea, Nigeria, South Sudan and Chad

Governance indices

Measured with a set of governance indicators (corruption, effectiveness, political stability, regulatory quality, rule of law and voice and accountability), mining countries have developed significantly better than non-mining countries and oil producing countries. In oil producing countries the indicators rule of law and voice and accountability even show a situation in 2015, which is worse than it was in 1996.

Inequalities and Gini coefficient

The development of the Gini coefficient in the 20 low- and middle-income countries with the highest MCI-Wr ranking in 1996 over a period until the mid-2010s is shown in Table 10. The Gini coefficient is not calculated for all countries for every year and hence the comparison cannot be made for the same year for all the countries. The Gini coefficient, i.e. inequality, has been constant or decreased in 13 countries and increased only in four countries. This is a first and preliminary indication that inequality, as measured by the Gini coefficient, is not necessarily directly linked to development of mining in LIE and MIE countries.

To conclude this brief and introductory statistical survey of social indicators in mining countries, particularly in Africa, there are indications that economic development in the mining sector does not automatically mean a deterioration or slowdown of social development. The World Bank report 'The Contribution of the Mining Sector to Socioeconomic and Human Development'[22] and ICMM's 'Social progress in mining-dependent countries' give further examples and discuss these issues in more detail.

Future developments of the contribution of mining

The present metal and mineral price cycle bottomed out during 2016 and a recovery has been taking place since then. Metal and mineral prices have fallen since the peaks of 2011, but prices are well above the levels of the late 1990s and early 2000s before the 'super cycle' kicked in. As Fig. 14 shows, the price index has been on a downward trend since 2011 with a flattening in 2016 and increase in 2017 and the beginning of 2018. During the years of decline (2012–2016), prices were always at relatively high levels on average 2–3 times higher than in the period preceding the 'super cycle'. Even copper and nickel, which experienced the deepest dip, bottomed out in 2016 at levels above where they were in the end of the 1990s. Non-ferrous exploration expenditure dropped to 7300 MUSD in 2016, only a third of the 2012 level. In 2017, there was a strong recovery in prices, which has continued into 2018. Exploration increased by 15% in 2017.[23] Investments into new mines remain however at low levels.

[22] McMahon, Gary; Moreira, Susana. 2014. The Contribution of the Mining Sector to Socioeconomic and Human Development. Extractive industries for development series; no. 30. World Bank, Washington, DC.

[23] S&P Global, World Exploration Trends, 2018. This is the same source as the one previously cited SNL Metals & Mining World Exploration Trends.

Table 10 Gini coefficient in Top 20 mining countries in the early 1990s compared to 2000/2010s

MCI-Wr top 20, 2016	Gini	Year	Gini	Year	+/-
Botswana	48.5	1994	48.1	2010	− 0.4
Chile	56.43	1994	50.45	2013	− 5.98
Congo, Dem. Rep.	42.16	2004	42.1	2012	− 0.06
Eritrea	–	–	–	–	–
Ghana	40.07	1997	42.77	2005	2.7
Guinea	46.08	1994	33.73	2012	− 12.35
Guyana	52.8	1993	35	2006	− 17.8
Kazakhstan	32.67	1993	26.33	2013	− 6.34
Kyrgyz Republic	31.04	2000	26.82	2014	− 4.22
Lao PDR	34.9	1997	37.89	2012	2.99
Liberia	–	–	36.48	2007	–
Mauritania	50.05	1993	32.42	2014	− 17.63
Mongolia	33.2	1995	32.04	2014	− 1.16
Namibia	74.3	1993	59.7	2010	− 14.6
Papua New Guinea	50.9	1996	43.88	2009	− 7.02
Peru	44.02	1994	44.14	2014	0.12
Sierra Leone	40.17	2003	33.99	2011	− 6.18
Suriname	57.61	1999	–	–	–
Tanzania	38.1	1993	37.78	2011	− 0.32
Zambia	52.61	1993	55.62	2010	3.01

Source: World Bank Data, UNU-WIDER

Demand for metals and minerals in general has not dropped, rather it stays at the same levels as before and continues to increase slowly but steadily. There are some indications that the price trough is generated by an over-supply situation rather than by a fall in demand.[24] Gradual improvements in standard of living, increased life expectancy and continuing urbanization, remain in force and together they form the major long-term drivers of metal and mineral use.[25] On top of this, continuing, slow and gradual increase in metal demand the urgent switch to fossil free electricity and energy supply will dramatically increase demand for most metals and minerals. Increased recycling will not change this situation in the short term but will affect mid-term scenarios and might double the growth rates previously projected.[26]

One of the major reasons for the 'super cycle' was the slow supply response of the mining industry to increased demand.[27] It takes a minimum 3–5 years to increase capacity in an existing mine and 10–15 years for a green field project to start producing. This time lag is further continuously increasing due to several factors: increasing advantages of scale economies, i.e. bigger mines with larger investments, longer and more difficult permitting processes depending on more stringent societal demands and regulations and increasing opposition by local residents (NIMBY). The global mining industry might be facing a similar situation during the 2020s as it did in the early 2000s: slowly increasing demand but hesitancy about investing and low supply elasticity in response to demand. There are at present no indications of a new 'super cycle'; nevertheless, at some point, metal prices might shoot up again when supply and demand does not meet any longer.[28] The situation could be exacerbated by the lack of exploration during the past years and also the swinging popular sentiments towards mining as well as restricted access to the most prospective countries because of war and politics.

As can also be seen from Fig. 14, mineral prices are one important but not the sole determinant of the changing levels of exports, value of mine production, mineral rents and exploration expenditures also play an important role.

Conclusions

Contribution of mining to national economies

There are 14 low-income countries, 33 middle-income countries and 3 high-income countries among the 50 countries with the highest MCI-Wr score in 2016. It is obvious that mining plays an important role particularly in many low- and middle-income countries. Among the top 20 countries, Congo (DRC) has the highest score followed by Burkina Faso, Mali, Papua New Guinea and Eritrea. Chile and Australia show that also in some high-income countries, mining remains a vital part of the national economy. African economies are dominating among the top 20 countries, with 12 countries. The African mining vision of metals and minerals as important parts of African economic and social development is clearly well founded.

Change in contribution over the past 20 years

Eleven economies have climbed up one step on the GNI development classification, to lower middle, upper middle or high-income category among the 20 low- and middle-income countries with the highest MCI-Wr score in 1996. There are certainly many drivers contributing to this development but mining is one important factor. Geographically, Africa, in its entirety, and in particular West Africa is a good example of economic development of mineral-producing countries.

The figures for both GDP and export share of metals and minerals are considerably higher on average for the LIEs than for the MIEs. The levels of GDP and export contributions in 2016 are still at a higher level than in 1996 in spite of the poor development of metal prices since the end of the 'super cycle'.

[24] See for example: Tim Worstall, Rio Tinto and Vale killed the commodities 'super cycle' not China or the Fed, Forbes 29th November 2015.

[25] McKinsey Global Institute, Reverse the curse: Maximizing the potential of resource-driven economies, December 2013.

[26] World Bank/International Bank for Reconstruction and Development, The Growing Role of Minerals and Metals for a Low Carbon Future, Washington, DC 2017.

[27] This paragraph is largely based on David Humphreys, The Remaking of the Mining Industry, Palgrave MacMillan 2015.

[28] See for example: Kip Atkinson Keen, Next upswing in metal prices inevitable with few quality mines coming online, S&P Global Market Intelligence 7 September 2016.

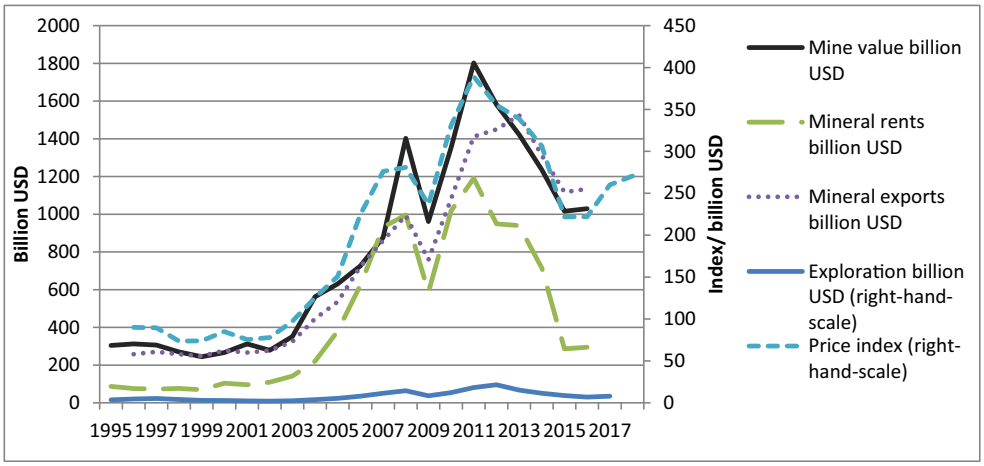

Fig. 14 Mining development trends 1995–2018: prices, exports, exploration, value of mine production, mineral rents Sources: Raw Materials Data, World Bank, SNL Metals & Mining, UNCTAD 2016. Note: The price index includes copper, gold, iron ore, nickel and zinc. The weighting on the price index was calculated as an average based on the contribution of each metal to the total value of all metal and mineral (excluding non-fuel minerals and cola) products of mining industry. The weighting was used to combine the price development of different metals and minerals into one index. 1995 is the base year for the index. All prices are in nominal dollars.

The MCI-Wr index for individual countries has moved up and down depending on the performance of their mining sector relative to other sectors of the economy and on the global metal market trends. It is difficult to draw conclusions from these changes over time as the relative MCI-Wr index. There is a need to further develop the contribution index to deal with this issue.

Impact of the end of the 'super cycle'

Mining's contribution to GDP and exports reached a maximum at the height of the 'super cycle' in 2011. The figures for mining's contribution have declined for most countries by 2016 but the levels were still considerably higher than in 1996.

Socio-economic impacts

There are many reasons why mineral-rich countries developed during this period, and certainly not only because of mining activities and rich mineral resources. Nevertheless, the statistical conclusion from the 2014 MCI-W study is confirmed by this update including also socio-economic indicators. Mining can trigger and have triggered development in several countries. When the analysis is expanded to include also 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 countries with the highest MCI-Wr scores in 1996, the GINI coefficient has remained constant or decreased, i.e. inequalities diminished in 13 countries and increased in 4 countries. HDI has increased in mining countries with 43% between 1995 and 2015. African mining countries have done better than African oil-producing countries.

Contribution or dependency?

'Contribution' or 'dependency'—already by choosing the words to describe the relationship between national economies and the extractive sector a fundamental choice is made between good or bad. The traditional and current perspective, in many high-income countries rich in mineral resources, such as Canada, Sweden, the USA and other countries, is that mineral resources are and have been fountains out of which wealth flow and development grow. It is clear that 'resource-rich countries have an apparent advantage over other countries because they have a source of revenue with which to finance investment and development', but on the other hand 'managing the windfall from resource rents poses well-known challenges for macroeconomic management'.[29] During the late 1900s until recently, the dependency approach was dominating norm claiming that abundance of mineral resources hinders economic development rather than facilitating it.[30] The resource curse paradigm was another starting point for critical analysis.[31] During and after the 'super cycle', with high metal and oil prices, this a priori negative starting point was beginning to be questioned.[32,33,34]

[29] Lange, Wodon and Carey 2018, p. 82.
[30] For a discussion and definition of resource dependency see for example Lange, Wodon and Carey op. cit. and ICMM 2018 pp. 12–13.
[31] For an extended discussion of the resource curse please see Nülle and Davis *Neither Dutch nor disease?–natural resource booms in theory and empirics*, Mineral Economics 2018, 31 pp. 35–59.
[32] This turnaround is described and analysed more deeply in the introductory chapter by Tony Addison and Alan Roe in the *Extractive Industries: The Management of Resources as a Driver of Sustainable Development*.
[33] McKinsey Global Institute, *Reverse the curse: Maximizing the potential of resource-driven economies*, December 2013.
[34] Ana Elizabeth Bastida. Editor, *Can mining be a catalyst for diversifying economies?*, special issue of Mineral Economics Vol 27, numbers 2–3 December 2014.

The results of this survey do not support the widespread view that mineral resources create a dependency which might not be conducive to economic and social development. Rather the opposite—if more LIE and MIE were rich in non-fuel minerals their chances of economic development and possibly also socio-economic progress would have been better than they are at present when only limited non-fuel mineral resources are known. Certainly, the four 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 LIE and MIE countries could localize new mineral resources, their chances of economic development would improve. It remains important for mining countries not to focus too much on mineral and metal prices in the short term but to maintain a steady approach and stick to their long-term strategies for development of their national mineral resources, their management and also diversification opportunities should they appear. A continued and growing supply of metals and minerals will be particularly important in the transition to a fossil-free future and this additional demand for metals and minerals could be turned into economic and social development in mineral-rich emerging economies.

Appendix 1

	% of total export			Production value % of GDP			Exploration % of value			Mineral rents (% of GDP)			MCI-score				MCI Rank		
Year	1996	2014	2016	1996	2014	2016	1996	2014	2016	1996	2014	2016	1996	2014	2015	2016	1996	2014	2016
Congo, Dem. Rep.	72.4	80.9	86.0	7.73	14.7	11.6	0	3.98	2.1	1.04	18.4	13.2	72.2	93.3	92.8	93	29	1	1
Burkina Faso	7.7	49.6	78.3	0.32	6.01	5.89	104	9.27	4.04	0	8.78	10.3	55.6	90.8	91.9	92.9	64	5	2
Mali	8.3	65.7	74.7	0.92	5.28	5.68	25.9	4.01	3.49	0	7.97	8.97	59.4	87.9	90.4	91.6	57	9	3
Papua New Guinea	24.5	37.9	39.2	8.95	14	10.2	3.35	5.91	3.22	12.4	10.9	11.3	89.5	92	89.9	91.1	3	3	4
Eritrea	62.8	38.6	54.5	0	7.22	3.44		4.99	4.69	0	14.3	6.8	24.4	89.9	90.4	90.3	119	7	5
Namibia	38.3	50.3	58.6	1.91	6.91	6.11	2.23	3.83	2.47	0.41	6.49	6.68	83.5	87.3	89.3	90.1	11	10	6
Mauritania	35.9	58.1	50.7	4.44	10.2	7.89	0.8	1.55	1.61	5.78	27.6	22.3	84.9	86.8	87.6	89.5	9	13	7
Suriname	68.8	33.8	38.4	1.84	5.98	7.14	9.52	3.66	2.33	0	16.2	24.0	66.5	85.6	93.6	89.3	42	16	8
Peru	48.3	53.8	61.0	1.82	5.76	6.02	5.63	2.74	1.86	0.51	6.15	6.72	86.7	84.8	87.3	88.3	8	17	9
Liberia	49.3	39.3	32.3	1.08	11.3	6.05	0	4.67	2.43	9.26	22.1	17.6	67.6	92	92.1	88.2	37	4	10
Botswana	80.9	91.3	92.7	9	12.8	9.09	0.23	1.13	1.11	0.45	12	7.48	83.8	86.2	87.2	88.2	10	15	11
Chile	47.7	57.0	51.9	3.45	9.52	7.04	2.29	1.91	1.55	6.14	14	9.84	88.6	86.9	88.1	87.8	4	11	12
Zambia	75.9	75.1	75.0	3.59	7.58	5.52	1.42	2.79	1.4	3.87	12.7	10.9	87.5	88.6	89.5	87.3	5	8	13
Guyana	37.4	61.2	59.6	6.34	10.5	18	3.99	5.34	0.81	5.55	10.6	11.8	90.8	93	90.4	87.2	2	2	14
Sierra Leone	27.8	93.6	88.2	0.51	14.9	6.03	5.66	1.76	1.1	0.04	18.1	9.89	77.2	89.9	87.5	87.1	19	6	15
Mongolia	57.5	80.4	82.5	5.55	16.7	14.7	0	0.99	0.48	9.68	21.1	21.5	72.8	86.9	86.8	86	27	12	16
Australia	34.7	56.7	54.9	4.37	11.9	10.1	2.68	1.04	0.83	1.09	6.46	5.01	87.4	83.3	83.7	84.6	6	18	17
Guinea	76.3	52.1	61.6	5.81	8.81	9.79	3.33	2.65	0.56	5.17	7.49	9.76	91.7	86.8	86.3	84.3	1	14	18
Tanzania	3.9	38.1	44.5	0.19	1.47	1.47	34.9	5.4	3.26	0.02	2.5	2.97	66.9	80.5	81.5	83.4	41	19	19
Kyrgyz Republic	7.1	28.5	47.8	0.85	4.72	5.34	6.95	1.8	1.09	0.22	7.07	8.23	77	80	83.8	83.2	20	20	20
Ghana	28.4	23.0	36.4	1.87	4.07	5.26	6.33	2.11	1.11	1.09	6.47	6.08	86.7	79.2	81.9	81.6	7	23	21
Lao PDR	1.5	36.5	32.7	0.03	3.25	2.59	43	2.91	1.48	0	8.16	5.63	53.7	59.1	60.9	81.2	69	61	22
Senegal	9.9	15.9	20.3	0.52	1.06	1.43	15.7	14.4	8.35	0	1.58	1.77	57.9	76.1	80	81	61	24	23
Bolivia	31.0	27.4	40.1	1.13	5.59	3.64	6.87	0.48	1.16	0.01	3.51	2.75	78.9	73.3	82.4	80.9	18	32	24
Armenia	24.1	47.3	50.6	0.14	2.29	2.76	0	1.23	1.05	0.47	3.32	4.6	53.2	76.1	84.1	80.8	71	25	25
Zimbabwe	15.9	20.1	41.1	2.18	9.85	7.2	1.38	0.55	0.43	4.32	4.45	4.62	81.9	75.8	75.7	79.1	15	26	26
Mozambique	6.4	51.1	51.9	0.15	2.9	1.64	0.89	2.99	1.03	0.01	1.39	2.32	58.9	80	83.5	78.2	59	21	27
Uzbekistan	9.9	30.5	47.6	2.37	3.09	2.65	0.1	0.6	0.43	1.65	5.5	5.1	76.1	73.8	75.2	76.5	22	31	28

Canada	8.3	11.4	11.0	1.122	2.174	1.864	4.27	4.48	3.32	0.44	0.78	0.7	79.06	74.28	75.8	75.89	17	30	29
South Africa	35.9	38.2	35.2	4.829	7.067	5.899	0.37	0.41	0.24	2.96	5.1	4.59	82.65	75.33	76.28	75.06	13	28	30
Madagascar	8.0	37.4	27.0	0.61	2.061	1.509	2.23	0.54	1.24	0	3.41	1.33	67.67	71.29	75.88	75.06	36	34	31
Tajikistan	30.2	59.1	54.7	0.364	1.898	2.369	18.6	1.13	0.24	0.27	1.74	2.98	80.37	74.78	75.98	75.03	16	29	32
Cote d'Ivoire	0.7	5.8	6.1	0.052	1.001	1.326	18.6	7.19	4.51	0	1.4	2.42	36.3	69.9	73.09	74.53	102	38	33
Colombia	12.1	16.6	21.5	0.496	1.645	1.384	0.18	1.84	1.41	0.11	1.12	1.16	67.58	70.93	74.29	73.89	38	35	34
Fiji	9.2	6.4	8.1	1.037	0.64	0.872	15.9	18.9	9.07	1.05	0.9	0.95	82.77	68.68	74.06	73.62	12	42	35
Niger	21.3	29.1	30.0	0.176	0.291	0.326	81.9	51.4	3.25	0.13	0.29	0.42	76.54	70.04	75.24	72.64	21	37	36
Kazakhstan	26.2	10.0	16.5	3.23	4.181	4.185	0.82	0.71	0.38	2.18	3.05	4.1	82.28	69.82	71.25	72.3	14	39	37
Lesotho	3.5	26.4	22.3	0	6.382	6.045		1.68	0.05	0	6.33	5.96	14.45	79.83	71.87	71.9	140	22	38
Jamaica	49.7	48.1	46.3	1.194	1.238	1.055	0	1.3	0.56	2.89	0.95	1.05	67.45	70.05	75.05	71.87	39	36	39
Nicaragua	1.8	8.3	7.9	0.214	1.113	1.173	37.5	3.62	1.88	0.05	2.03	1.93	65.22	69.43	73.84	71.52	44	40	40
Sudan	4.2	27.4	26.9	0.091	1.864	2.315	0	0.54	0.14	0.07	2.45	2.91	42.54	68.83	71.16	69.74	91	41	41
Brazil	11.5	16.3	13.1	0.391	1.327	1.254	1.74	0.74	0.66	0.31	1.69	1.37	73.04	65.92	68.56	68.54	26	46	42
Dominican Republic	1.5	20.0	20.2	0.339	1.242	1.617	1.56	0.41	0.33	0.67	1.94	1.77	61.75	63.7	66.52	68.51	52	52	43
Russian Federation	11.2	8.7	11.7	1.008	1.889	1.704	0.1	0.81	0.53	0.47	1.11	1.37	71.86	64.88	67.65	68.5	31	50	44
Macedonia, FYR	9.6	5.2	3.9	2.281	3.03	1.897	0	1.6	1.73	0.39	2.88	1.37	62.6	68.53	68.53	68.42	50	43	45
Togo	32.8	30.5	27.9	1.54	9.684	6.326	0.46	0.14	0	0	14.6	11.9	55.32	75.51	75.58	68.12	65	27	46
Gabon	4.0	6.0	5.4	0.256	1.995	2.115	0.7	3.83	1.76	0	0.15	0.31	56.66	66.19	68.19	67.81	62	45	47
Philippines	4.2	7.7	5.8	0.154	0.99	0.575	10.6	2.16	2.46	0.33	2.32	0.98	68.72	66.42	67.19	67.78	35	44	48
Solomon Islands	0.1	3.5	2.3	0	1.533	0.537		37	99	0.01	3.33	2.97	18.56	72.36	68.79	67.76	132	33	49
Argentina	1.2	6.0	6.8	0.018	0.555	0.48	80.3	3.51	3.61	0	0.41	0.37	52.06	59.95	65.36	67.33	75	59	50
Afghanistan	1.4	18.2	27.2	-	0.002	0.002	0	0	198	0	0.22	0.18	9.141	36.84	65.12	67.12	158	114	51
Serbia	14.9	5.8	5.2	2.76	3.037	2.868	0	1.52	1.09	0.08	0.67	0.55	62.32	65.52	66.11	66.4	51	48	52
Georgia	8.1	12.2	21.7	0.069	0.784	0.844	0	0	0.48	0.14	0.82	0.74	46.09	48.79	62.71	66.1	86	87	53
Honduras	1.7	6.4	6.9	0.148	0.59	0.381	1.39	1.55	2.3	0.11	0.74	0.59	55.17	58.21	58.56	65.64	67	63	54
Mexico	2.3	4.0	4.1	0.241	0.819	0.765	4.7	4.24	2.44	0.13	0.74	0.86	64.01	63.33	65.22	65.49	46	54	55
Bulgaria	9.8	14.8	11.6	2.143	3.025	2.421	0.07	0.11	0.2	1.41	1.3	1.08	74.78	63.62	65.42	65.4	24	53	56
Indonesia	8.1	16.3	15.7	0.364	1.625	1.374	4.12	0.43	0.18	0.76	1.68	1.19	75.11	64.6	67.67	64.65	23	51	57
Morocco	10.5	7.9	6.7	0.686	1.264	1.078	0	1.57	0.5	0.03	1.75	2.24	55.23	65.47	68.77	63.91	66	49	58

Congo, Rep.	1.9	10.3	12.1	0	0.002	0.025		1412	69.8	0.04	0.03	0.05	29.67	56.35	64.56	63.87	112	67	59
Finland	3.2	5.7	5.4	0.136	0.719	0.564	0.2	4.07	2.4	0.01	0.29	0.22	51.34	61.53	66.06	63.73	76	56	60
Ukraine	8.9	11.3	9.7	1.937	2.921	2.025	0.02	0	0.01	0.69	3.45	2	72.17	62.45	63.71	63.03	30	55	61
Guatemala	0.6	8.0	6.7	0	1.065	0.849		2.21	0.73	0	1.07	0.64	6.538	65.86	66.15	62.48	171	47	62
Sweden	2.9	5.1	4.5	0.337	0.789	0.706	1.99	2.11	1.67	0.03	0.46	0.2	61.51	59.25	59.99	61.44	53	60	63
India	16.2	11.7	14.3	0.719	0.879	0.771	0.01	0.1	0.08	0.98	1.49	1.14	71.06	56.8	61.51	60.88	32	66	64
Turkey	2.5	6.1	9.5	0.457	0.931	0.562	0.34	0.66	0.67	0.04	0.26	0.21	58.19	54.48	59.43	60.84	60	72	65
Ecuador	2.8	4.7	2.6	0.166	0.165	0.183	7.75	9.32	11.4	0	0.18	0.21	59.07	58.07	64.6	60.67	58	65	66
Kenya	3.0	4.8	5.7	0.028	0.108	0.115	0	13.2	5.48	0	0.01	0.04	34.09	54.07	59.04	60.45	107	73	67
New Zealand	6.0	3.8	3.9	0.356	0.611	0.51	3.38	1.13	1.98	0.1	0.36	0.29	69.26	52.5	57.83	60.4	33	78	68
Egypt, Arab Rep.	5.6	6.9	16.4	0.035	0.163	0.144	0	0.76	0.48	0.02	0.28	0.27	40.24	49.8	56.34	58.19	97	85	69
Albania	9.6	7.6	8.6	0.192	0.974	0.532	11.1	0.04	0.63	0.12	0.34	0.11	72.44	49.91	61.18	58.18	28	84	70
Uganda	3.9	2.8	8.3	0	0.056	0.012		9.53	27.5	0	0	0	14.68	48.16	51.83	58	139	89	71
United Kingdom	4.5	11.4	7.7	0.15	0.067	0.031	0	1.61	5.36	0.01	0	0	41.55	49.28	56.41	57.53	95	86	72
New Caledonia	42.2	36.6	39.0	15.62	22.05	14.43	0.51	0.41	0.35	0	0	0	61.41	55.3	56.42	56.71	54	70	73
United States	4.2	6.2	5.6	0.489	0.646	0.418	0.64	0.71	0.69	0.22	0.31	0.2	65.59	53.87	57.28	56.61	43	75	74
Montenegro		32.1	31.9	-	1.465	1.258		0	0	0	0.38	0.41	0.42	53.66	56.8	56.34	211	77	75
Rwanda	2.8	44.6	45.3	0.14	1.554	1.004	0	0.04	0	0	0.39	0.23	36.64	60.91	62.57	56.29	101	58	76
Israel	31.9	31.2	27.2	0.213	0.588	0.52	0	0	0.03	0	0.05	0.06	34.31	45.68	50.01	56.2	106	99	77
Cuba	15.8	17.4	9.4	0.245	0.312	0.183	5.38	0	0.36	0.2	0.56	0.31	73.79	45.71	57.69	55.92	25	97	78
Azerbaijan	1.6	1.0	5.2	0	0.052	0.065		2.4	1.49	0	0.08	0.2	9.911	39.87	46.29	55.86	155	110	79
Bosnia and Herzegovina	6.8	10.8	9.5	0.557	3.068	2.765	0	0.08	0	0.04	0.9	0.57	52.76	61.22	55.21	55.53	72	57	80
Greece	6.8	7.9	8.7	0.993	1.67	0.915	0.08	0.39	0.2	0.02	0.17	0.06	63.6	56.25	58.07	55.5	48	68	81
Jordan	21.2	7.9	9.0	0.864	1.463	1.84	0	0	0	0	0.96	1.25	39.35	50.12	55.12	55.09	98	82	82
Myanmar	7.9	19.4	6.1	0.032	0.476	0.572	26.3	0.32	0.09	0	0.62	0.55	46.42	54.77	58.73	54.46	85	71	83
Iran, Islamic Rep.	1.4	5.4	4.6	0.099	0.453	0.357	0.04	0.54	0.44	0.09	0.77	0.42	46.94	51.52	57.52	54.36	81	81	84
Oman	1.5	4.8	5.2	0.011	0.194	0.098	0	3.73	1.58	0	0.09	0.02	12.95	53.85	61.38	54.12	144	76	85
Poland	11.4	5.3	4.1	2.02	1.535	1.135	0	0.13	0.1	0.54	0.61	0.54	64	53.87	56.92	54.09	47	74	86
Malaysia	1.4	3.1	4.2	0.058	0.18	0.093	3.8	0.9	1.12	0.06	0.28	0.19	54.47	45.7	54.92	54.05	68	98	87
Burundi	32.3	41.6	44.4	0	0.524	0.243		0	0	0.36	0.45	0.5	44.22	50.04	55.9	53.6	88	83	88

Panama	2.7	5.1	2.4	0.039	0	0.001	116		639	0	0	0.04	43.77	24.57	45.32	52.3	89	129	89
Norway	7.1	5.5	6.3	0.082	0.16	0.075	0	0.72	0.99	0	0.04	0.02	41.43	45.48	50.26	51.46	96	100	90
Malawi	0.2	1.5	1.5	0.032	0.031	0.016	0	98.6	50.1	0	0.04	0.04	9.575	46.92	56.24	51.21	156	94	91
Sri Lanka	6.1	3.8	2.4	0.025	0.019	0.012	0.47	18.7	23.7	0	0	0	34.85	48.73	51.79	50.61	104	88	92
Uruguay	0.9	1.3	1.1	0	0.105	0.062		5.47	3.52	0	0.09	0.09	7.352	47.18	31.09	50.49	166	92	93
China	3.1	1.5	1.4	2.067	2.356	1.533	0.01	0.15	0.13	0.22	1.9	0.73	65.2	51.77	51.22	50.43	45	80	94
Portugal	1.7	2.7	2.4	0.112	0.215	0.18	0.86	4.12	0.99	0	0.15	0.13	33.55	52.33	54.82	50.11	109	79	95
Ireland	1.2	1.4	0.9	0.118	0.213	0.083	1.82	4.71	4.29	0.01	0.07	0.04	50.33	48.03	49.65	50.02	78	90	96
Kosovo				-	3.635	3.329		0	0.27	0	1.24	0.68	0.42	40.01	50.89	50.02	212	109	97
Saudi Arabia	0.8	1.1	2.4	0.014	0.034	0.074	1.74	11.1	1.46	0	0.05	0.08	26.78	44.94	56.24	49.97	114	101	98
Cambodia	0.3	1.4	9.3	-	-	0.027			97.3	0	0	0	4.606	5.13	36.01	48.89	185	190	99
Spain	2.5	3.9	3.8	0.158	0.142	0.119	0.57	0.86	0.8	0	0.04	0.03	52.11	43.86	50.19	48.8	74	102	100
Cameroon	5.5	3.9	6.3	0	0.038	0.055			0.23	0.01	0.12	0.13	33.6	31.54	53.06	48.55	108	121	101
Yemen, Rep.	0.6	1.6	30.6	-	-	0.006			2.61	0	0	0	5.653	5.821	44.85	48.26	177	188	102
Thailand	3.0	3.8	4.8	0.185	0.2	0.157	0.17	0.06	0.13	0.03	0.09	0.06	53.53	39.38	45.66	46.56	70	111	103
Cyprus	1.7	8.3	3.7	0.014	0.071	0.047	0	8.97	0.8	0.01	0.07	0.03	31.39	58.35	53.89	46.36	110	62	104
Nauru	73.2	83.3	72.1	-	7.985	5.204	0	0	0	0	0	0	24.84	47.52	47.38	46.23	116	91	105
Romania	3.4	2.7	2.0	0.815	0.567	0.407	0	0.38	0.53	0.15	0.05	0.04	52.32	41.26	47.65	46.04	73	106	106
Vietnam	2.0	1.4	1.5	0.301	0.847	0.611	0.52	0.08	0.07	0.03	0.7	0.4	55.9	41.66	48.47	45.64	63	105	107
Japan	1.4	3.4	3.7	0.015	0.008	0.009	1.65	2.27	1.44	0	0	0	43.73	41.25	44.28	45.46	90	107	108
Bhutan	4.0	16.5	12.0	0.174	0.171	0.185	0	0	0	0.22	0.08	0.11	46.47	40.59	45.1	45.13	84	108	109
Czech Republic	4.9	2.6	1.7	1.654	1.271	0.907	0.03	0.01	0.01	0.26	0.12	0.1	66.89	43.15	45.39	43.9	40	104	110
Switzerland	5.1	27.0	29.5	0.004	0.004	0.005	0	1.68	1.25	0	0	0	18.52	37.23	40.54	43.78	133	113	111
Ethiopia	0.4	3.7	6.3	0.101	0.305	0.205	2.67	4.51	0	0.04	0.57	0.35	50.33	58.2	68.13	43.62	77	64	112
Angola	5.2	3.4	2.3	0.347	0.776	0.628	0.24	4.81	2.56	0	0	0	42.2	43.37	46	43.22	94	103	113
Slovak Republic	5.4	2.5	1.9	0.225	0.114	0.089	1.81	4.21	0.64	0.01	0.02	0.03	61.34	47.12	47.55	43.02	55	93	114
Djibouti	6.1	3.3	11.7	-	-	-			4800	0	0	0	16.82	10.2	18.6	41.5	136	165	115
Korea, Rep.	5.0	2.2	2.3	0.056	0.031	0.028	0	0.54	0.49	0	0.01	0	38.82	32.87	42.27	39.49	99	118	116
Swaziland	1.6	4.6	5.2	0.079	0.556	0.098	86.8	0.36	0	0.23	0.15	0.13	63.12	46	37.99	39.49	49	96	117
Pakistan	0.3	1.8	1.5	0.038	0.07	0.069	1.96	0.13	0.14	0.06	0.08	0.05	46.53	32.85	40.12	38.02	83	119	118

Slovenia	3.4	3.7	4.6	0.511	0.428	0.348	0	0	0	0.01	0.02	0.02	47.2	32.57	36.98	37.65	80	120	119
Tunisia	1.7	1.8	1.6	0.433	0.297	0.3	0	1.31	0	0.01	0.41	0.5	42.22	46	47.37	37	93	95	120
Paraguay	0.4	1.1	1.4	-	-	0.002			161	0	0	0	4.839	3.747	34.9	35.83	184	198	121
France	2.6	2.5	2.3	0.044	0.022	0.016	0.42	0.47	0.25	0	0	0	46.62	31.25	36.7	35.51	82	122	122
Italy	1.3	3.0	2.9	0.015	0.031	0.025	1.2	0.09	0.08	0	0	0	42.26	29.98	37.77	35.33	92	123	123
Germany	2.6	3.1	2.7	0.365	0.503	0.388	0	0.06	0	0.02	0.02	0.01	44.71	36.5	41.76	34.7	87	116	124
Venezuela, RB	6.0	1.7	4.2	0.272	0.125	0.153	2.36	0.16	0.29	0.28	0.36	0	68.82	36.76	32.76	33.07	34	115	125
Austria	3.0	3.6	3.5	0.047	0.103	0.073	0	0.41	0	0	0.03	0.01	34.93	38.5	40.06	32.49	103	112	126
Belarus	1.0	0.9	1.2	0.519	2.273	2.718	0	0.11	0.09	0	0	0	24.78	27.61	31.14	32.09	117	126	127
Benin	0.6	11.9	25.8	-	-	0				0	0.01	0.01	6.118	29.87	30.56	31.78	174	124	128
Iraq	0.2	0.4	4.6	0.014	0.023	0.017	0	0	0	0	0	0	7.552	15.77	11.19	31.32	164	152	129
Nigeria	0.2	0.7	2.0	0.008	0.022	0.048	0	0.09	0	0	0.04	0.07	21.75	24.97	26.52	31.05	125	127	130
Central African Republic	56.0	39.1	8.7	1.473	2.658	0	0	0		0.01	0.1	0.1	60.8	55.93	36.7	30.62	56	69	131
Chad	0.1	0.1	12.5	-	-	0				0	0.02	0.03	3.095	13.58	14.25	30.54	195	156	132
Hungary	4.3	1.7	1.3	0.414	0.329	0.237	0	0.32	0	0.03	0.01	0.01	48.76	34.95	30.26	29.58	79	117	133
Luxembourg	6.4	8.3	6.0	0	0	0				0	0.03	0.05	17.24	29.63	28.35	27	135	125	134
Croatia	2.2	4.7	3.2	0.004	0	0.004	0		0	0	0	0	29.07	23.78	17.42	26.81	113	132	135
Costa Rica	1.3	1.1	1.1	0.025	0	0.054	170		0	0	0.02	0.02	38.21	16.54	27	26.57	100	150	136
Nepal	0.1	3.9	3.0	0	0.001	8E-04		0	0	0	0	0	2.934	24.31	24.79	26.1	197	131	137
Algeria	0.6	0.2	0.3	0.034	0.029	0.036	0	0	0	0.03	0.06	0.07	29.8	18.31	26.47	25.65	111	141	138
Lebanon	10.6	19.1	22.3	-	-	9E-04			0	0	0	0	19.61	19.53	25.81	25.53	130	137	139
Netherlands	2.9	2.9	2.8	0.021	0.039	0.041	0	0	0.03	0	0	0	17.87	13.51	18.97	24.62	134	158	140
French Polynesia	71.0	68.2	64.9	-	-	-				0	0	0	24.61	24.6	24.47	24.34	118	128	141
Bangladesh	0.0	0.5	0.4	5E-04	0.03	0.026	0	0	0	0	0.02	0.01	4.143	18.12	23.39	23.41	189	144	142
Korea, Dem. People's Rep.	10.8	49.1	52.7	-	-	-	0	0	0	0	0	0	19.84	23.22	23.54	23.41	128	133	143
Denmark	1.0	1.6	1.3	0.007	0.01	0.011	0	0	0	0	0	0	10.52	7.88	12.37	23.21	153	176	144
French Guyana				-	-		31.5	25.2	6.71	0	0	0	23.47	24.49	23.89	23.1	121	130	145
Montserrat	0.2	25.3	38.7	-	-					0	0	0	3.327	20.22	19.76	21.8	193	135	146
Belgium	9.6	7.5	7.0	0.011	0.008	0.01	0	0	0	0	0	0	22.18	17.08	22.38	21.75	124	146	147
Iceland	10.6	39.0	36.4	-	-	0				0	0	0	19.72	22.41	22.52	21.45	129	134	148

United Arab Emirates	4.2	13.2	26.9	-	-	0				0	0	0	14.96	18.26	18.95	20.06	138	142	149
Bahrain	42.3	24.6	22.7	-	-	-				0	0	0	23.44	20.11	20.1	19.58	122	136	150
British Virgin Islands	36.2	12.8	19.2	-	-	-				0	0	0	22.98	18.15	18.24	18.76	123	143	151
Somalia	0.0	10.3	18.9	-	-	-				0	0	0	1.932	17.23	16.52	18.65	204	145	152
Northern Mariana Islands	3.3	13.6	18.6	-	-	-				0	0	0	13.91	18.38	17.21	18.53	141	140	153
Bonaire, Sint Eustatius and Saba		2.5	16.8	-	-				0	0	0	0	0.42	8.125	20.34	18.43	213	173	154
Libya	0.0	2.3	17.2	-	-	-			0	0	0	0	1.583	7.664	16.91	18.41	206	178	155
Hong Kong SAR, China	2.5	14.7	15.4	-	-	0				0	0	0	11.93	18.49	17.8	17.97	146	139	156
Sint Maarten (Dutch part)		3.1	14.6	-	-	-				0	0	0	0.42	9.623	19.74	17.72	214	169	157
Aruba	0.6	2.3	14.0	-	-	-				0	0	0	6.234	7.895	8.106	17.48	173	175	158
American Samoa	0.0	3.8	12.4	-	-	-				0	0	0	0.42	11.58	11.68	17.13	215	161	159
Cayman Islands	5.0	0.9	10.3	-	-	-				0	0	0	15.77	3.171	2.807	16.32	137	201	160
State of Palestine	0.0	9.1	8.8	-	-					0	0	0	0.42	16.77	16.3	15.64	216	148	161
Equatorial Guinea	0.0	0.0	0.1	-	-	0				0	0.03	0.06	1.467	13.8	14.57	15.46	207	155	162
China, Macao SAR	0.4	5.7	8.4	-	-	0				0	0	0	5.188	13.89	15.15	15.18	181	154	163
Grenada	0.2	10.1	8.2	-	-	0				0	0	0	3.676	17	16.88	14.94	192	147	164
Gambia, The	67.7	8.7	8.2	-	-	0				0	0	0	24.37	16.42	17.46	14.83	120	151	165
Dominica	1.7	7.5	6.9	-	-				0	0	0	0	9.955	15.15	15.04	14.24	154	153	166
Latvia	1.1	3.3	2.1	-	-	0.005			0	0	0	0	7.978	10.08	15.61	13.29	161	166	167
Moldova	1.4	1.8	1.1	-	-	0.018			0	0	0	0	9.025	6.397	14.63	12.25	159	186	168
Turkmenistan	1.0	0.5	1.0	-	-	0.013			0	0	0	0	7.746	2.48	11.96	11.59	162	206	169
El Salvador	1.4	2.0	1.3	-	-	0.01			0	0	0	0	9.257	7.088	13.03	11.5	157	182	170
St. Lucia	0.2	3.5	4.4	-	-	0				0	0	0	3.211	10.89	7.662	11.34	194	162	171
Mauritius	1.9	5.4	4.3	-	-	0				0	0	0	10.89	13.54	13.42	11.22	150	157	172
Guam	0.0	8.7	4.1	-	-	-				0	0	0	0.42	16.65	15.59	10.62	217	149	173
Syrian Arab Republic	0.9	2.2	4.1	-	-	-	0	0	0	0	0	0	7.048	7.319	6.493	10.51	168	180	174
Andorra	3.2	5.0	3.9	-	-	-				0	0	0	13.56	12.96	12.71	10.27	143	159	175
Tonga	0.4	3.2	3.8	-	-	0				0	0	0	5.071	9.853	9.967	9.942	182	168	176
Kuwait	0.9	0.4	0.9	-	-	9E-04			0	0	0	0	7.281	2.019	8.972	9.461	167	209	177
St. Vincent and the Grenadines	0.1	3.4	3.4	-	-	0				0	0	0	2.63	10.54	9.851	9.361	199	163	178

Turks and Caicos Islands	0.1	3.3	3.4	-	-	-				0	0	0	2.862	10.31	11.22	9.343	198	164	179
Trinidad and Tobago	1.0	1.5	3.0	-	-	0				0	0	0	7.397	5.476	4.782	9.012	165	189	180
Palau	0.6	2.5	2.8	-	-	0				0	0	0	6.467	8.471	5.704	8.78	172	172	181
Singapore	2.1	2.0	2.5	-	-	0				0	0	0	11.35	7.204	7.317	8.315	148	181	182
Anguilla	0.1	3.2	2.5	-	-					0	0	0	2.513	9.969	10.2	8.198	200	167	183
China, Taiwan Province of	1.3	2.3	2.5	-	-		0	0	0	0	0	0	8.444	7.78	7.893	8.082	160	177	184
Comoros	0.0	3.0	2.4	-	-	0				0	0	0	1.816	9.277	9.621	7.733	205	170	185
Qatar	0.3	1.2	2.4	-	-	0				0	0	0	4.141	4.439	8.584	7.501	190	194	186
Estonia	2.9	2.4	2.2	-	-	0				0	0	0	12.75	8.01	7.202	6.803	145	174	187
Bahamas, The	15.4	1.9	2.2	0.343	0.762	0	0	0		0	0	0	34.63	18.57	22.72	6.687	105	138	188
Cook Islands	27.0	1.9	2.0	-	-					0	0	0	21.7	6.628	6.856	6.222	126	185	189
Maldives	0.3	1.9	1.8	-	-	0				0	0	0	3.909	6.743	5.128	5.989	191	184	190
Haiti	0.6	1.9	1.5	-	0	0				0	0	0	5.885	7.039	6.05	5.408	176	183	191
Sao Tome and Principe	1.8	1.2	1.4	-	-	0				0	0	0	10.54	4.554	4.321	5.059	152	193	192
Barbados	2.1	2.2	1.4	-	-	0				0	0	0	11.23	7.434	5.819	4.942	149	179	193
Cabo Verde	1.8	1.6	1.3	-	-	0				0	0	0	10.77	5.936	3.169	4.71	151	187	194
Lithuania	2.5	1.4	1.3	-	-	0				0	0	0	11.82	4.899	4.552	4.361	147	191	195
Tokelau	0.3	3.9	0.9	-	-					0	0	0	4.257	12.04	13.19	3.315	188	160	196
Antigua and Barbuda	9.6	0.8	0.8	-	-	0				0	0	0	18.91	3.056	5.473	3.198	131	202	197
Timor-Leste		0.2	0.8	-	-	0				0	0	0	0.42	1.213	1.556	3.082	218	215	198
Malta	0.6	0.7	0.8	-	-	0				0	0	0	5.537	2.941	3.054	2.966	178	203	199
Seychelles	0.3	0.9	0.6	-	-	0				0	0	0	4.49	3.402	2.017	2.733	186	200	200
Bermuda	0.1	1.2	0.6	-	-	-				0	0	0	2.978	4.323	3.728	2.715	196	195	201
Belize	0.4	1.1	0.6	-	-	0				0	0	0	5.304	4.093	5.589	2.617	180	197	202
Samoa	0.4	1.1	0.5	-	-	0				0	0	0	4.955	3.632	6.395	2.501	183	199	203
Brunei Darussalam	0.0	0.5	0.5	-	-	0				0	0	0	2.048	2.365	2.363	2.384	203	207	204
Gibraltar	18.5	0.6	0.4	-	-	-				0	0	0	21	2.711	2.691	2.134	127	204	205
Tuvalu	0.0	1.3	0.3	-	-	0				0	0	0	0.42	4.784	6.741	2.035	219	192	206
St. Kitts and Nevis	0.0	0.2	0.3	-	-	0				0	0	0	1.234	1.558	1.787	1.919	209	212	207
Guinea-Bissau	0.1	0.4	0.3	-	-	0				0	0	0	2.164	1.904	1.902	1.803	202	210	208
Vanuatu	0.4	0.3	0.3	-	-	0				0	0	0	5.42	1.674	1.211	1.687	179	211	209
Micronesia, Fed. Sts.	0.0	0.2	0.2	-	-	0				0	0	0	1.351	1.443	1.672	1.454	208	213	210
Greenland	0.0	2.8	0.1	-	-	-				0	0	0	1.118	9.047	8.797	1.203	210	171	211
Marshall Islands	0.9	0.5	0.1	-	-	0				0	0	0	6.932	2.134	2.478	0.989	169	208	212
Faroe Islands	0.0	0.2	0.1	-	-	-				0	0	0	0.42	1.328	1.309	0.971	220	214	213
Saint Helena	0.7	1.2	0.1	-	-								6.583	4.208	0.75	0.873	170	196	214
Kiribati	1.0	0.1	0.0	-	-	0				0	0	0	7.63	0.982	1.326	0.756	163	216	215
Niue	0.6	0.6	0.0	-	-					0	0	0	6.002	2.595	2.709	0.64	175	205	216
Falkland Islands (Malvinas)	0.3	0.0	0.0	-	-					0	0	0	4.374	0.637	0.635	0.524	187	217	217
Western Sahara	86.7			-	-					0	0	0	25.3	0.406	0.52	0.408	115	219	218
Netherlands Antilles	3.2			-	-					0	0	0	13.79	0.406	0.52	0.408	142	220	219
St. Martin (French part)	0.1	0.0		-	-					0	0	0	2.397	0.522	0.865	0.408	201	218	220
Wallis and Futuna Islands	0.0	0.0		-	-					0	0	0	0.42	0.406	0.52	0.408	221	231	231
Christmas Island				-	-		0	0	0	0	0	0	0.42	0.406	0.52	0.408	222	222	222
Channel Islands				-	-					0	0	0	0.42	0.406	0.52	0.408	223	221	221
Curacao				-	-					0	0	0	0.42	0.406	0.52	0.408	224	223	223
Isle of Man				-	-					0	0	0	0.42	0.406	0.52	0.408	225	224	224
Liechtenstein				-	-					0	0	0	0.42	0.406	0.52	0.408	226	225	225
Monaco				-	-					0	0	0	0.42	0.406	0.52	0.408	227	226	226
Puerto Rico				-	-					0	0	0	0.42	0.406	0.52	0.408	228	227	227
San Marino				-	-					0	0	0	0.42	0.406	0.52	0.408	229	228	228
South Sudan				-	-	0				0	0	0	0.42	0.406	0.52	0.408	230	229	229
Virgin Islands (U.S.)				-	-					0	0	0	0.42	0.406	0.52	0.408	231	230	230

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