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EU Policy on Natural Resources

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# European dependence on and concentration tendencies of the material production

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# 2. European dependence on and concentration tendencies of the material production

*Henrike Sievers, Luis Tercero*

**The European economy is highly dependent on primary metal imports, since they build the base of the EU's industrial production. Only a minor amount of the European metal consumption is mined within the EU or can be covered from secondary resources. For several metals, including such as RE, vanadium, magnesium, cobalt and PGMs to name just a few, the EU countries completely rely on imports. Geological reserves and as well as the mine production of various raw materials are geographically highly concentrated. Not only the case of the Chinese RE production is an example for a high concentration, but also the production of niobium in Brazil or PGM production in South Africa. The political stability of raw material producing countries adds a further aspect to the discussion of potential supply risks.**

**Especially RE, germanium (refined production), tin, antimony and tungsten show a low performance in governance in their producing countries, which is indicated by the World Bank's world governance indicators.**

## *2.1 The EU's import dependence*

The European economy is highly dependent on primary metal imports. The EU is self-sufficient in the production of construction minerals and has also has a large production of industrial minerals, but is a net importer for many of these materials. For metals the situation is different. Only a minor amount of the European consumption of metals is mined in the EU. Examples for EU metal production are the copper mines in the Kupferschiefer in Poland, the copper-zinc mine Neves Corvo in Portugal or the Swedish copper mine Aitik and the iron ore mine Kiruna (Sweden). This production is by far not sufficient to meet the European demand.

For several metals, including rare earths and PGMs, the EU countries completely rely on imports.

The import dependence for 32 non-energy raw materials was estimated from foreign trade data and EU production data as the ratio

$$\text{import dependence} = \frac{\text{net imports}}{\text{net imports} + \text{EU production}}$$

Trade data were extracted from the UN comtrade[1] and Eurostat ComExt[2] foreign trade databases. The trade codes used for this were selected as close to the raw material as possible, i.e. ores and concentrates instead of semi-finished products. Production data were obtained from the British Geological Survey[3], the United States Geological Survey[4], the Austrian Ministry of Economy, Family and Youth[5], Eurostat Prodcom[6] and the German Federal Institute for Geosciences and Natural Resources[7]. All data pertain to 2006.

Notice that the extreme case of 0% import dependence only occurred for gallium (and was found to vary strongly from year to year). Nevertheless, gallium (metal) is produced as a by-product of aluminium refining from bauxite and the EU is 95% dependent on bauxite imports. This means that with regard to the mine production Europe is highly import dependent on gallium, which is only refined in Europe but originates from bauxite from states like Guinea or Australia. On the other hand, there was no primary production of 14 of the selected raw materials within the EU, leading to 100% import dependence.

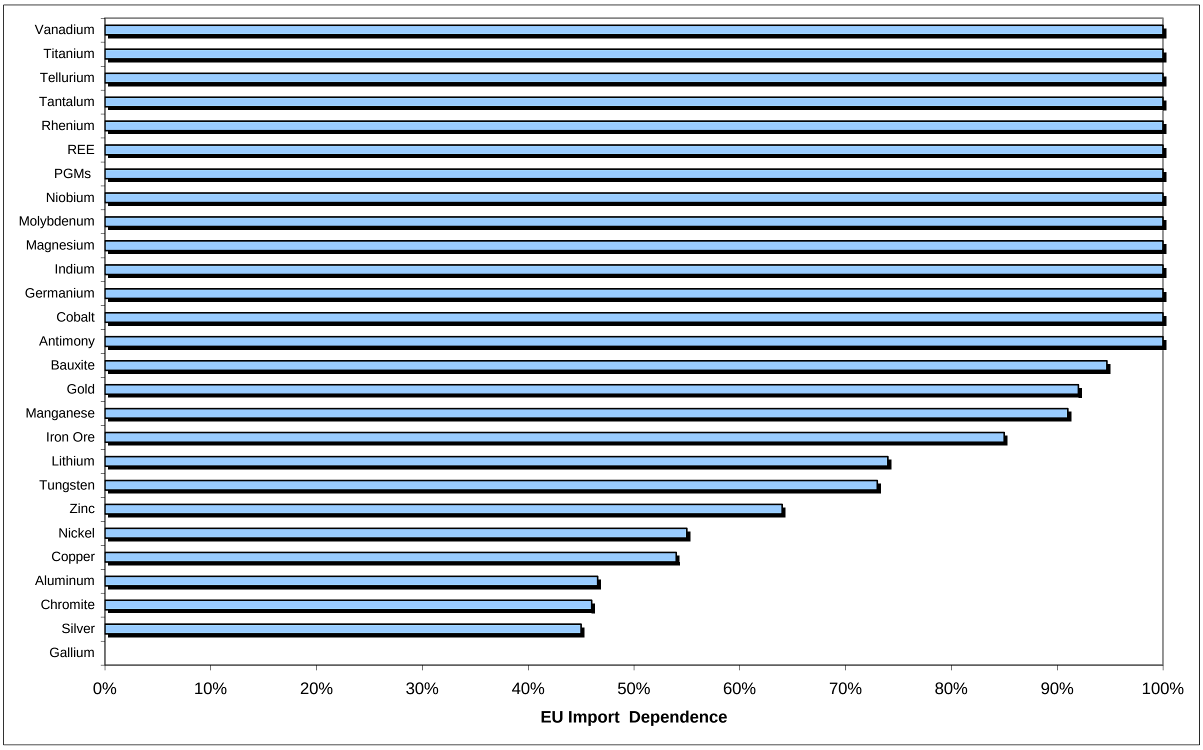


**Figure 1: The import dependence of EU countries on several raw materials (ores and concentrates).**

[1] http://comtrade.un.org/
[2] http://epp.eurostat.ec.europa.eu/newxtweb/
3 http://comtrade.un.org/
3 http://epp.eurostat.ec.europa.eu/newxtweb/
[3] T. J. Brown, L. E. Hetherington, N. E. Idoine, S. F. Hobbs, T. Bide: *European Mineral Statistics 2003-2007*. Keyworth (Nottingham) 2009.
[4] U.S. Geological Survey, Mineral Commodity Summaries, 2010.
[5] L. Weber, G. Zsak, C. Reichl, M. Schatz: *World Mining Data 2009*, Volume 24, Vienna 2009.
[6] http://epp.eurostat.ec.europa.eu/portal/page/portal/prodcom/data/database
[7] BGR provided data directly within POLINARES.

## 2.2 The country concentration of mine production

Herfindahl Hirschmann Index (HHI) was used to characterize the concentration of the production of a raw material on country level. The values of the calculated HHI can vary between 0 and 10000, where a value above 1800 is regarded as a critical concentration, between 1000 and 1800 as moderate and below 1000 as noncritical. The analysis shows the highest country concentration for the production of REE, of which 97% originate from China. Also germanium, niobium, antimony, tungsten, magnesium and platinum show a very high concentration of the global production.

Lower HHI values, but still values representing a critical concentration in the global production can be observed for palladium, tantalum, vanadium, lithium, cobalt, tin, chromium, molybdenum and lead.

Only the concentration of silver and gold can be regarded a non-critical, while tellurium, copper, bauxite, manganese, iron ore, zinc and nickel show moderate concentration values.

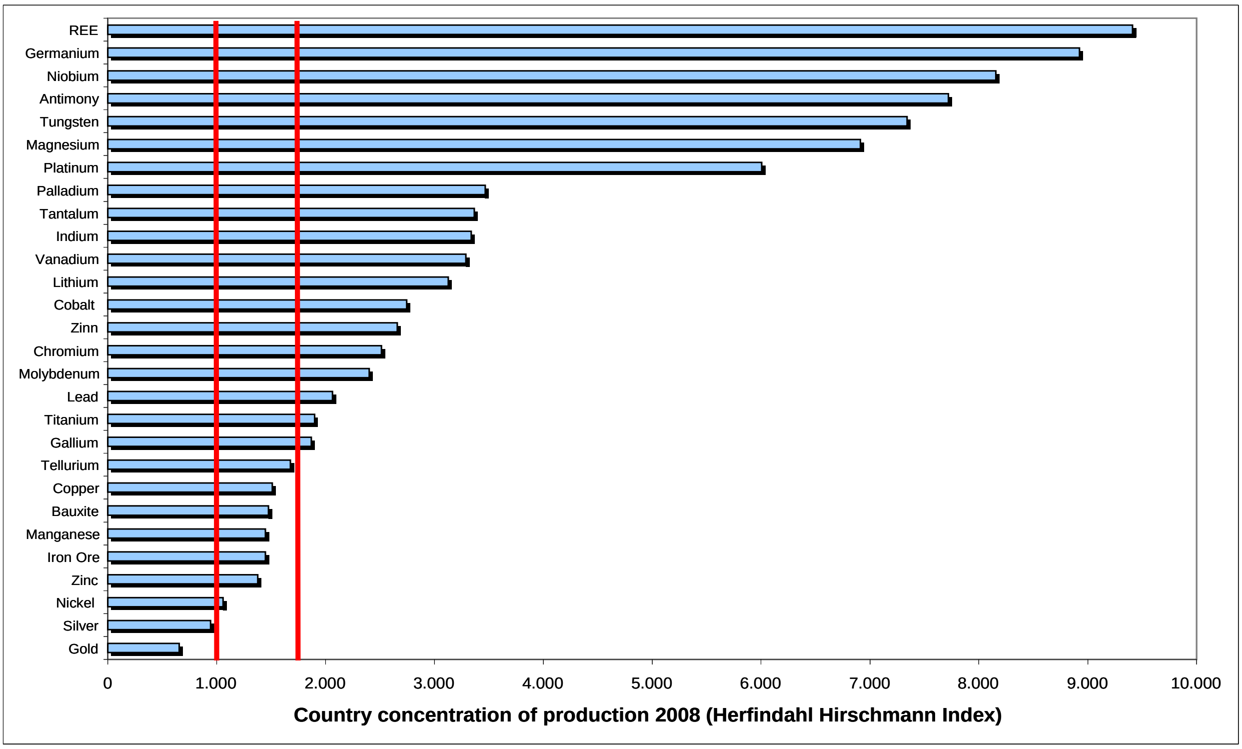


**Figure 2. Country concentration of mine production (2008). A value for the Herfindahl Hirschmann Index higher than 1800 is regarded as critical, a value between 1000 and 1800 as moderate.**

The table below shows the major producing countries for the minerals showing critical values in the country concentration. In many of these cases, China is the dominant producer (REE, antimony, tungsten, magnesium etc.), but a highly concentrated production is also found in other countries. More than 90% of the global niobium production for example originates from Brazil. Platinum and palladium are predominantly produced in Russia and South Africa and the Congo is the major producer of cobalt.

**Table 1: Major producers of mineral raw materials with a critical country concentration.**

| Raw Material | Major producing countries (share of global production 2008 ) |
|---|---|
| REE | China 97% |
| Niobium | Brazil 92%, Canada 6% |
| Antimony | China 87%, Guatemala 3%, Australia 2% |
| Tungsten | China 78%, Russia 5%, Canada 4% |
| Magnesium | China 80%, USA 5%, Russia 4%, Israel 4% |
| Platinum | South Africa 77%, Russia 12%, Canada 4%, Zimbabwe 3% |
| Palladium | Russia 43%, South Africa 37%, Canada 7%, USA 6% |
| Tantalum | Australia 50%, Brazil 16%, DR Congo 9%, Ruanda 9%, Ethiopia 7% |
| Vanadium | South Africa 36%, China 36%, Russia 26% |
| Lithium | Chile 42%, Australia 25%, China 13%, Argentina 12% |
| Cobalt | DR Congo 48%, Canada 14%, Australia 9%, Zambia 6%, Russia 6%, Cuba 5% |
| Tin | China 37%, Indonesia 32%, Peru 13%, Bolivia 6%, Brazil 4%, DR Congo 4% |
| Chromium | South Africa 43%, India 18%, Kazakhstan 15%, Turkey 8% |
| Molybdenum | China 42%, USA 21%, 16% Chile |
| Lead | China 39%, Australia 17%, USA 11%, Peru 9%, |
| Titanium | Australia 25%, South Africa 18%, Canada 13%, China 9% |
| Germanium (Refinery) | China 94%, USA 5% |
| Gallium (Refinery) | China 32%, Germany 19%, Kazakhstan 14%, Japan 10%, Russia 10% |
| Indium (Refinery) | China 54 %, South Korea 13%, Japan 11%, Canada 8% |

The concentration of the metal production over time does not remain stable, as shown in the figure below. Production data of several raw materials from the last four decades has been analysed and the results show a continuous concentration tendency of the production for some of those raw materials. Antimony, RE, tungsten, platinum and germanium experienced a growing concentration since the 70s. On the other hand the concentration of nickel and cobalt production decreased, while the concentration of iron ore and bauxite remained fairly stable.

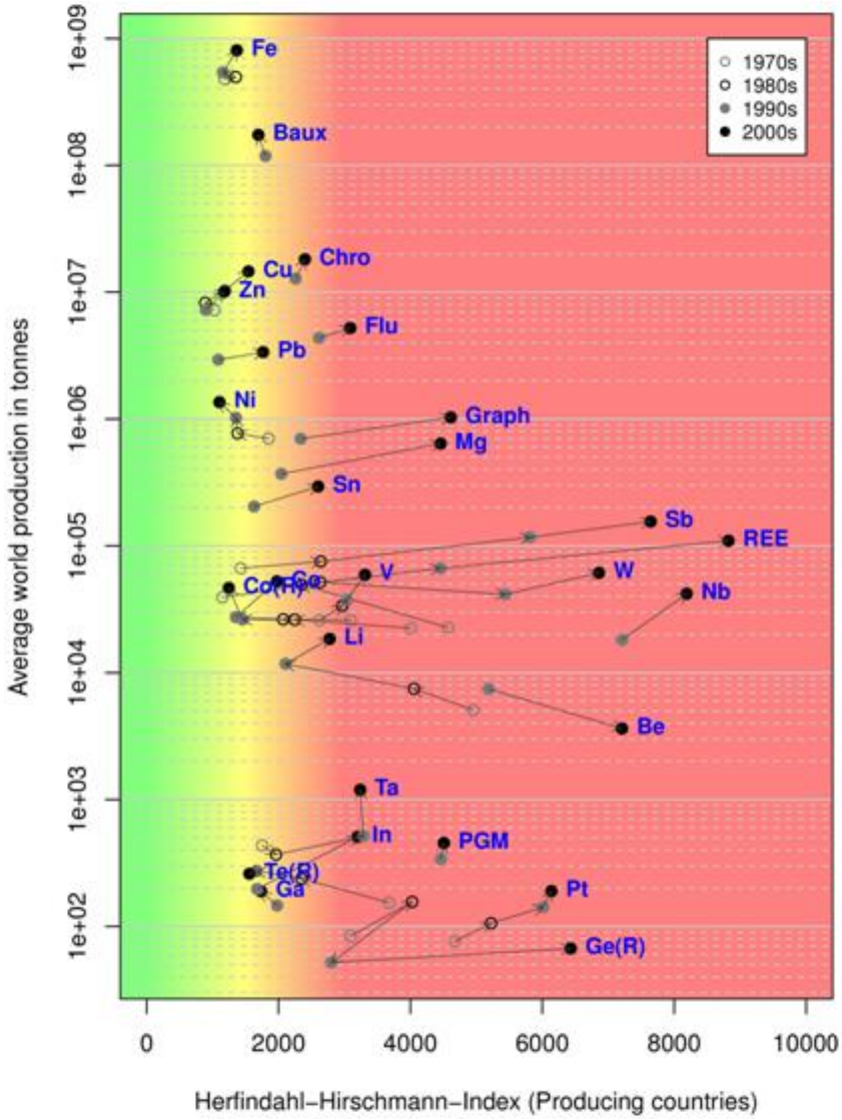


**Figure 3: Development of the HHI over time. Metals like germanium, platinum, rare earths and aantimony experienced an increase of production concentration.**

## *2.3 Country concentration of reserves*

Reserves of metallic raw materials are, as the mine production is, unevenly distributed over the world, but not in all cases the reserves are concentrated to the same amount in the same region as the production is. Re production from China is an example for this shift. While China produces 97% of the global REO supply, it hosts only about two third of the global RE reserves. Tungsten shows a similar picture. While China is the biggest tungsten producer, delivering 86% of the global supply, the country accounts for just over 60% of world reserves. The USGS estimates global tungsten reserves at 2.8Mt (W content). Other countries with significant reserves of tungsten include Canada, the CIS and the USA. Most remaining reserves are located in Asia, with smaller, but nevertheless important, deposits in Europe, Latin America and Australia.

PGM and niobium are the raw materials showing the highest geographical concentration of the known reserves. PGM reserves are highly concentrated in South Africa and niobium in Brazil.

For tungsten, RE and antimony the concentration of the reserves (measured by the HHI, Herfindahl Hirschman Index) is significantly lower than the concentration of the mine production. For PGM and tantalum the mine production is less concentrated than the reserves.

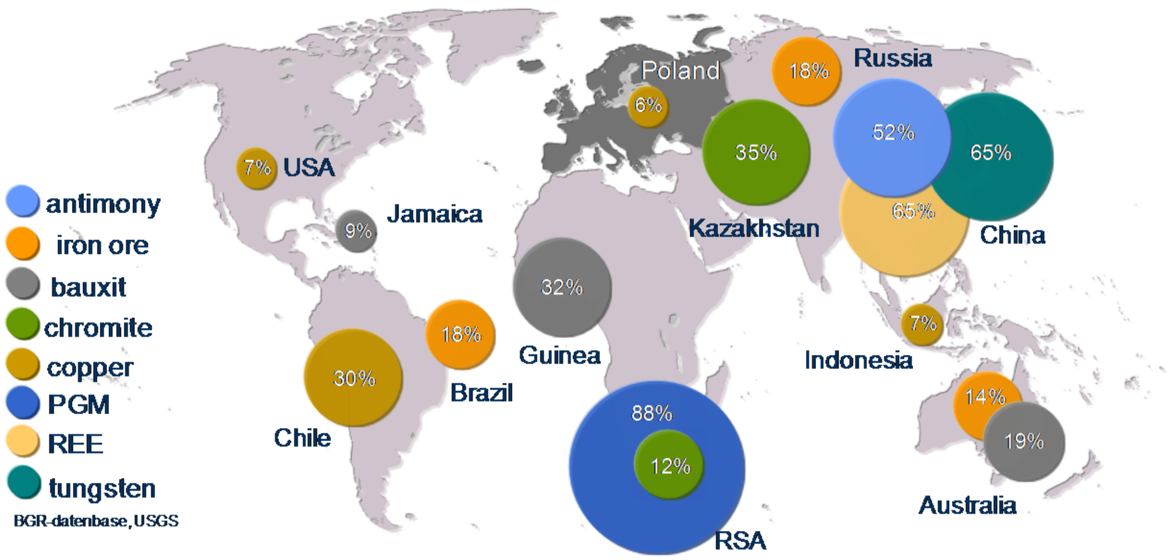


**Figure 4: Concentration of the reserves for several metallic raw materials in 2010 (source: BGR database).**

Analysis of reserve data (reserve and reserve base) in relation to the actual production of 15 mineral raw materials shows in the case of niobium, vanadium, molybdenum, and titanium only minor changes in the resulting country concentration. For rare earth elements, antimony, tungsten, cobalt, tin, iron and lead is the country concentration of the reserve base and reserve lower, whereas the country concentration of reserves is higher for PGM, tantalum, lithium, and chromium in comparison to the production.

The country risk of the reserve and the reserve base is lower for lead, cobalt, rare earth, tantalum, molybdenum and the platinum group metals. The country risk increases for titanium and lithium. Iron, antimony, chromium, tungsten, tin and niobium show no significant change of the country risk.

**Table 2: Mineral raw materials with a critical country concentration or country risk as well as iron analysed by BGR for the Polinares project.**

| Mineral raw material | Production 2009 / 2010 | | | Reserve base 2008 (USGS) | | Reserve 2010 (USGS) | |
|---|---|---|---|---|---|---|---|
| | Country risk | HHI | Major producer | Country risk | HHI | Country risk | HHI |
| Iron | 0.17 | 1566 | China 24%, Brazil 21%, Australia 19% | 0.08 | 1074 | 0.10 | 1133 |
| Titanium | 0.89 | 1697 | Australia 30%, South Africa 17%, Canada 17% | 0.25 | 1347 | 0.18 | 1538 |
| Lead | 0.06 | 2384 | China 45%, Australia 14%, USA 9% | 0.65 | 1819 | 0.47 | 1732 |
| Cobalt | -0.47 | 3434 | DR Congo 57%, Australia 8%, Russia 7% | -0.19 | 1830 | -0.22 | 2641 |
| Tin | -0.45 | 2819 | China 44%, Indonesia 27%, Peru 11% | -0.24 | 1946 | -0.28 | 1536 |
| Vanadium | -0.37 | 3313 | China 41%, Russia 29%, South Africa 28%, | -0.09 | 2805 | -0.43 | 3398 |
| Molybdenum | -0.20 | 2495 | China 42%, USA 21%, Chile 15% | 0.32 | 2911 | 0.17 | 2837 |
| Lithium | 0.91 | 2362 | Chile 30%, Australia 34%, Argentina 12%, | 0.08 | 3105 | 0.60 | 4406 |
| Antimony | -0.47 | 8041 | China 90%, Australia 2%, Tajikistan <2% | -0.41 | 3377 | -0.56 | 3353 |
| REE | -0.49 | 9400 | China 97%, USA 1%, Russia 1% | -0.11 | 3430 | -0.28 | 4360 |
| Chromium | -0.07 | 2235 | South Africa 40%, Kazakhstan 19%, India 14% | -0.16 | 4059 | -0.20 | 4086 |
| Tungsten | -0.41 | 7468 | China 86%, Canada 3%, Russia 3% | -0.21 | 4604 | -0.33 | 4481 |
| Tantalum | -0.15 | 1444 | Brazil 21%, Rwanda & DR Congo 22%, Mozambique 13%, | 0.80 | 4841 | 0.67 | 4984 |
| Niobium | 0.10 | 8563 | Brazil 92%, Canada 7%, Nigeria <1% | 0.21 | 7573 | 0.17 | 9691 |
| PGM | -0.07 | 3844 | South Africa 60%, Russia 28%, North America 6% | 0.24 | 7762 | 0.28 | 9088 |

| |
|---|
| low |
| moderate |
| High |
| Extremely high |

## 2.4 Country risk of raw material production

For classifying raw materials as critical it is obviously not enough to look at the degree the EU depends on import and at the concentration of raw material production. It is also necessary to have a measure for assigning a country's governance. A raw material might show a lower HHI value, because several producers are competing on the market, but if these producers are all ranked low in their governance performance the potential risk of a supply shortage might be higher (because of higher risk of internal problems affecting the mining industry) than for a raw material with a critical country concentration, but originating from a stable country with good governance. While the case of REE from China has been discussed intensely during the last months, the production concentration of niobium in Brazil barely captured any attention.

The World Bank annually evaluates the governance performance in over 200 countries in its Worldwide Governance Indicators (WGI)[8]. The value for each country is composed of six indicators. The indicator in not specific for the resource industry, but aspects like low governance, corruption, low political stability and the failure of political institutions often play an important role in evolving resource conflicts.

The World Bank describes the six indicators to assess the countries governance as follows:

- Voice and Accountability: the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, association, and the press.
- Political Stability and Absence of Violence: the likelihood that the government will be destabilized by unconstitutional or violent means, including terrorism.
- Government Effectiveness: the quality of public services, the capacity of the civil service and its independence from political pressures; the quality of policy formulation
- Regulatory Quality: the ability of the government to provide sound policies and regulations that enable and promote private sector development
- Rule of Law: the extent to which agents have confidence in and abide by the rules of society, including the quality of property rights, the police, and the courts, as well as the risk of crime.
- Control of Corruption: the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as elite "capture" of the state

In this study the aggregated WGI values per country (including all six indicators), ranging from -2.5 to 2.5, are weighted by the production of each country.

To group the values into four groups the 20, 40, 60 and 80 percentile values of all WGI values was used. A very low performance is defined by WGI values between -2.5 and -0.83, low performance in governance is defined by values between >-0.83 and -0.36, a medium performance is defined by values from >-0.36 to 0.24, countries with a high performance have values >0.24 to 0.8 and countries with a very good performance have values >0.8.

[8] Governance Matters VIII: Aggregate and Individual Governance Indicators, 1996-2008. Kaufmann, Kraay & Mastruzzi, World Bank Policy Research Working Paper No. 4978, June 2009

For evaluating the weighted country risk only three categories were used, by joining the two low performance categories and the two high performance categories. Of the raw materials analysed, REE, germanium (refined production), tin, antimony and tungsten show a low performance in governance in their producing countries. Cobalt, vanadium and magnesium are ranked medium, but still have negative values and the values sharply increase towards chromium. Country risk values weighted by the production of course are only averages. In the case of cobalt for example nearly half of the global producing is mined in the DR Congo, but other major producers are Canada and Australia. The low WGI values of the Congo are lifted by high WGI values of Australia and Canada. Thus the resulting country risk value is in the "moderate risk" range and this might lead to the misjudgement that there is no major risk for the cobalt supply; though looking into the detail would tell us that half of the world's production has a high risk.

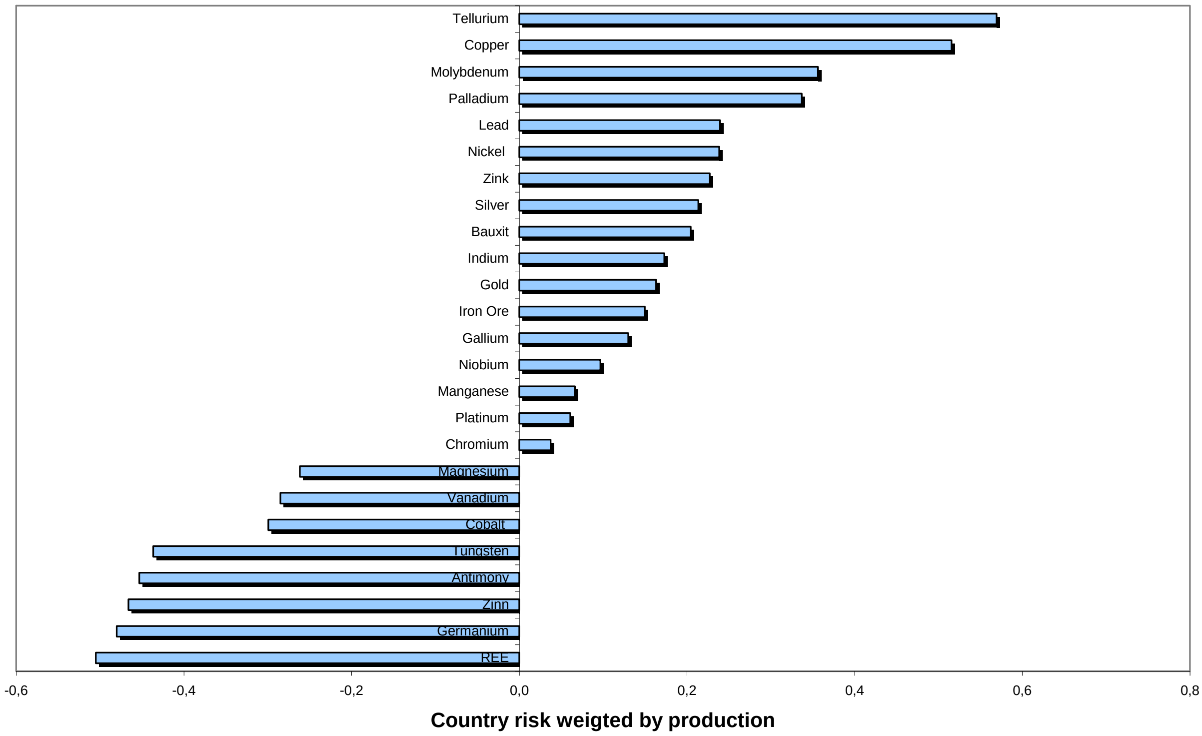


**Figure 5:** Country risk based on the Worldbank's WGI (Worldwide Governance Indicators) weighted by the share of the global mine production for each raw material (year 2008)

## 2.5 Export dependence of countries

For many Sub-Saharan African countries minerals and fuels are important expert products. Metals, metal ores and concentrates provide more than 50% of total merchandise exports, e.g. in Mali (80%), Zambia (79%), the DRC (78%), Guinea (73%), Niger (71%), Mauritania (69%), Liberia (65%), Mozambique (64%), and Tanzania (54%). Fuels provide an important share of total merchandise exports in Angola, Nigeria, and Chad. Mining exports also provide more than 10% of the GDP, e.g. in Zambia (31.5%), Mozambique (21.6%) and Namibia (11.6%). This clearly shows that mining has an important impact on many Sub-Saharan African economies.

Also several South American countries are highly depended on their raw material exports. While Venezuela depends on its oil exports, Chile relies mainly on copper exports. Most countries with a high export dependence on raw material exports have rather low merchandise exports. Exceptions are including Australia, Russia, Norway and some Middle Eastern countries.

According to Buchholz & Stürmer (2011), raw material exporting countries have experienced rising export revenue from the extractive sector due to high world market prices and between 2003 and 2008 the annual export revenue nearly tripled to US$ 139 billion in 2008.

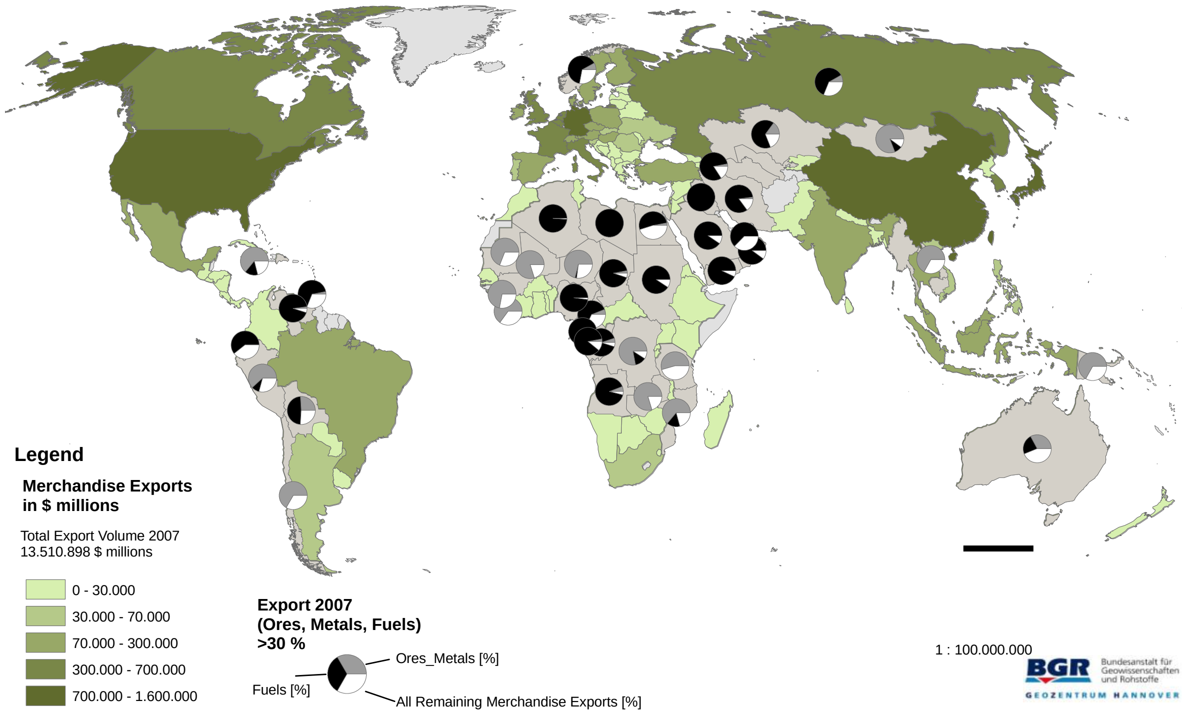


**Figure 6: Total merchandise exports and export structure of countries with a high dependence on raw material production (Buchholz & Stürmer, 2011)**

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**Buchholz, P. & Stürmer, M. (2011):** An Overview of geological resources in Sub-Saharan Africa: Potential and opportunities for tax revenue from the extractive sector., in: Geological Resources and Good Governance in Sub-Saharan Africa, Runge & Shikwati (eds), Taylor and Francis Group, London, ISBM 978-0-415-58267-4