Chapter 2
Risks by Volatility and Peaks of Resources Market Prices

Susanne Hartard

It can be observed in the last 10–15 years that the risks for national economies and producing companies have risen through an increasing volatility of resources market prices. The reasons and most important drivers of this development are not understood well-enough and intransparent. Therefore, research studies were ordered in industrial countries to get a deeper knowledge on coherences of the resources market (Bretschger et al. 2010; Gandenberger and Glöser et al. 2012; Deutsche Rohstoffagentur 2013).

The oil price shock and peak (contribution of Ipsen in Part II) of the last oil crises in 1973 and 1980/1981 (see Fig. 2.1) had not led to remarkable changes in renewable resources management, but made apparent the dependencies on the global market and market power of organizations like OPEC.

The last sensitive general price peak for several raw materials can be determined for 2008 (oil, phosphorus, metals) with an impact on many sectors and the expected subsequent recession. Not only producing and serving companies were affected, like the automotive industry which tried to compensate by increasing metal prices in the supply-chain. Also, private consumers paid extreme high energy prices in 2008, especially for oil, which started to be life threatening for low-income families.

There is a close relationship between the oil price and food price. A rising oil price induces the production and distribution of food (Deutsche Bank Research 2011). Non-ferrous metals like lead, zinc, tin and copper have a relatively homogenous price development, also dependent on oil price as an energy-intensive extraction sector. Another group are the light metals with aluminium, titanium and magnesium used in automotive companies, air and spaceship industry.

Rising oil prices also have an impact in the form of a switch from fossil energy use to biofuel production. This happened in the United States with a follow-up

S. Hartard (✉)
University of Applied Sciences Trier, Environmental Campus Birkenfeld, Gebäude: 9912
Raum: 008, 55768 Hoppstädten-Weiersbach, Germany
e-mail: s.hartard@umwelt-campus.de

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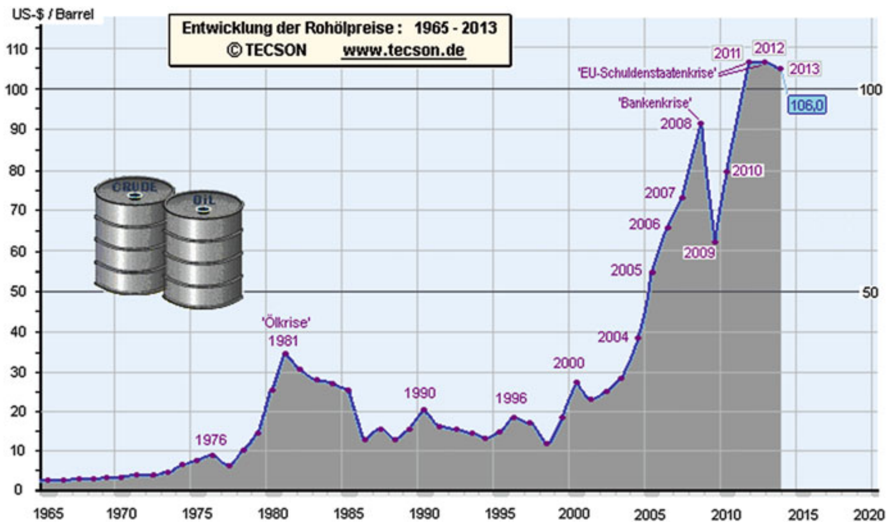

Fig. 2.1 Oil price development 1965–2014. Source: Tecson (2014)

food-crisis in Mexico, known as the Tortilla crisis. Imported US maize for Tortilla production in Mexico started to become very expensive, because the demand on maize as input material for US biofuel production had risen to substitute expensive oil in the US. The Tortilla crisis led to a price increase of 67–180 % of US export maize in 2006 (Hartard 2014). According to Pimentel (2010) the U.S. biofuel program was subsidized with $12 billion per year, finally 1.5 gallons of fossil energy were invested to produce 1 gallon of ethanol. The ethanol production had a follow-up on the U.S. food market: beef, chicken, pork, eggs, breads, cereals and milk became 10–30 % more expensive (Pimentel et al. 2009).

According to the Hotelling rule (1931), the long term prices of exhaustible resources should increase based on the market interest rate. That means the interest rate level determines the real market price and is somehow calculable through certain assumptions and predictions of the interest rate policy. But reality shows that the long-term resources price trend is influenced by a lot of surrounding factors and the expected price development by Hotelling rule has not been justified (Bretschger et al. 2010). Scientists have tried to adjust the Hotelling model to real market conditions with an inelastic resources demand (Acemoglu et al. 2012; Atawamba 2013). But the distortion of the market price development is influenced by a lot of factors so that the rule is called into question. The following factors are discussed to influence the market price development:

- Weak organizational structures and political unrests (state failure) in developing countries, where civil wars result in an incomplete competition on the resource market.
- The external effects of resource consumption e.g. climate change and loss of biodiversity are not expressed in market prices.

- Monopolies, cartels and oligopoly structures in resource extraction are misused for market manipulation. Pro-cyclical and time-lagged investments in market supplies distort regular market dynamics.
- The real quantity of extraction is limited by risks, such as rising extraction costs, differences to expected reserves, decreasing demands and lack of legal certainty in countries with political unrests.
- Pure speculations on the resources market are difficult to identify in their relevance, but nowadays are part of the intransparent resource market with rising price volatility.
- The backstop-technologies substitution potential, for example, the solar industry, will reduce the demand of fossil energy and change the structure of the energy supply sector.
- Technology development like fracking and new reserves (North Pole, deep sea) and general uncertainties about the existing reserves will influence the existing resources market.

As a result the complexity of influences on resources price dynamics requires additional interpretations and research for a sustainable and secure future economy. Research studies showed that physical scarcity is often not the background reason for price peaks. A German survey on the reasons of actual resources price peaks (DERA 2013) showed that there have been earlier price peaks for several mineral resources before 2008 and there can be several reasons for price increases like the global financial crises of the last years. Price drivers can also be the high demand of emerging countries, new technologies (screens, LED, Lithium-Ion batteries, solar cells, wind power generators). In addition to the above-mentioned factors, one can list speculation risks, monopoly structures and political unrests. The capital and resources markets are interdependent (Gandenberger and Glöser et al. 2012).

Germany has started a new information policy on the resources market to reduce the risks of raw material procurement. New publications like resources identity cards by the German BGR/DERA are complemented by price monitoring and volatility monitoring since 2014. First results show price increases for the rare earths Neodymium and Dysprosium by factor 20–30 from 2009 until 2011, but a decrease in volatility for many resources in 2012.

Reasons for this development are the rising demand of high-tech devices and technologies of the future like screens, PV-cells, LED lamps, batteries and other IT and electronic equipment (see Fig. 2.2).

The market for rare earths is different from the metals quoted on the London metals exchange. It is a small market, several elements are by-products from ore extraction which have a very low supply price elasticity (Liedtke/DERA 2014). Considering the years from 2009 until 2013, the price volatility was high for chromit (57,3 %), iron ore (32,5 %), cadmium (33 %), magnesite (36,9 %), molybdenum (31 %), phosphate (33,7 %), quicksilver (31,1 %) and several rare earths (cerium 75 %), dysprosium metal (46,7 %), europium oxide (51,5 %), lanthanum oxide (71 %), neodymium metal (40,9 %) and praseodymium metal (37,8 %), but has gone down the last year (2013–2014) (BGR/DERA volatility monitor 2014).

The contribution of Hartard in Part IV refers to price volatility and risks by resources price peaks and gives additional information on price peaks of copper,

Fig. 2.2 Development of copper price. Source: Oracle Mining Corp. 2012 http://www.oracleminingcorp.com/_resources/images/May_2012/copper_price_trend.jpg

phosphate and lithium which had an impact on the push of research activities to phosphorus recovery.

In conclusion resources price risk knowledge and management is a big challenge in a future economy. This has led to comprehensive activities by international researchers to define the criticality of resources by quantitative indicators, accumulated in a variety of studies (National Research Council of National Academies 2007; Angerer et al. 2009; EUCOM 2010; BGR 2010; Erdmann et al. 2011; EU 2014) and compared methodologies to measure the criticality of resources in national economies (Graedel and Erdmann 2012; Häußler and Mildner 2012).

Indicators to be defined are the ***geographical distribution of resources*** which leads to market power of countries (see Fig. 2.3); an example for this is the "Rare Earth crisis" regarding market shortages induced by China, negotiated by World Trade Organization after complaints of Industrial importing countries. The ***business concentration of resource extraction companies*** in countries can lead to monopoly structures, calculated by the Herfindahl-Hirschmann-Index. For example, a HHI of 10,000 expresses a monopoly of one firm with 100 % market share.

The closer a market is to being a monopoly, the higher the market's concentration (and the lower its competition). If, for example, there were only one firm in an industry, that firm would have 100 % market share, and the HHI would equal 10,000 (100^2), indicating a monopoly.

The ***political stability of countries*** is already traditionally calculated by the World Governance Index of the World Bank. There are six governance indicators that have been calculated for 215 economies for the following six dimensions of governance: voice and accountability, political stability and absence of violence,

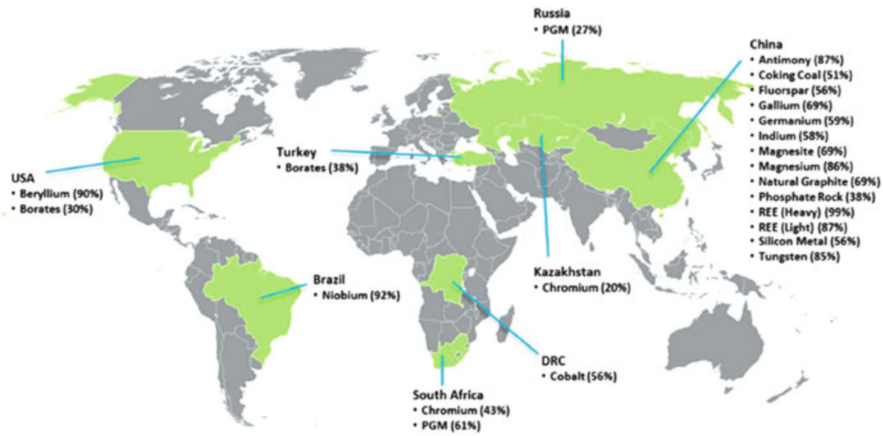

Fig. 2.3 The major producers of the twenty EU critical raw materials (2013). Source: European Commission Enterprise and Industry (2013) http://ec.europa.eu/enterprise/policies/raw-materials/media/photos/crm3.png

government effectiveness, regulatory quality, rule of law and the control of corruption.

The ***static reach of resources*** is not taken into consideration as a limitation factor by geologists who believe in new reserves findings in the long-term. But in general statistics of static reach are integrated as serious indicators in criticality calculations in many criticality analyses. The ***recyclability of resources*** is especially in the rare earth and noble metals group essential for their future usability.

Resources substitution potentials reduce scarcities and risks and make companies more flexible. Price risks haven influenced multinational enterprises to pick up substitution strategies and prove the necessity of rare earth and noble metals as input materials beside efficiency strategies. But in the metal high tech industry resource substitution seems to be least developed, whereas fossil-based polymers can be substituted by a rising biopolymer market.

Environmental policy influence on resource management is still primarily put into practice, with available options being resource taxes, trading certificates and funding (grant, subvention, subsidy). The strong sustainability strategy forces the replacement of finite resources by renewable resources and the strong conservation of natural capital. This strategy seems to be taken seriously on the pathway of energy transformation in Germany to a renewable energy-based economy but there are no real solutions to be seen for high-tech material supplies. The weak sustainability strategy of substituting exhaustible resources by capital (Hartwick 1977) cannot be a realistic strategy, because capital can never buy back consumed finite resources like fossil fuel.

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