

Impact of market prices of carbon dioxide -within planetary boundaries - on the extractive industry

A.M. Gómez Cuartas

EAFIT, Columbia

INTRODUCTION

This paper analysis the hypothetical economic impacts on revenues of 16 of the largest producers of copper, aluminium, gold and iron - if CO₂ emissions were appropriately costed. For this, the author compiled prices of CO₂/t from academic studies that are given in ascenario in which global temperature may not rise more than 2°C, as well as self-reported annual CO₂ emissions of the mining companies in 2018. Total costs of emissions were subtracted from the revenues of each assessed firm. The results show that costs of CO₂ emissions per ton of copper, aluminium, iron and gold vary substantially, partly due to the differences in mining method and processing, but also due to the large scale of prices across the different studies. It becomes apparent that an appropriate costing of released carbon emissions would significantly diminish certain companies' revenues. The applied methodology may allow for a more in-depth analysis within the mining industry or other industries and can inform targeted environmental policy making and taxation in the future. This paper focuses on climate change as a relevant planetary boundary for the extractive industries. The author adopts the long-term development goals of the Paris Agreement that aims to tackle climate change by limiting the rise of global temperature in the 21st century to well below 2°C.

METHODOLOGY

Literature review and data compilation was conducted to identify costs of CO₂/t under the 2°C threshold, likewise information on carbon emissions of 16 of the large-scale mining (LSM) companies worldwide that extract iron, gold, copper and aluminium, which excluding gold, represent ca. 96% of all metals mined worldwide in terms of bulk tonnage¹ were obtained.

¹ Tost, M., Bayer, B., Hitch M., Lutter, S., Moser, P. & Feiel, S. 2018. Metal Mining's Environmental Pressures: A Review and Updated Estimates on CO₂ Emissions, Water Use, and Land Requirements. Sustainability 10:2-14.

No commonly accepted carbon valuation methodology exists yet, therefore the author compiled different costs of CO₂ from ten influential studies with a 2°C threshold boundary. In order to make pricing scenarios comparable, all costs were converted to 2016 USD base year prices² and currencies were converted to USD using World Bank exchange rates³. While not explicitly stated as such in the source, the price quoted in Nordhaus (2007, 2013)^{4,5} is assumed to be a maximum value; a minimum value is not given in this source. Unless otherwise specified, USD values are from the year of publication of each study. For this paper, an average of the studies' adjusted minimum and maximum values was formed, which accrued to a minimum price of USD 18.97 per CO₂/t and a maximum price of USD 100.39 per CO₂/t.

The impact on revenues of the largest producers of copper, aluminium (bauxite ore), iron and gold are assessed by multiplying the corresponding average of the obtained minimum and maximum prices of CO₂/t to the amount of companies' self-reported emissions in the year 2016. Such theoretical costs are subtracted from revenues of each company in order to identify the relative additional costs of CO₂ emissions.

RESULTS

All reviewed companies reported on their emissions and revenues in annual reports valid for the year 2018. In terms of total outputs, the LSM assessed that extract bauxite ore accounts for the largest CO₂ emissions to the atmosphere with an overall of ca. 123 Mt, followed by copper producers with ca. 31 Mt. Iron and gold producers contribute with ca. 16 Mt and 15 Mt respectively. Accordingly, a pricing scheme for carbon emissions would have the highest negative impact on aluminium producers' revenues. Notably, copper mining companies' revenues were not only the highest in 2016 for this sample, but their total CO₂ emissions were also only about a fourth of those from bauxite ore extraction.

The data shows that the carbon emission levels are strongly dependent on the commodity, with copper having the highest emissions per ton produced, then bauxite, and with much lower emissions per output, iron. The output of gold is measured in ounces and is analysed separately. Significant differences exist in the efficiency of production per ton measured in CO₂ output. Since the major source of emissions in the mineral industry stems from processing and the associated power consumption, these findings suggest that efficiencies can be improved for low-performing companies.

However, the absence of a clear regulation for reporting of CO₂ emissions makes such values difficult to compare. While those companies listed on international exchanges are required to disclose their emissions, there is no defined methodology in doing so. This becomes particularly apparent for the CO₂ emissions reported by the Chinese state-owned Aluminium Corporation of China (Chalco). Chalco's sustainability report does not distinguish CO₂ emissions by commodity type. While its economic key activity is the exploration and mining of bauxite, other resources are also exploited by this company, such as coal. This may explain the outlier of Chalco.

This study further analysed the impact on companies' profitability. If the same costs for emissions are applied to all companies, the extent to which the profitability of each firm is affected depends on the amount of emissions and revenues. There exist significant differences in both revenues and emissions across the assessed companies, irrespective of which mineral they produce. Copper producers tend to

² The Balance. 2019. US Inflation Rate by year from 1929 to 2020: How bad is inflation? Past, Present, Future. Retrieved from: <https://www.thebalance.com/u-s-inflation-rate-history-by-year-and-forecast-3306093>

³ The World Bank. 2019b. Official exchange rate (LCU per US\$, period average). Retrieved from: <https://data.worldbank.org/indicator/pa.nus.fcrf>

⁴ Nordhaus, W. 2007. *The Challenge of Global Warming: Economic Models and Environmental Policy*. Yale University. 153 p.

⁵ Nordhaus, W. 2013. *DICE 2013R: Introduction and User's Manual*. Second Edition. 102 p.

have the most revenues compared to their CO₂ emissions, with Glencore and BHP performing significantly better than other companies. The next best ratio is by iron producers, followed by gold producers. Bauxite producers perform the worst, with all companies below the overall average. Notably, Chalco was excluded due to the distortion of the extreme values of carbon emissions of 68 Mt.

Consistent with these findings, costs under different pricing scenarios for CO₂ emissions turn out differently. In the minimum pricing scenario (USD 18,97 CO₂/t), the costs of emissions accrue to an average share of each companies' revenue of 1.62% and 8.54% under the maximum pricing scheme (100,39 CO₂/t). These averages however mask the very significant effect on the worst-performing companies, which, for example, under the maximum pricing scheme accrue up to 31.71% of revenues of Chalco or 26.18% of those of Alcoa. In comparison, the share of revenue from such additional taxes of the best performing company Glencore is affected by less than 1% in both pricing scenarios.



Ana María Gómez Cuartas

I studied in Colombia Geology and finished my master studies in Advanced Mineral Resources Development at the TU Bergakademie, Freiberg- Germany. Since my return to Colombia in the year 2020, I got a position at the National Authority of Environmental Licensing, in which I am in charge of the evaluation and technical analysis of the Environmental Impact Assessments that are submitted by large scale mining companies that are applying for an environmental license to be able to operate.

