Assessing the U.S.-China Competition for Minerals Crucial to the Development of Emerging Technologies

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Whether it is rhenium in jet engines, indium in flat panel displays, or gallium in smartphones, global demand for obscure minerals that enable important emerging technologies has elevated concerns regarding supply security, especially for countries that are highly reliant on mineral imports. Few studies assess import reliance, and none compare the import reliance of countries concurrently. Doing so provides insights into resource interdependency and international competition dynamics. In this study, researchers compare the import reliance of the U.S. and China for 42 minerals that enable emerging technologies.

The data. Researchers measured the “net import reliance” (NIR) of China and the U.S. across 42 minerals commonly used in emerging technologies. NIR quantifies how much of a country’s domestic consumption is obtained from foreign sources and is calculated as a percentage of each country’s consumption on a scale of 0 (when a country is a net exporter) to 100 (when imports are required to fulfill all of the country’s consumption). Researchers also used the Herfindahl-Hirschman Index to gauge the degree of geographical concentration in the global production of each resource. Mineral production data are primarily obtained from U.S. Geological Survey publications. U.S. consumption data are either reported or estimated using trade statistics from the U.S. Census Bureau. Chinese consumption data are primarily reported by industry and government sources. The 42 minerals assessed in this study were selected based on the availability of sufficient data.

While this analysis focuses on data from 2014, researchers note that changes in mineral production and consumption occur slowly, suggesting that the 2014 estimates remain relevant today.

U.S. mineral reliance. Researchers find that of the 42 minerals deemed important for emerging technologies, the U.S. is mostly import-reliant on 13 minerals that China is less import-reliant on. Notably, China is a leading source of U.S. imports for 9 of the 13 minerals, including rare earth elements (REE). China is also the dominant producer of 6 of these minerals globally.

INSIGHTS

- **Of the 42 minerals studied that enable emerging technologies, the U.S. was mostly import-reliant on 13 minerals, for which China was not. Of these 13, China was the leading source of U.S. imports for 9.**

- **Alternatively, China was mostly import-reliant on 8, for which the U.S. was not. The U.S. was the dominant global supplier for only one of these (beryllium).**
The reliance of the U.S. on REE epitomizes concerns about both China’s control of raw materials and its effort to reduce supply risks. From 1965 through the mid-1980s, the U.S. dominated REE mine production, but by exploiting its significant REE endowment, China produced more than 90% of world REE production by the early 2000s. China’s move to lower its REE export quota during a diplomatic dispute in 2010 with Japan demonstrated how near-monopoly production can impact foreign mineral dependence and China’s capacity to increase its own mineral production for global market dominance. The U.S. is also highly import-reliant on minerals like gallium and germanium, both of which China, a dominant supplier, recently curbed exports of.

China’s mineral reliance. China is highly import-reliant on 8 of the 42 minerals that the U.S. is not import-reliant on. Of these 8 minerals, iron ore and mined copper are vital for China’s continuing industrialization and urbanization. However, their import reliance reflects unprecedented growth, rather than a lack of domestic resources. In fact, China is the third largest producer of iron ore and second largest producer of mined copper.

All 8 minerals that China is import-reliant on are widely available except beryllium (crucial for military, aerospace, and nuclear applications), for which the U.S. is the dominant global supplier. Because China can obtain the majority of what it needs (except beryllium) from several other countries, its supply risk is relatively lower. Moreover, China appears to have mitigated its import reliance on key minerals: China’s state-owned firms have addressed prominent cobalt-mine and copper-mine supply risks through so-called “infrastructure-for-minerals” deals with African governments, while China’s one-time vulnerability to gallium has likely already been eliminated through domestic capacity expansions.

U.S.-China mineral competition. Researchers find that of the 42 minerals, both the U.S. and China are highly import-reliant on 11, on account of heavy domestic consumption, limited resource endowments, or limited processing capacity. Among these minerals are niobium, a mineral crucial for bridges, skyscrapers, oil pipelines, and vehicles; platinum, palladium, and rhodium, which are collectively recognized for their use in catalytic converters; and rhenium, a crucial substance in future contests of air superiority.

While China has taken measures to subsidize and expand substance manufacturing domestically as well as investing in and acquiring overseas production sites for several of the 11 minerals, U.S. firms are more restricted regarding import sources than China. This is true in the case of tantalum, a mineral credited with financing armed rebel groups accused of human rights violations in the Democratic Republic of Congo. While the U.S. has sanctioned imports to disrupt these financing sources, China has no such policies.

Intensified resource competition on the horizon. China appears to have taken steps to actively reduce its supply risk for the 42 minerals assessed in this study. Apart from beryllium, however, the U.S. remains heavily import-reliant on foreign countries, especially China. With increasing demand for these minerals that are crucial to enabling sustainability and defense-related technologies, resource competition may continue to intensify, especially for the minerals that neither the U.S. nor China has secure access to. While improvements in recycling, mineral processing, material efficiency, substitution, and domestic production may alleviate import reliance and resource competition in the long run, such factors are often constrained in the short run by existing technology and manufacturing capital and long development timeframes. Prolonged price increases or more favorable policies could potentially augment global mineral supplies, although such projects also face long development timeframes. Given these market dynamics, the results likely reflect the near-term situation for most minerals covered in this study.