Rare Earth Elements (REE)

Production & Market Concentration Analysis

Comprehensive Analysis Report

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1. Project Goal & Questions

Goal

To analyze global REE production trends, quantify market concentration risk, and forecast future supply to inform strategic sourcing decisions.

Key Questions

- How concentrated is the global REE market? (Quantified by HHI)
- What is the projected global REE production trend over the next few. years?
- Which nations dominate the supply chain?

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2. Data Source

- **File:** `mcs2024-raree_world-1.csv`
- **Source:** [USGS]
- **Time Period:** 2022–2023

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3. Methodology & Tools

- **Environment:** Jupyter Notebook
- **Tools:** `pandas` for data manipulation, `plotly` for interactive visualization.
- **Advanced Analysis:** Calculation of the **Herfindahl-Hirshman Index (HHI)** for market concentration.
- **Modeling:** Predictive analysis using `statsmodels`.

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4. Key Findings & Results: Rare Earth Element (REE) Mine Production (2022–2023)

The analysis of 2022–2023 global Rare Earth Element (REE) mine production reveals a market structure characterized by **extreme supply concentration**, which poses a significant strategic sourcing risk.

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5. Regression Analysis Key Findings

This section summarizes the primary insights from the Ordinary Least Squares (OLS) conducted in the notebook to explore the relationship

between production and reserves.

- **Highly Significant Predictor**: The independent variable ('prod_t_est_2023') is highly statistically significant.
- **Postive Correlation**: The corfficient of **254.6** indicates a strong positive relationship. An increase in

production directly correlates with a substantial increase in reserves

concerns

- **Numerical Instability**: The high condition number suggests the predictor variables are hoghly correlated with each other.

Market Concentration (HHI)

	Metric	Value	Interpretation	
	Global HHI	**4,909**	Highly Concentrated Market (>2,500)	

- The Herfindahl-Hirshman Index (HHI) for the global REE market is **4,909** (based on 2023 estimated production).
- **China's dominance** is the primary driver of this concentration, with its squared market share contributing approximately **94%** of the total HHI value.
- > **Implication:** This ultra-high HHI highlights that the global REE supply chain is **highly vulnerable** to geopolitical risk, trade disputes, or production disruptions in a single country.

Nations Dominating the Supply Chain

- **China** remains the undisputed global leader, accounting for the vast majority of mine production (approx. **240,000 metric tons** in 2023).

• **Secondary Producers (2023):**
• United States: 43,000 mt
• Burma: 38,000 mt
• *Note: Their combined output is only a fraction of China's.*
• The **top five producers** (China, United States, Burma, Australia, and Thailand) collectively control the overwhelming majority of the global REE supply.

Production Trend (2022–2023)

• **Global Growth:** The overall global production trend from 2022 to 2023 was **positive**, driven by increases in a few key nations.
• **Notable Increases:**
• **Burma** saw the largest relative growth, with production surging by approximately **217%** (from 12,000 mt to 38,000 mt).
• **China** also increased its output by about **14.3%** in 2023.
• The **United States** had a modest increase of about **2.4%**.

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5. How to Run the Analysis (Reproducibility)

1. Ensure you have Python 3.9+ installed.

2. Install dependencies: `pip install pandas plotly statsmodels jupyter`.

3. Place `mcs2024-raree_world-1.csv` in the root directory.

4. Open the main analysis file: `jupyter notebook rare_earth_analysis.ipynb`.