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# The Role of Rare Metal Supplies in Enhancing the Financial Returns of Technology Companies' Investments: An Analytical Study of Key Financial Indicators

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## **Abstract:**

This study aims to highlight the role of rare metal companies in shaping the financial returns of technology companies, through the supply chains that provide the latter with rare earth elements. A descriptive methodology was adopted to clarify the nature of this relationship by presenting and analyzing a set of selected data from financial indicators drawn from a large and influential group of leading companies in both sectors (mining and technology). The study's key findings indicate that the financial valuations of rare metal companies, governed by supply and demand dynamics, support the structure of financial returns for major technology firms, making them an extension of innovation-driven value. Furthermore, a downward trend in the financial returns of energy transition companies was observed, influenced by the strategic dimension of the rare metals market.

**Keywords:** Rare Metals, Value, Financial Returns, Technological Investments, Financial Indicators.

**Jel Classification Codes :** Q31, G12, O32, G32, C58.

### 1. Introduction

The contemporary drive toward shaping the future relies fundamentally on supply chains for rare earth metals, given the unique properties these materials contribute to many advanced and innovative products. As such, numerous technology companies are dependent on the availability of these elements. Although they occur naturally in the earth's crust, their concentration levels are often low, and the costs associated with extraction, processing, and recycling remain high. Moreover, their geographic distribution is concentrated in certain countries, creating disparities in access.

This reality places technology companies before the challenge of ensuring adequate supply to sustain their production processes. With the rise of innovation across various fields, the demand for these elements has been increasing steadily. In order to enhance profits by creating value and accumulating financial returns—returns that are typically reinvested in innovative ventures—technology companies are driven to further increase their demand for rare earth metals.

Against this backdrop, the present study poses the following main research question:

- **To what extent do rare metal supplies stimulate the financial returns generated by technology companies' investments?**

### Study Hypotheses

- The financial valuations of rare metal companies extend into the composition of major technology companies' financial returns through the interplay of supply and demand.
- The financial returns of energy transition companies are influenced by the dynamics of the rare metals market.

### Study Significance

Rare earth metals are of critical importance due to their indispensable role in what is often referred to as the "industries of the future." As with any investment aimed at generating profit and accelerating the accumulation of returns, these resources have become the subject of intense international competition. They serve as a fundamental pillar for technology companies, particularly those investing in the green energy transition—an approach that itself promises substantial financial gains and wealth creation.

This gives the topic multiple dimensions of strategic importance, including:

- Global dominance in resource access and market influence,
- High-potential investments in both mining and technological applications,
- Realized and anticipated financial returns as drivers of economic growth,
- Prospective wealth creation tied to innovation-led industries.

## Study Objectives

- To identify the importance of rare earth elements in future-oriented industries.
- To examine the financial returns of technology companies and rare metal producers, and to evaluate the investment performance of each.
- To present financial projections regarding the nature and sources of value, in relation to the production activity and financial returns of both technology and mining companies.

## Study Methodology

This study adopts a descriptive analytical approach, presenting foundational concepts of value—both innovative and financial—and their significance in business enterprises. Technology companies and rare earth mining companies are taken as case models to highlight the nature of the relationship between the two sectors. The analysis is based on financial data that enables the formulation of a set of conclusions, reflecting the degree and nature of interdependence between them.

## 2. Value and Innovative Capabilities in Business Enterprises

### 2.1 The Concept of Value in Classical Economics and in Finance

According to classical economic theory, as presented by A. Smith, D. Ricardo, J. S. Mill, and J.-B. Say, value is distinguished between use value and exchange value, with the economic value of a good defined by its exchange value—whether in the trade of goods or in terms of money.

Financial value, in turn, refers to the monetary assessment of an asset, which holds significant importance when the asset is listed on the stock market (Testenoire, 2016, p. 45). The stock market value of a company is directly linked to its financial statements and its expected profit-generating potential from the invested asset.

### 2.2 Industrial and Financial Valuation of Business Assets

Business valuation generally relies on three main approaches:

- Asset-based valuation methods,
- Cash flow-based valuation methods, and
- Goodwill-based methods.

The goodwill-based approach is considered hybrid, bridging the gap between the previous two categories. It encompasses:

- Industrial goodwill, representing operational and production-related factors, and
- Financial goodwill, referring to financial performance and value generation.

Both components allow for an accurate determination and evaluation of the industrial and financial factors that contribute to generating returns or value. They provide a more comprehensive understanding of the process of value creation (Pierre Gérard Charreaux, 2019, p. 03).

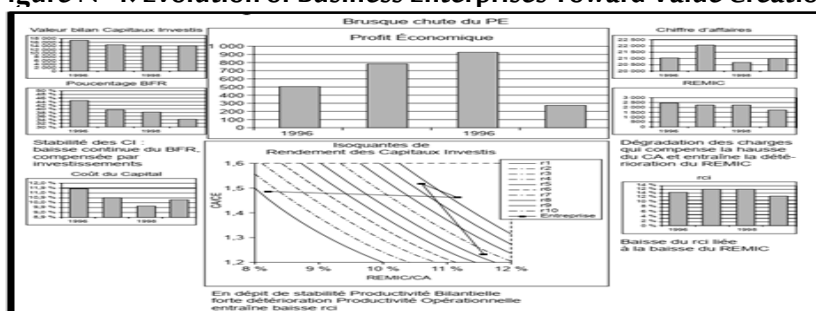
### 2.3 Integrating Value Creation into the Business Investment Process

In value management systems, the measurement of value or economic profit becomes a central element. Value management involves two levels of company analysis:

- Macro-level financial analysis—intended for the company, its investors, and financial analysts—focusing on the relationship between the investor and the company's top management. At this level, macroeconomic and financial concepts dominate, including invested capital and its cost, return on invested capital, and their respective components.
- Macro-level operational analysis—aimed at operational staff within the company—focusing on internal processes that contribute to value generation.

As (Dumouchel, 2010, p. 149) notes, this system provides a framework for aligning investment activities with value creation goals.

**Figure N° 1. Evolution of Business Enterprises Toward Value Creation**



**Source:** (Dumouchel, 2010, p. 150).

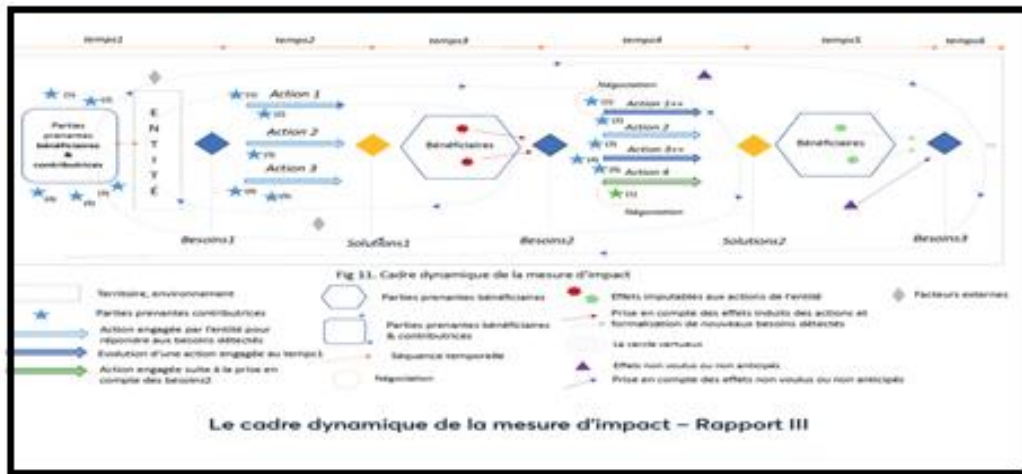
The value management system can be reinforced through strategic management, which is closely linked to the process of making strategic decisions. This involves effectively reducing the risk of investment downturns while increasing the capacity to identify and seize appropriate investment opportunities. Such reinforcement can be achieved through project evaluation, market entry and exit strategies, institutional restructuring and re-engineering, as well as the adoption of new technologies. Market coverage and development, financing, technology management, and research and development (R&D), among other activities, represent significant transformations in the field of modern business (Boyer & Others, 2003, p. 03).

### 2.4 Measuring the Renewed Impact of Value Over Time

Measuring impact over time is a fundamental component of the evaluation process. It requires the development of the most appropriate and adaptive indicators to assess the effects of actions implemented within the company—both to understand them and to anticipate and adapt to them. Developing a methodology tailored to the specific context, to be applied before, during, and after the evaluation process, is therefore essential.

Mastering the management of the time factor is a prerequisite for maximizing opportunities for value creation. The following figure illustrates the process of impact in relation to the time factor (La Fonda, 2019, pp. 15-16):

Figure N° 2. Renewed Impact of Value and the Time Factor



Source: (La Fonda, 2019, p. 16).

## 2.5 Value and the Extended Value Chain in Business Enterprises

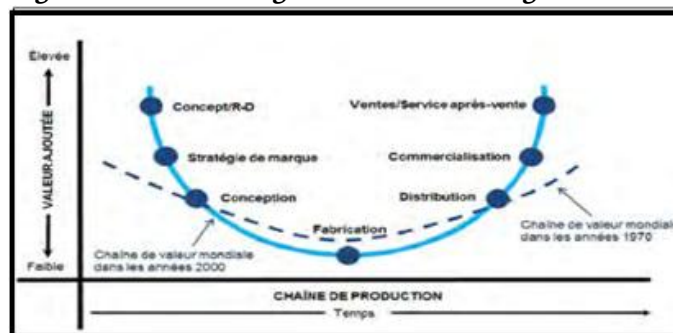
Value and the value chain are fundamentally concerned with the creation and re-creation of value—keeping it active rather than dormant—through the joint construction of value creation chains that capitalize on the compounding of capabilities over time. Investment in value creation enables the diversification of its dimensions through various fields of innovation, aiming to achieve a renewed and sustained impact (Alexei Tabet, 2018, p. 09).

## 2.6 Value Migration (Profit Migration)

A bias in the value chain can be observed through its inclination toward specific primary and secondary production sectors. This tendency within production stages is referred to as the “smiling curve”, which can be applied to the redistribution of value between industrialized nations and emerging economies (e.g., China and other parts of Asia). This represents an indirect example of an initial migration of value.

Accordingly, the “smiling curve” can be interpreted as the long-term migration of corporate profits from core manufacturing sectors toward primary and secondary production segments. Emerging economies, in particular, aim to move upward into research and development (R&D) activities, which are strongly associated with profitability. This shift points to a new geographical redistribution of value (Corinne Vadcar Jean, p. 12).

Figure N° 3. Value Migration – The Smiling Curve



Source: (Corinne Vadcar Jean, p. 12).

### 2.7 Companies' Innovative Capabilities and Profit Generation

Companies' innovative capabilities are characterized by their efficiency and their ability to: renew investments, increase production, innovate, and more. These capabilities are associated with high performance in profit generation at the company level, rather than at the sectoral level. This reflects the performance gap between competitors within the same industry who face identical sectoral constraints. In other words, a company's ability to achieve competitive advantage lies "within the company" itself.

In this regard, Al Philips (1971) and Arold Demsetz (1975) emphasize that "market concentration results from the competitive superiority of the most efficient firms, rather than from barriers to market entry or restrictive practices" (Laurence Capron, 1992, pp. 238-240).

### 2.8 Business Strategy and the Capabilities–Resources Approach

One of the justifications for a company's competitive advantage is the adoption of the capabilities–resources approach, which represents the extent to which resources contribute to company performance through a complex causal relationship. The connection between a company's resources and its performance lies in:

- The process of developing resources,
- Integrating them with other resources, and
- Relying on complex mechanisms of organizational integration and coordination.

These factors create significant barriers that make it difficult for competing companies to replicate a specific strategy (Laurence Capron, 1992, pp. 238-240).

## 3. The Importance of Investing in Rare Metals in Technology and Energy Transition

### 3.1 Concept of Mineral Resources

Some specialists define minerals from a **scientific perspective**, focusing on their chemical and physical properties, while others emphasize the **economic aspects** of minerals. The following table presents their classifications (Khaled Zaki Mohamed El-Deeb, 2006, p. 07).

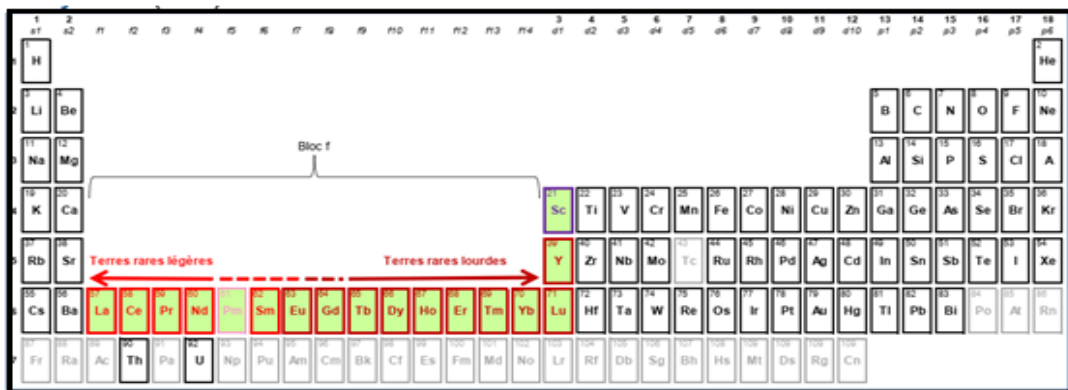
Table N° 1. Types of Minerals and Their Classification

Mineral by Property	Examples of Minerals by Property
<b>Metallic Minerals</b>	
Heavy Metals	Iron and copper – commonly referred to as basic metals
Light Metals	Aluminum, titanium, and magnesium
Precious Metals	Gold, silver, and platinum
Alloy Metals	Chromium, nickel, vanadium, and manganese
Rare Metals	Mercury, radium, and uranium
<b>Non-Metallic Minerals</b>	
Energy Minerals	Coal, petroleum, and natural gas
Building Materials	Sand, gravel, basalt, gypsum, and others
Ceramic, Refractory, Insulating, and Filtering Minerals	Clay, graphite, synthetic diamond, and asbestos
Gemstones	Diamond, ruby, peridot, and turquoise

Source: Prepared by the researcher based on (Khaled Zaki Mohamed El-Deeb, 2006, p. 12).

Rare metals, represented by sixteen core elements, constitute a fundamental pillar for the products of technology companies and a cornerstone for alternative energy strategies. Accordingly, they may be regarded as a pivotal driver for value creation in numerous technological investments. The following figure presents the range of rare earth elements:

Figure N° 4. List of Rare Earth Elements



Source: (Jean-François Labbé et Gaétan Lefebvre, 2016, p. 06).

### 3.3 Uses of Rare Metals in Industrial and Digital Products

Owing to their unique properties, rare earth metals are employed in a wide range of applications. The following table presents a list of these metals, together with their composition and the products in which they are used:

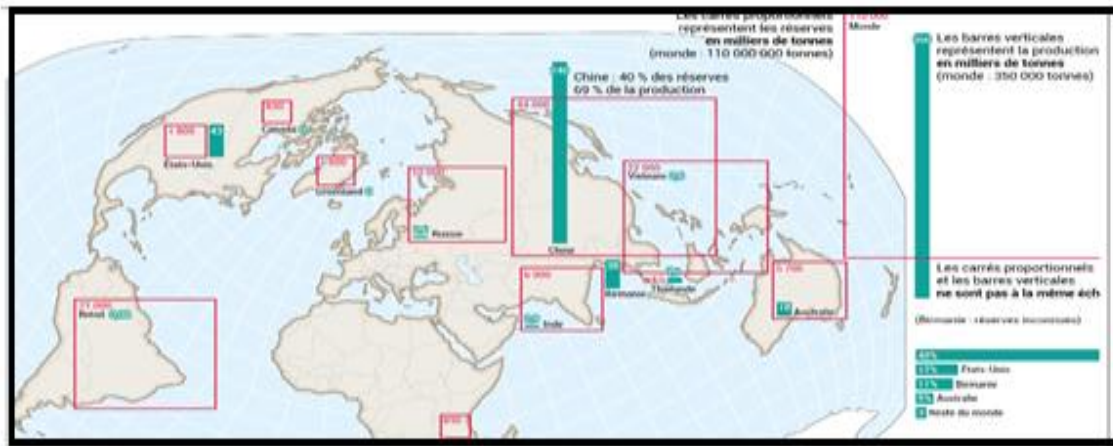
Table N° 2. Rare Metals (Composition and Selected Applications)

Composition	Symbol	Rare Metal	Composition	Symbol	Rare Metal
Tb <sub>4</sub> O <sub>7</sub>	Tb	Terbium	La <sub>2</sub> O <sub>3</sub>	La	Lanthanum
Dy <sub>2</sub> O <sub>3</sub>	Dy	Dysprosium	CeO <sub>2</sub>	Ce	Cerium
Ho <sub>2</sub> O <sub>3</sub>	Ho	Holmium	Pr <sub>6</sub> O <sub>11</sub>	Pr	Praseodymium
Er <sub>2</sub> O <sub>3</sub>	Er	Erbium	Nd <sub>2</sub> O <sub>3</sub>	Nd	Neodymium
Th <sub>2</sub> O <sub>3</sub>	Tm	Thulium	Pm <sub>2</sub> O <sub>3</sub>	Pm	Promethium
Yb <sub>2</sub> O <sub>3</sub>	Yb	Ytterbium	Sm <sub>2</sub> O <sub>3</sub>	Sm	Samarium
Lu <sub>2</sub> O <sub>3</sub>	Lu	Lutetium	Eu <sub>2</sub> O <sub>3</sub>	Eu	Europium
Y <sub>2</sub> O <sub>3</sub>	Yt	Yttrium	Gd <sub>2</sub> O <sub>3</sub>	Gd	Gadolinium
<b>Technological Products</b>				<b>Rare Elements Used</b>	
Polishing products				La .Ce	
Glass and ceramics, especially LCD screens				Y .La .Ce .Pr .Er	
Luminous lamps				Y .Ce .Pr .Eu .Gd .Tb .Er	
Medical imaging (MRI), X-ray systems				Gd .Tm .Yb	
Magnets				Pr .Nd .Tb .Dy	
Rechargeable batteries				La .Ce .Pr .Nd .Sm	
Alloys				La .Ce .Pr .Nd .Gd	
Oil refining				La .Ce	
Automotive catalysts (catalytic converters, oil cracking, etc.)				La .Ce .Pr .Nd	
High-power lasers				Nd .Eu .Ho	

Source: (Cédric Schnyder, 2022, p. 04; Clamadieu & Butstraen, 2019, p. 95).

### 3.4 Concentration of the Rare Metals Market: Between Monopoly and Scarcity

Thomas Behrsing and others assert that “rare earth metals have become the answer to everything,” positioning them as a central factor in numerous economic activities. According to the market research agency Persistence, the global rare earth metals market is projected to reach USD 11.5 billion by 2031, registering a compound annual growth rate of 10.2% (Awad, 2024, p. 62).



Source: (J.-B. Bouron, 2025, p. 1).

China holds 40% of the world’s reserves and accounts for 69% of total production according to 2023 statistics, due to its low-cost manufacturing advantage, which has positioned it as the global leader in production concentration. The United States ranks second in terms of global reserves with only 12%, while the rest of the world shares the remaining reserves in very small proportions. This indicates a significant imbalance in the control of rare earth markets in favor of China.

### 3.5 Analytical Study of Financial Returns on Investments in Rare Metals and Leading Technology Companies:

To achieve the study’s objectives, a sample of financial indicators was selected for data analysis, in addition to examining the financial returns of 40 international companies, identified as being among the top 10 in each selected index.

### 3.6 Definition of Financial Indicators Comprising Technology, Green Energy Transition, and Rare Earth Elements Companies

The following summary table presents the selected financial indices, which address the relevant aspects of the study’s topic:

Table N° 3. Selected Indices for the Study and Their Definitions

Financial Code	Index	Definition
BCGETII		A financial index measuring the impact of green energy and green technology, tracking the market performance of listed companies on recognized exchanges (weighted by the free-float market capitalization).
BGGEME		A global index for green energy minerals (comprising companies engaged in the mining of rare earth elements and other minerals), which the International Energy Agency considers critical for the transition to

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	environmentally sustainable energy. Its components are weighted according to free-float market capitalization using adjusted algorithms.
<b>BITA L1X</b>	Designed to include the top 10 American technology companies, it tracks the performance of a basket of the largest U.S. firms listed on the NASDAQ, which derive the majority of their revenues from technology products and activities.
<b>BEVUSI</b>	An index created to track the performance of companies investing in electric vehicles, listed on U.S. exchanges, provided that at least 50% of their revenues are generated from the production of electric vehicles and related components.

**Source:** Prepared by the researcher based on: (Index Methodology Guidebook:BEVUSI, 2022, p. 4), (Index Methodology Guidebook:BL1XUT, 2024, p. 5), (Index Methodology Guidebook: BGGEME, 2022, p. 4), (Index Methodology Guidebook : BCGETII, 2024, p. 4).

It is noteworthy that the aforementioned indices combine a diverse and integrated cluster in the fields of rare earth metals production, green investment, and technology investment in its broadest sense. On this basis, their price movements, denominated in US dollars, will be presented from the inception of these indices up to July 2025.

**Figure N° 6. Movements in Financial Index Prices : (BEVUSI – BITA L1X – BGGEME – BCGETII)**



**Source:** (Fintech BITA:BCGETII, 2025, p. 1), (Fintech BITA : BEVUSI, 2025, p. 1) ,(Fintech BITA : BGGEME, 2025, p. 1),(Fintech BITA : BL1XUT, 2025, p. 1).

The figures above illustrate a distinct pattern of price developments observed across several sectors. Specifically, major technology companies, firms engaged in green technology investments, and the alternative energy sector have all exhibited notable growth from 2018 through mid-2025. In addition, the financial values of metal production companies experienced significant increases beginning in 2020, reaching their peak in 2022, before entering a downward trend. Nevertheless, these values remained above their 2020 levels up to mid-2025. By contrast, the stock prices of electric vehicle manufacturers have shown consistent and substantial declines from 2021 through mid-2025.

### 3.7 The Top 40 Companies According to Index Ranking in Terms of Financial Performance

The top 10 companies within each of the aforementioned indices (a total of 40 international firms) were ranked based on financial returns and investment performance over a progressively expanding time horizon.

**Table N° 4. Lists of the Top Ten Companies in Each Index Based on Realized Financial Returns  
(Ranked as of 2025)**

Financial Index Code (Energy Impact)		Financial Index Code (Metals)		Financial Index Code (Technology Enterprises)		Financial Index Code (Electric Vehicle Manufacturing)	
BCGETII		BGGEME		BITA L1X		BEVUSI	
Leading Companies	Symbol	Leading Companies	Symbol	Leading Companies	Symbol	Leading Companies	Symbol
Johnson Controls International	JCI	First Quantum Minerals Ltd	FM	Palantir Technologies Inc-A	PLTR	QuantumScape Corp	QS
Eaton Corp Plc	ETN	China Northern Rare Earth –A	600111	Nvidia Corp	NVDA	Microvast Holdings Inc	MVST
Trane Technologies Plc	TT	Albemarle Corp	ALB	Alphabet Inc-Cl A	GOOGL	Rivian Automotive Inc-A	RIVN
Carrier Global Corp	CARR	Boliden Ab	BOL	Broadcom Inc	AVGO	Solid Power Inc	SLDP
Abb Ltd-Reg	ABBN	Antofagasta Plc	ANTO	Amazon.Com Inc	AMZN	Tesla Inc	TSLA
Byd Co Ltd-H	1211	Alcoa Corp	AA	Microsoft Corp	MSFT	Aptiv Plc	APTIV
Li Auto Inc – Adr	LI	Norsk Hydro Asa	NHY	Tesla Inc	TSLA	Li Auto Inc – Adr	LI
Sika Ag-Reg	SIKA	Aluminum Corp Of	601600	Apple Inc	AAPL	Xpeng Inc – Adr	XPEV

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		China Ltd-A					
<b>Lennox International Inc</b>	LII	Lundin Mining Corp	LUN	Meta Platforms Inc-Class A	META	Quantumscap Corp	QS
<b>Vestas Wind Systems A/S</b>	VWS	Mp Materials Corp	MP	Netflix Inc	NFLX	Microvast Holdings Inc	MVST

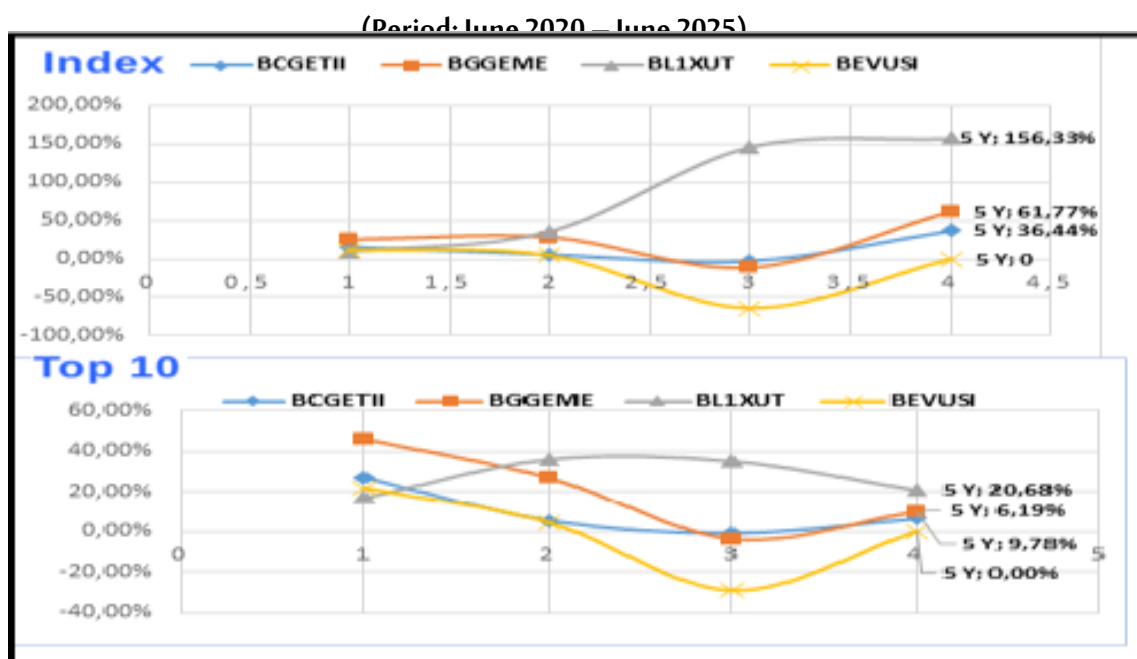
Source: Compiled by the researcher based on : (BITA BGGEME, 2025), (BITA BCGETII, 2025), (BITA BL1XUT, 2025), (BITA BEVUSI, 2025).

The previously presented company lists encompass a highly significant combination of internationally renowned technology firms, including those contributing to the energy transition, as well as prominent metal producers—particularly rare metals companies, whose influence is especially notable. This composition lends strong analytical value to the selected financial indices under study.

### 3.8 Analysis of Financial Returns for the Indices

The indices examined, along with the top ten companies ranked within each, achieved varying levels of financial returns. These results are illustrated in the following figure:

Figure N° 7. Annual Financial Returns of the Indices and the Top Ten Companies within Each Index



Source: Compiled by the researcher based on data : (BITA BGGEME, 2025) .(BITA BCGETII, 2025) (BITA BL1XUT, 2025) .(BITA BEVUSI, 2025), (Fintech BITA:BCGETII, 2025, p. 2), (Fintech BITA : BEVUSI, 2025, p. 2), (Fintech BITA : BGGEME, 2025, p. 2), (Fintech BITA : BL1XUT, 2025, p. 2).

It is observed that the annual financial returns of the BL1XUT index tend to increase over longer time horizons, recording the highest outcome in the fifth year at 156.33%. In contrast, the financial returns of the top ten

companies ranked within the same index followed a downward trajectory after the first year of investment, reaching 20.68% in the fifth year. Nevertheless, these companies continued to hold the leading position in terms of the highest recorded financial returns compared with the other indices under study.

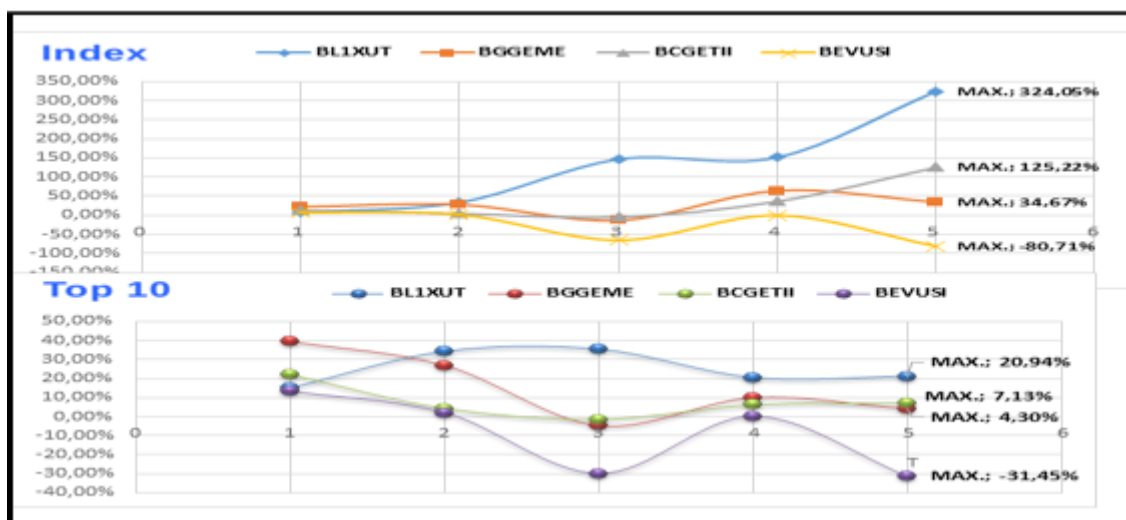
With regard to the BCGETII index and the top ten companies ranked within it, their annual financial returns achieved the best performance in the fifth year, at 36.44% and 6.19%, respectively. The index's returns did not deviate significantly from those of earlier years, while the featured companies recorded a pattern of successive declines. Overall, these companies are evaluated as having modest returns compared with those of major technology firms.

As for the BGGEME index and the leading rare earth production companies (the top ten by index ranking), the highest financial returns were recorded in the fifth year, amounting to 61.77% and 9.78%, respectively. However, losses of -4.30% were registered in 2022, largely attributable to the repercussions of the Russia–Ukraine war, which had a widespread impact on international energy markets. Even leading technology firms (BL1XUT) experienced declines in financial returns during the period 2022–2025, alongside a general slowdown in the index's return growth.

Given the inverse relationship between rare earth producers (supply side) and technology companies that use these materials (demand side), the financial returns clearly reflect the nature of this relationship, as can be observed in the preceding figure.

Concerning the BEVUSI index and its top ten companies, heavy losses were recorded, exceeding 50% for the index and 30% for the top companies. These losses eventually narrowed, stabilizing around 0% for both. When examined through cumulative financial returns, the data can be summarized in the following figure:

**Figure N° 8. Cumulative Financial Returns of the Selected Financial Indices and the Top Ten Companies in Each Index (MAX–MIN)**



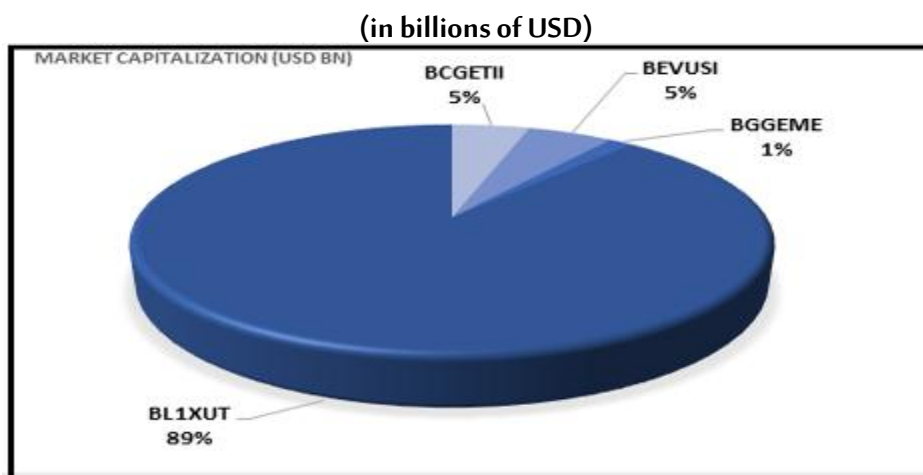
Source: Compiled by the researcher based on data : (BITA BGGEME, 2025), (BITA BCGETII, 2025), (BITA BL1XUT, 2025), (BITA BEVUSI, 2025), (Fintech BITA:BCGETII, 2025, p. 2), (Fintech BITA : BEVUSI, 2025, p. 2), (Fintech BITA : BGGEME, 2025, p. 2), (Fintech BITA : BL1XUT, 2025, p. 2).

- Considering the cumulative financial returns, we find that the indices (and the best-performing companies within each index)—BL1XUT, BCGETII, BGGEME, BEVUSI—achieved the following financial ratios: 324.05%, 125.22%, 34.67%, and -80.71% (with respective annualized returns of 20.94%, 7.13%, 4.30%, and -31.45%). Within these results, the superior performance of large technology companies is particularly evident. This can be attributed to several objective factors, including diversification, innovation, continuous renewal, and global reach. These factors reduce the extent to which their financial returns are tied to fluctuations in rare metal prices, at least in the short and medium term, as reflected in the indices' financial data.
- In contrast, companies supporting the green energy transition, including electric vehicle (EV) manufacturers, appear to follow a different investment trajectory compared to technology giants (it should be noted that Tesla Inc. is listed in two indices due to its diversified investment profile). The data show that as the use of rare earth elements in investments increases, the volatility of recorded financial returns also rises. This is particularly evident in the case of EV manufacturers, whose financial valuations have declined to levels that may jeopardize the sustainability or future growth of the industry.

#### 5.4. Market Capitalization of Financial Indices

- The figure below illustrates the distribution of market capitalization across the studied indices. This distribution helps explain the financial outcomes obtained, particularly in terms of how returns are allocated among the indices.

Figure N° 9. Contribution rate to the market capitalization of the selected financial indices



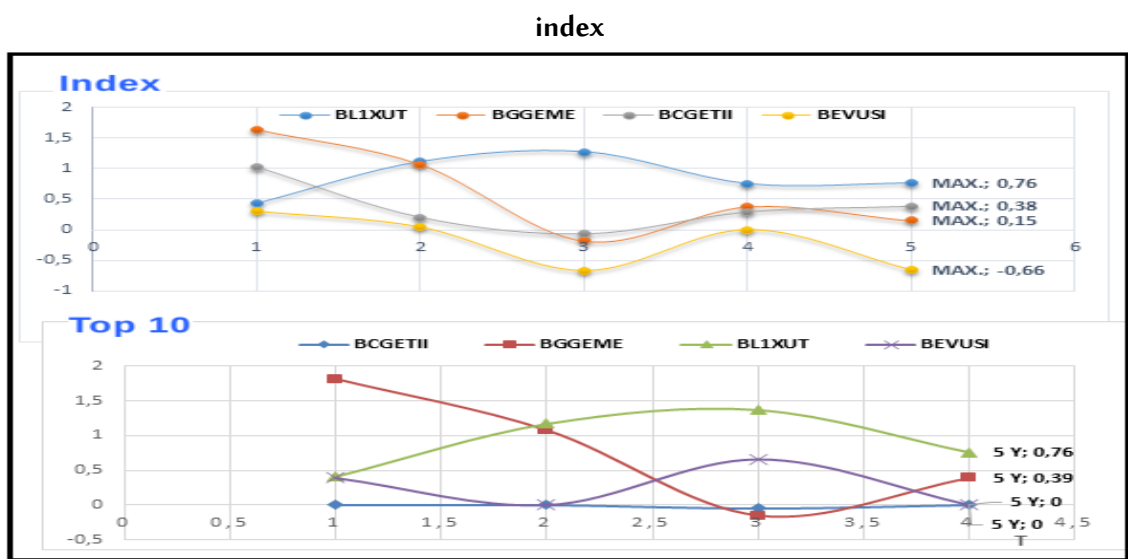
Source: Prepared by the researcher based on available data : (Fintech BITA:BCGETII, 2025, p. 2), (Fintech BITA : BEVUSI, 2025, p. 2), (Fintech BITA : BGGEME, 2025, p. 2), (Fintech BITA : BL1XUT, 2025, p. 2).

It is noteworthy that there is a substantial concentration of market capitalization within the BL1XUT index, representing major technology companies, at 89%, to the detriment of other firms. Companies specializing in clean alternative energy account for only 5% across both relevant indices, while the market capitalization of firms engaged in rare metals and rare earth elements amounts to merely 1% of the total capitalization of the companies listed in the studied financial indices.

#### 6.4. Investment Performance (Indices – Top 40 Companies)

- With respect to the investment performance of the examined sample, as measured by the Sharpe ratio, the results were as follows:

Figure N° 10. Investment performance of the selected financial indices and the top 10 companies in each index

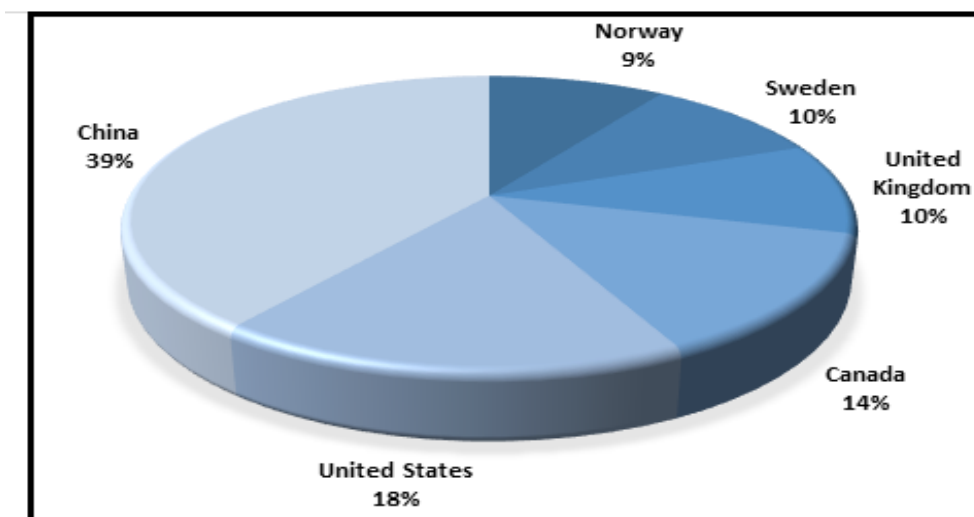


Source: Prepared by the researcher based on available data :(BITA BGGEME, 2025), (BITA BCGETII, 2025), (BITA BL1XUT, 2025), (BITA BEVUSI, 2025), (Fintech BITA:BCGETII, 2025, p. 2), (Fintech BITA : BEVUSI, 2025, p. 2), (Fintech BITA : BGGEME, 2025, p. 2), (Fintech BITA : BL1XUT, 2025, p. 2).

- According to the investment performance criterion of financial indices, the BL1XUT index (representing major technology companies) recorded the best performance compared to the results of the other indices and companies, most of which reported negative values or ratios below 1.5. However, even for BL1XUT, the values ranged only between the acceptable level and below, based on the Sharpe ratio classification.
- Overall, it is observed that the values of the leading financial indices and top-ranked companies tend to follow a convergent pattern as the investment horizon extends, though without a progressive upward trend. This indicates that the investment performance of the examined category does not guarantee stable financial returns when the investment period is prolonged, particularly under shifting strategic orientations.

- It is also worth noting that companies engaged in rare metals and rare earth elements recorded a negative performance of -0.15 in 2022. Similarly, electric vehicle manufacturers registered a negative performance of -0.66 by mid-2025, with their excess investment performance approaching similar values as early as 2022. This suggests that investments in these companies have incurred significant losses. The reasons can be traced to the strategic role played by rare metal markets on the one hand, and, on the other, to the inherent characteristics of these mining-based products, which cannot match the production capacities of technology giants. The following figure highlights the headquarters (parent companies) of the top ten firms investing in rare metals and rare earth elements, offering insights into the strategic dimensions of these markets.

**Figure N° 11. Headquarters (parent companies) of the top 10 investors in rare metals and rare earth elements**



**Source:** Prepared by the researcher based on available data :(Fintech BITA : BGGEME, 2025, p. 2).

The percentages presented in the figure above illustrate China's dominance in investment in rare earth elements and other metals (such as aluminum), accounting for 39%. The United States ranks second with 18%, followed by Canada (14%), then the United Kingdom and Sweden (each at 10%), while Norway occupies the final position with 9%. These figures represent the share of the top-performing companies in terms of additional investment performance and realized financial returns.

It can be concluded that China plays a leading role in these investments, where rare metals—particularly rare earth elements—are used as instruments of leverage against importing companies. This is often achieved through suspending supply chains to countries with which China has disputes or conflicts, thereby affecting both financial returns and investment performance (serving as one of the explanations for the volatility in returns). This effect is especially pronounced in industries heavily dependent on these raw materials, such as electric vehicle manufacturing.

## 7. Conclusion

Since the future of industry and technological development has become contingent upon the availability of rare earth element supplies (supply constraints), investments by technology companies—particularly in alternative energy—have become significantly linked to mining companies. This interdependence may affect the continuity of investments for many firms, given the absence of viable substitutes in the short term. Consequently, this has implications for the intrinsic value, anticipated profits, actual financial returns, and investment performance of these companies. In this regard, the main findings can be summarized as follows:

### 7.1. Study Findings

- There is a cumulative trend in the value generated from technology investments, partially supported by rare metals, particularly among large technology companies.
- Large technology firms exhibit a sustained value effect, evident in the accumulation of financial returns exceeding 100% in the medium term alone. This resilience stems from their capacity to absorb the expansion of the value chain over time, owing to the diversity and breadth of their innovative activities.
- Trends in rare metal markets have a greater impact on the financial structure of companies investing in alternative energy than on other technology firms, a result of their higher dependence on these scarce elements.
- Rare earth mining companies show a non-renewable value effect, as strategic pressures, high costs, and scarcity in the mining sector have contributed to financial losses and negative investment performance, particularly in the BGGEME and BEVUSI indices.

### 7.2. Study Recommendations

- Greater efforts should be directed towards research projects exploring competitive alternatives to rare earth elements in terms of abundance and cost—such as magnesium—alongside the necessity of stimulating refining processes for these materials, with the aim of alleviating price volatility resulting from market concentration.

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- The attempts by advanced economies—particularly the United States, through NASA and innovative corporations—to materialize extraterrestrial mining projects for precious and rare earth minerals require high-level international coordination, rather than constituting a renewed pursuit of broader dominance over rare and valuable resources.
- It is necessary to diversify investments both within rare earth mining companies and within firms engaged in energy transition projects, in order to reduce the degree of dependence on rare earth market trends. This diversification would mitigate or offset losses in cases of price deterioration or political and trade measures adopted between economies to safeguard national interests.
- Environmental consequences of mining activities and technological waste must be carefully considered, rather than focusing solely on profit margins. This is crucial to ensuring continuity of production and, by extension, the sustainability of financial returns within a framework of long-term resilience.

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