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Chokepoint: The Financial Effects of Rare Earth Supply Disruptions

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Abstract

This paper constructs a high-frequency, news-based measure of rare earth supply shocks to examine how disruptions in these critical inputs affect global firm valuations. Using news articles between 2021 and 2025, I identify exogenous rare earth supply events, distinguishing between Chinese trade-restriction and global production shocks. Using a sample of 5800 public firms, I show that negative rare earth supply shocks, which are expected to raise input prices, cause significant and persistent declines in the equity prices of rare earth-exposed firms, especially those in the battery, semiconductor, and motor vehicle industries. Both trade and production shocks depress valuations, though trade restrictions shocks are particularly impactful. These findings highlight a financial channel through which the weaponization of critical-material supply chains transmits across global markets.

JEL Codes: G14, F14, F51, Q02.

Key Words: Rare earth elements; critical minerals; supply chains; supply shocks; large language models; geoeconomics; financial markets.

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1 Introduction

Rare earth elements have become central to the global race for technological and energy leadership. As critical and often difficult-to-substitute inputs in advanced manufacturing, clean energy technologies, and defense applications, rare earth elements enter the production of batteries, electric vehicle motors, wind turbines and semiconductors. At the same time, global mining and refining are highly concentrated in China. The combination of strong demand in strategic sectors, limited substitutability, and geographic concentration makes rare earths a natural chokepoint for geoeconomic policies such as export controls, sanctions, and tariffs.

Despite efforts by the United States, Europe, Japan, and Australia to diversify supply chains and expand rare earth recycling capacity, China's periodic export restrictions and quota adjustments have significantly disrupted global supply and triggered sharp price movements. Such disruptions raise expected input costs and increase uncertainty for firms that rely on rare earths. Because equity prices reflect the discounted value of expected future profits, they provide a forward-looking measure of how markets assess firms' exposure to supply-chain risk. For policymakers concerned with resilience and strategic autonomy, understanding how these risks are internalized by investors is therefore essential, yet systematic evidence on how financial markets price rare earth supply disruptions remains limited. This paper addresses that gap by quantifying how rare earth supply shocks, identified from contemporaneous news reports, affect the share prices of firms worldwide.

To do so, I develop a news-based measure of rare earth supply shocks covering the period 2021–2025. Using more than 1,100 Reuters articles containing the term rare earth, I apply large-language-model text classification combined with human auditing to isolate exogenous supply events, such as export controls, production outages, and new mining developments. Each event is coded by the expected direction of its price effect (positive for supply constraining, negative for supply expanding) and classified as either a trade-restriction or production-related shock. This methodology builds on and extends narrative approaches developed by Känzig (2021) for oil, Alessandri and Gazzani (2025) for natural gas, and by Rey (2025) for electrification commodities more broadly.

I then estimate local-projection regressions to trace the dynamic effects of these shocks on firm-level cumulative share-price returns for over 5,800 listed firms across major economies. Firms are classified as rare earth-exposed or non-exposed based on detailed industry mappings from geological and policy sources. This framework allows me to compare how financial markets revalue firms with differing dependence on rare earths in response to exogenous supply disturbances.

The results reveal that negative rare earth supply shocks (those expected to raise prices) lead to persistent declines in the cumulative returns of rare earth-exposed firms relative to non-exposed firms. Specifically, rare earth-exposed firms experience share price growth that is 2 percentage points lower than their non-exposed counterparts following a supply-constraining event, 90 days after the shock. The effects are strongest in industries where rare earths are core inputs, such as battery manufacturing, semiconductors, and motor vehicle production. Both trade restrictions and production shocks depress firm valuations, but investors react more sharply to policy-driven trade disruptions, consistent with their higher salience and perceived persistence. These findings imply that markets internalize supply-chain fragility in real time, embedding geopolitical risk directly into firm valuations.

Related Literature This paper relates to three strands of the literature: geoeconomics, industrial policy and supply chains, and narrative identification of exogenous shocks.

The geoeconomics literature studies how states use economic policies to exert influence. Clayton, Coppola, et al. (2025) document the sharp increase in the use of tariffs, sanctions, and export controls since the late 2000s and their growing focus on economic "chokepoints," namely industries and inputs that are particularly costly to restrict. In related work, Clayton, Maggiori, and Schreger (2024) develop a model in which countries target such chokepoints to increase the cost of non-compliance. Mohr and Trebesch (2025) adopt a broader definition of geoeconomic tools that includes foreign aid, financial infrastructure, and trade agreements. Farrell and Newman (2019) emphasize how central positions in global financial, data, military, and technological networks enable states to exercise such leverage. Earlier work by Hirschman (1980) shows that economic dependence arises when trade is concentrated among a small number of partners, making countries vulnerable to supply shocks.

A large literature studies how network structure shapes the transmission of supply shocks. Acemoglu et al. (2012), Carvalho (2014), and Baqaee and Farhi (2019) show that idiosyncratic sectoral shocks can generate sizable aggregate fluctuations when upstream sectors are highly concentrated. In concentrated networks, supply disruptions can therefore have amplified macroeconomic and firm-level effects. This mechanism is particularly relevant for rare earths, which are characterized by limited substitutability and highly concentrated production and processing. In response to the U.S. "Entity List" restrictions, Crosignani et al. (2024) document decoupling between affected U.S. firms and both targeted and non-targeted Chinese customers, with little evidence of reshoring or friend-shoring. U.S. firms experienced declines in returns, revenues, profitability, and employment, while Chinese firms re-established domestic supply relationships.

In the specific context of rare earths, Kalantzakos (2017) and Mancheri, Sundaresan, and Chandrashekar (2019) document how export quotas and state-led consolidation enabled China to dominate rare earth production and refining. Following China's 2010 export restrictions, Alfaro et al. (2025) show that U.S. firms highly dependent on rare earths increased patenting activity and formed new links with alternative input suppliers. Related work also studies the macroeconomic consequences of supply shocks in concentrated commodity markets. Rey (2025) shows that adverse supply news in electrification materials raises U.S. CPI and PPI and lowers industrial production, while Alessandri and Gazzani (2025) document similar amplification effects in European natural gas markets following supply disruptions.

These literatures jointly emphasize that supply shocks in concentrated input markets can have large economic effects and that such shocks can be identified using narrative methods.

Finally, this paper builds on the literature using narrative and text-based approaches to identify exogenous supply shocks. Ramey (2011) uses historical narratives of major U.S. events to study government spending multipliers, while Romer and Romer (2004) construct monetary policy shocks based on detailed readings of FOMC records. In commodity markets, Hamilton (1983) and Kilian (2009) show that oil supply disruptions are typically inflationary and recessionary, and Känzig (2021) refines this approach using high-frequency oil price movements around OPEC announcements. More recently, Rey (2025) uses AI-based text analysis to identify supply and demand shocks in electrification commodities. Following this approach, I construct a high-frequency rare earth supply shock series using AI-assisted classification of rare earth–related news and estimate how equity markets price these disruptions.

The remainder of the paper proceeds as follows. Section 2 describes the data sources and construction of the REE supply-shock series. Section 3 presents the empirical framework and baseline results on firm-level share-price responses and explores heterogeneity across shock types and industries. The last section concludes.

2 Data and Stylized Facts

In this section, I outline the data sources and methodologies used in my regressions. The datasets cover three main areas: rare earth supply shocks derived from news, rare earth exposure, and share price data. Together, these datasets allow me to estimate the effects of rare earth supply shocks on firm-level outcomes, conditional on each firm's exposure to rare earths.

2.1 Rare Earth Supply Shocks

This subsection describes the construction of my high-frequency rare earth supply shock series, which combines automated text classification and human verification of contemporaneous news events.

To construct the series, I first gather news from the Reuters News Archive that contains the tag "rare earth." As the archive only provides articles after 2021, this restricts my sample period to January 1st, 2021 through October 31st, 2025. Throughout this period, there are a total of 1,195 rare-earth-related articles listed in the archive. I extract the article titles, dates, and text bodies from each article.

My identification strategy builds on the news-based supply shock methodology of Alessandri and Gazzani (2025), who use contemporaneous news to identify natural gas supply shocks. I adapt their approach to the context of rare earths and extend it by combining an AI-based classification with human auditing to increase both scalability and precision in identifying supply events.

With these articles, I take a two-pronged approach to identify rare earth supply shocks: an AI-based classification of the news and a subsequent manual vetting of each article. The AI classification proceeds as follows: with the article titles, dates, and text bodies combined into a single file, I use the ChatGPT 4o API to read each article and classify it according to whether it describes a contemporaneous event affecting rare earth supply (e.g., production, mining, exports, or trade restrictions), demand (e.g., downstream usage in EVs, batteries, or defense applications), or is unrelated. The model is explicitly instructed to focus on *breaking news events* that are likely to influence the rare earth market and to disregard commentary or retrospective reporting.[1] This AI-assisted approach allows for consistent and replicable classification of a large corpus of articles, while the subsequent manual review ensures accuracy and economic relevance. In the end, I am left with 410 supply-related articles and 785 articles tagged as demand-related or ambiguous/unrelated.

Next, I manually verify that the articles flagged as unrelated to supply were indeed categorized correctly. This vetting and final selection process was conducted entirely by the author. There were no instances of false negatives (i.e., no articles flagged as demand-related or unrelated that were actually supply-related). However, I did identify some false positives—articles initially tagged as supply-related that, upon review, were ambiguous, retrospective, or unlikely to meaningfully affect global supply. Most of the articles categorized as unrelated discussed the financial performance of rare-earth-producing firms, downstream firm developments affecting demand, or general mining news not specific to rare earths. After this careful vetting process, I was left with 29 supply shock events. These events are listed in Table 1.

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[1] The complete AI prompt used for classification is provided in Appendix B.1.

Table 1: News Articles Related to Rare Earth Supply

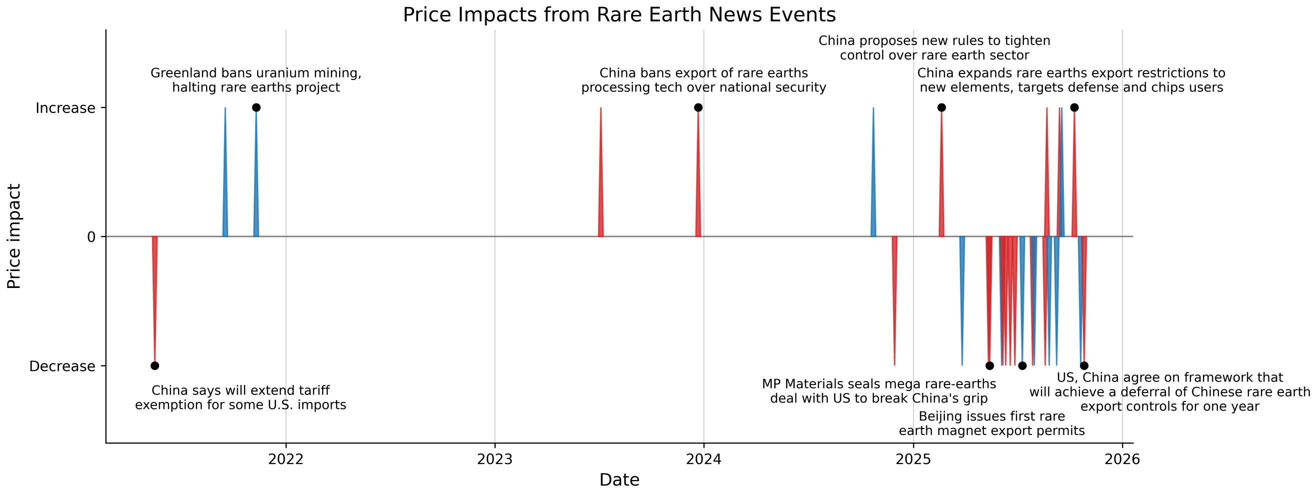
Date	Headline	Price Impact	Shock Type	Country
5/17/21	China says will extend tariff exemption for some U.S. imports	Lower	Trade Restriction	China
9/17/21	Greenland prepares legislation to halt large rare-earth mine	Raise	Production	Greenland
11/10/21	Greenland bans uranium mining, halting rare earths project	Raise	Production	Greenland
7/5/23	Beijing imposes chip material export curbs in US-China tech fight	Raise	Trade Restriction	China
12/22/23	China bans export of rare earths processing tech over national security	Raise	Trade Restriction	China
10/23/24	Armed group says it takes control of Myanmar rare earth mining hub	Raise	Production	China/Myanmar
11/29/24	China to extend tariff exemptions for some US products to 2025	Lower	Trade Restriction	China
2/19/25	China proposes new rules to tighten control over rare earth sector	Raise	Trade Restriction	China
3/27/25	Myanmar rebel group allows export of rare earth inventories to China, sources say	Lower	Production	China/Myanmar
5/12/25	Trade truce allows US customers to get Chinese rare earth permits more easily	Lower	Trade Restriction	China/USA
5/14/25	Beijing issues first rare earth magnet export permits	Lower	Trade Restriction	China
6/4/25	EU picks 13 new critical material projects, including in Greenland	Lower	Production	Greenland/EU
6/6/25	China issues rare earth licenses to suppliers of major US automakers	Lower	Trade Restriction	China/USA
6/11/25	US anticipates greater supply of rare earths from China after trade talks; Chinese rare earths magnets makers receive first export licenses	Lower	Trade Restriction	China/USA
6/19/25	China grants rare earth export licences to some firms	Lower	Trade Restriction	China
6/27/25	US says deal with Beijing will expedite rare earth exports from China	Lower	Trade Restriction	China/USA
7/10/25	MP Materials seals mega rare-earths deal with US to break China's grip	Lower	Production	USA
7/21/25	China quietly issues 2025 rare earth quotas	Unclear	Trade Restriction	China
7/28/25	US, China hold new talks on tariff truce ahead of Trump-Xi meeting	Lower	Trade Restriction	China/USA
7/31/25	Trump administration to expand price support for US rare earths projects, sources say	Lower	Production	USA
8/19/25	China lifts curbs on export of rare earth magnets to India, says Indian media	Lower	Trade Restriction	China/India
8/22/25	China tightens grip over rare earth supply quotas	Raise	Trade Restriction	China
8/26/25	Critical Metals signs agreement to supply rare earth to US government-funded facility	Lower	Production	USA
9/8/25	Glencore's former head of recycling launches critical minerals processing firm	Lower	Production	USA
9/13/25	China launches discrimination and dumping probes into US chips ahead of trade talks	Raise	Trade Restriction	China
9/17/25	Myanmar rebels disrupt China rare earth trade	Raise	Production	China
10/9/25	China expands rare earths export restrictions to new elements, targets defense and chips users	Raise	Trade Restriction	China
10/20/25	US, Australia sign critical minerals agreement	Lower	Production	USA/Australia
10/26/25	US, China agree on framework that will achieve a deferral of Chinese rare earth export controls for one year	Lower	Trade Restriction	China

I classify each of the 29 supply shock events according to their expected effect on global supply and, by extension, on prices. I infer the expected price impact directly from the news narrative. Events that constrain supply—such as export bans, production halts, or regulatory tightening—are coded as $+1$, corresponding to expected price increases. Conversely, events that expand supply—such as new mining capacity, lifted export restrictions, or increased quotas—are coded as -1, corresponding to expected price declines. To construct the supply shock series, I create a daily time series where each day's value equals $+1$ if there is a negative supply shock, -1 if there is a positive supply shock, and 0 if there is no supply news. On days with multiple supply-related events, all items point in the same direction of expected price impact, so the day is coded as either $+1$ or -1 accordingly. I verify that on days with nonzero values, there is no significant demand-related news to ensure that the series does not capture simultaneous supply and demand events. This coding convention ensures that a positive value of the shock variable consistently corresponds to an expected increase in rare earth prices.

Next, I identify the country or countries of origin for each of the supply shock events according to where the underlying policy action or production disruption originates, rather than where its effects are felt. For example, if China imposes export controls on rare earths, I classify the event as originating from China, even though it affects all importing countries. Likewise, production-related shocks are attributed to the country where the mining or processing activity occurs. In cases where the event involves actors or assets from multiple countries—such as China imposing export controls specifically on the United States, the disruption of a Chinese-owned mining operation in Myanmar, or a bilateral critical minerals agreement between the United States and Australia—I assign all relevant countries as joint origins. Identifying the origin of each event is useful for later examining whether market responses differ depending on whether shocks stem from China, the United States, or other producers. Of the 29 identified supply shock events, 21 either completely or partially originate from China, 10 from the United States, and 7 from other countries, including Greenland, the European Union, Myanmar, India, and Australia.

Finally, I distinguish between two types of supply shocks: trade restriction shocks (18) and production shocks (11). This classification is conceptually motivated by the two main channels through which supply disruptions arise in commodity markets—policy-imposed trade constraints and physical production changes. This distinction follows directly from the classification process, as supply-related events in the rare earth market primarily arise either from policy actions that restrict or ease trade flows (e.g., export controls, tariffs, or licensing rules) or from changes in physical production capacity (e.g., mine disruptions, new projects, or processing bottlenecks). These two channels exhaust the relevant mechanisms through which supply can change in my dataset, making them mutually exclusive and collectively exhaustive within the set of identified events. Figure 1 plots the resulting supply shock series, with trade restriction shocks shown in red and production shocks in blue.

Figure 1: Rare Earth Supply Shock Series



Notes: Trade restriction shocks are shown in red and production shocks in blue.

2.2 Rare Earth Exposure

In order to determine whether firms are rare-earth users, I select a group of NAICS six-digit industry codes that directly use rare earth elements (REEs) as inputs to production.

To identify these REE-using industries, I rely on a range of scientific, technical, and policy sources that document the material flows and industrial applications of rare earths. In particular, I draw on the U.S. Geological Survey's *Rare Earth Elements—End Use and Recyclability* (Goonan (2011)), which provides a comprehensive account of the end uses of rare earth elements across industrial sectors[2]; the U.S. Department of En-

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[2] See Table 1 in Goonan (2011) which reports estimated worldwide end uses for rare earth elements in 2008.

ergy (2021)'s *Critical Minerals and Materials Strategy*, which highlights the role of REEs in magnets, batteries, lighting, and electric motors; the European Union (2024)'s *Critical Raw Materials Act*, which identifies sectors such as renewable energy, e-mobility, hydrogen, and advanced electronics as major strategic users of critical raw materials; and the OECD and IEA reports on clean energy technologies and critical materials, which emphasize REEs as essential inputs in wind turbines, electric vehicles, and energy storage systems. Together, these sources provide a consistent and empirically grounded mapping between rare earth applications and the industrial sectors that depend on them.

Guided by this literature, I include only those industries in which rare earths are essential to production processes, excluding significantly downstream activities (e.g., retail or wholesale trade of products containing rare earths) or sectors where rare earths play only a minor or substitutable role. This restriction ensures that my classification isolates firms for which changes in rare earth supply conditions are likely to have a direct and measurable effect on production costs and profitability.

The rare earth uses that I identify fall into four broad application categories consistent with the above sources: *(i)* electronics and consumer goods (e.g., permanent magnets, batteries, displays, and lighting); *(ii)* clean energy and transportation (e.g., electric and hybrid vehicles, wind turbines, and catalytic converters); *(iii)* medical and scientific applications (e.g., medical imaging, optical technology, and oil refining); and *(iv)* defense and aerospace (e.g., guidance and radar systems, and temperature-resilient alloys).

Having identified the principal applications of rare earths from authoritative scientific and policy sources, I systematically map each documented use to the corresponding six-digit NAICS industries whose production processes directly incorporate these materials. This mapping links, for example, the use of neodymium and dysprosium in permanent magnets to the manufacture of magnetic and electric motor components (NAICS 335312 and 336320), or the use of cerium in catalytic converters to motor vehicle parts manufacturing (NAICS 336390). Similarly, rare earths used in phosphors, displays, and advanced alloys correspond to industries producing electronic components, lighting, and aerospace materials. In this way, the selection of industries is directly grounded in established end-use evidence from the U.S. Geological Survey, the U.S. Department of Energy, the European Commission's *Critical Raw Materials Act*, and the OECD and IEA analyses of critical materials in clean energy technologies. A complete list of the resulting rare-earth-exposed industries and their corresponding NAICS codes is provided in Figure 2. This mapping ensures that the exposure measure reflects sectors whose operations fundamentally depend on rare earth inputs.

Figure 2: List of NAICS Industries Corresponding to Rare Earth Uses

NAICS Code	**Industry Description**
221111	Hydroelectric Power Generation
221115	Wind Electric Power Generation
324110	Petroleum Refineries
325180	Other Basic Inorganic Chemical Manufacturing
327212	Other Pressed and Blown Glass and Glassware Manufacturing
331492	Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except Copper and Aluminum)
332999	All Other Miscellaneous Fabricated Metal Product Manufacturing
333242	Semiconductor Machinery Manufacturing
334111	Electronic Computer Manufacturing
334412	Bare Printed Circuit Board Manufacturing
334413	Semiconductor and Related Device Manufacturing
334416	Capacitor, Resistor, Coil, Transformer, and Other Inductor Manufacturing
334419	Other Electronic Component Manufacturing
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
334610	Manufacturing and Reproducing Magnetic and Optical Media
335132	Commercial, Industrial, and Institutional Electric Lighting Fixture Manufacturing
335139	Electric Lamp Bulb and Other Lighting Equipment Manufacturing
335312	Motor and Generator Manufacturing
335910	Battery Manufacturing
336320	Motor Vehicle Electrical and Electronic Equipment Manufacturing
336390	Other Motor Vehicle Parts Manufacturing
336414	Guided Missile and Space Vehicle Manufacturing
336415	Guided Missile and Space Vehicle Propulsion Unit and Propulsion Unit Parts Manufacturing
336419	Other Guided Missile and Space Vehicle Parts and Auxiliary Equipment Manufacturing
621512	Diagnostic Imaging Centers
811210	Electronic and Precision Equipment Repair and Maintenance

As firms may belong to multiple NAICS industries, some overlap naturally arises between rare-earth-exposed industries and other, non-exposed industries. For example, a firm classified under "Semiconductor Machinery Manufacturing" may also operate in a sector unrelated to rare earths. However, such overlap does not materially affect the classification of rare-earth exposure, as the vast majority of identified firms belong to manufacturing industries for which rare earths are core inputs. A detailed list of these tangential (non-exposed) industries, alongside the directly exposed industries, is provided in Appendix B.2.[3]

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[3] These tangential industries refer to industries other than the rare-earth-exposed ones that firms in my dataset also belong to. The figure in the appendix displays both the directly exposed industries and

2.3 Firm Share Prices

The outcome variable used in my analysis is the cumulative share price return of firms. I construct this dataset using daily share price data from a set of publicly listed firms, accessed through LSEG Workspace. My dataset contains share prices of companies listed on exchanges in the United States (Russell 3000), Japan (TOPIX), the European Union (STOXX Europe 600), Australia (S&P/ASX 200), and Canada (S&P TSX Composite Index). In total, I include 5,803 firms in my dataset, with roughly half being U.S.-listed companies.

Firms in the sample are classified as either rare-earth users or non-users, based on the industry mappings described in the previous section. I further exclude firms that are primarily rare-earth producers—those engaged in the extraction or upstream processing of rare earths or other metal ores—since such firms may benefit from negative supply shocks occurring abroad. Specifically, I remove all firms belonging to "Other Metal Ore Mining" (NAICS 212290) and "Support Activities for Metal Mining"(213114).[4]

As I run local projection regressions in my analysis, I use this daily share price data to construct cumulative returns between the day before the rare earth supply shock, $t-1$, and some horizon h, $t+h$. Therefore, my outcome variable becomes

$$Ret_{i,t+h} = \ln(P_{i,t+h}) - \ln(P_{i,t-1}),$$

where $P_{i,t+h}$ is firm i's share price h days after the supply shock event.

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these tangential industries.

[4] These producer industries are excluded to ensure that the identified share price responses reflect the impact of supply shocks on downstream users rather than upstream producers that could gain from tighter global supply.

3 Rare Earth Supply Shocks and Firm Equity Prices

In this section, I investigate the effect of rare earth supply shocks on firm-level cumulative share price returns, distinguishing between the effects of those that use REEs as inputs and those that do not.

3.1 Baseline Local Projection Regressions

My empirical framework follows the local projection method of Jordà (2005), which estimates the dynamic response of variables to shocks at each future horizon directly through separate regressions, rather than relying on a tightly specified dynamic model such as a VAR; this approach provides a flexible, data-driven way to trace impulse responses without imposing restrictive assumptions on the underlying data-generating process. The local projection specification that I estimate is:

$$Ret_{i,t+h} = \alpha_i + \delta_t + \beta_h \big(\text{Shock}_t \times \mathbb{1}_i^{\text{REE}}\big) + \boldsymbol{\gamma_h' Ret_{i,t-1:t-5}} + u_{i,t+h} \tag{1}$$

where $Ret_{i,t+h}$ is the log change in firm i's share price between $t-1$ (the day before the supply shock) and $t+h$, $Shock_t$ is the rare earth supply shock (which takes a value of 1 if there is a predicted price increase and -1 if there is a predicted price decrease), and $\mathbb{1}_i^{\text{REE}}$ is an indicator variable which takes a value of 1 if firm i belongs to at least one rare earth-exposed industry. I include firm fixed effects (α_i) to control for time-invariant firm characteristics such as sector, scale, or long-run profitability, while time fixed effects (δ_t) captures day-specific factors common to all firms, such as macroeconomic conditions, monetary policy news, or market sentiment. This ensures that the estimated responses reflect within-firm variation attributable specifically to rare earth shocks. Next, I include five lags of returns to account for short-term persistence and autocorrelation in daily share price movements, ensuring that estimated shock responses are not driven by recent momentum effects. Finally, I cluster standard errors by firm and by time to account for potential correlation of residuals within firms over time (serial correlation) and across firms on the same day (common shocks), ensuring robust inference in a panel with both cross-sectional and temporal dependence.

The coefficient of interest in this regression is β_h, which estimates the difference in cumulative share price returns between rare earth-exposed firms and non-rare earth-exposed firms h days after a negative rare earth supply shock (i.e. rare earth price increase).

While β_h in Equation (1) estimates the difference in cumulative return between expose and non-exposed firms, I also run an augmented local projection specification in Equation (2), which estimates the effect of rare earth supply shocks on both exposed and non-exposed firms.

$$Ret_{i,t+h} = \alpha_i + \theta_h \, \text{Shock}_t + \beta_h \big(\text{Shock}_t \times \mathbb{1}_i^{\text{REE}}\big) + \boldsymbol{\gamma_h' Ret_{i,t-1:t-5}} + u_{i,t+h} \tag{2}$$

In this equation, the variables of interest are now θ_h, which estimates the effect of a rare earth price increase on the cumulative return of non-exposed firms, while β_h estimates the effect of a rare earth price increase on the difference between exposed and non-exposed firms' cumulative returns. Therefore $\theta_h + \beta_h$ is the effect of a negative supply shock on exposed firms' cumulative return. Equation (2) is otherwise identical to Equation (1), except that I remove time fixed effects as they are collinear with Shock_t.

To present the baseline results, I begin with the regression coefficients from Equations (1) and (2), reported in Table 2a and Table 2b, respectively. These tables report the estimated effects on impact and at 30, 60 and 90 days following a rare earth supply shock.

Table 2a presents the difference-in-differences estimates from Equation (1). The interaction coefficient $\text{Shock}_t \times \mathbb{1}_i^{\text{REE}}$ is negative and statistically significant at all reported horizons. On impact, REE-exposed firms underperform non-exposed firms by 0.13 percentage points. The differential widens over time, reaching 1.9 percentage points after 90 days. This pattern indicates a persistent and economically meaningful divergence in cumulative returns following a negative rare earth supply shock.

Table 2b reports the corresponding estimates from Equation (2), separating the responses of exposed and non-exposed firms. Non-exposed firms experience a decline

Table 2: Baseline Regression Results for Rare Earth Supply Shocks

(a) Difference-in-differences regression results

	H = 0	**H = 30**	**H = 60**	**H = 90**
$\text{Shock}_t \times \mathbb{1}_i^{\text{REE}}$	-0.0013**	-0.012***	-0.016***	-0.019*
	(0.0005)	(0.003)	(0.005)	(0.010)
Observations	7,942,884	7,768,854	7,594,886	7,421,264
Firm FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

(b) Exposed vs. non-exposed regression results

	H = 0	**H = 30**	**H = 60**	**H = 90**
Shock_t	-0.0006	-0.0179**	-0.0293***	-0.0527***
	(0.0011)	(0.0055)	(0.0088)	(0.0184)
$\text{Shock}_t \times \mathbb{1}_i^{\text{REE}}$	-0.0012**	-0.0116***	-0.0165***	-0.0198**
	(0.0005)	(0.0028)	(0.0047)	(0.0097)
$\text{Shock}_t + \text{Shock}_t \times \mathbb{1}_i^{\text{REE}}$	-0.0018**	-0.0296***	-0.0459***	-0.0725***
	(0.0011)	(0.0070)	(0.0119)	(0.0222)
Observations	7,942,884	7,768,854	7,594,886	7,421,264
Firm FE	Yes	Yes	Yes	Yes
Time FE	No	No	No	No

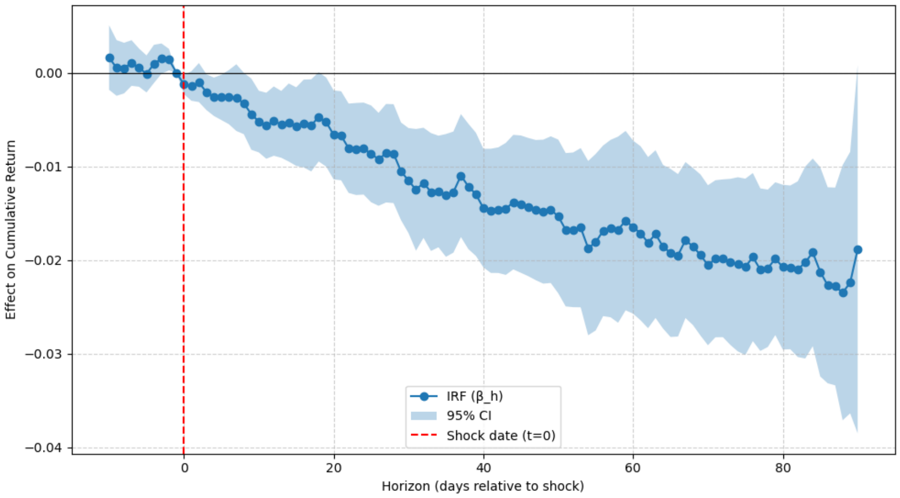
Notes: Subtable (a) reports the differential effect on exposed vs. non-exposed firms (Equation (1)), while subtable (b) reports separate effects for exposed and non-exposed firms (Equation (2)). Cluster-robust standard errors are reported in parentheses. All specifications include five lags of cumulative returns. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

in cumulative returns at medium and longer horizons. Exposed firms experience a substantially larger decline, with the combined effect reaching 7.3 percentage points after 90 days. The differential component remains negative and significant throughout.

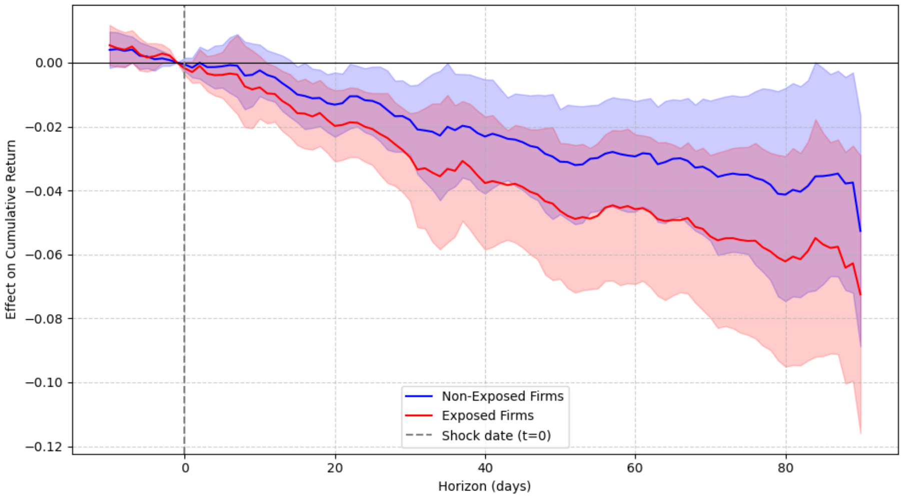
These results are consistent with a cost channel: increases in rare earth prices raise input costs for REE-exposed firms, compressing margins and reducing equity valuations relative to firms that do not directly rely on rare earth inputs.

Figures 3a and 3b plot the full impulse response functions corresponding to the estimates reported in Tables 2a and 2b. Figure 3a visualizes the dynamic path of the differential effect (β_h), confirming that the divergence emerges on impact and widens gradually over the 90-day horizon. Figure 3b shows that both exposed and non-exposed firms experience negative cumulative returns following an adverse supply shock, although the response is considerably stronger for exposed firms.

Figure 3: Impulse Responses to Rare Earth Supply Shocks



(a) Share price response differential between exposed and non-exposed firms (β_h in Equation (1))



(b) Share price response of non-exposed (θ_h) and exposed ($\theta_h + \beta_h$) firms in Equation (2)

Notes: Panel (a) shows the cumulative return response differential between exposed and non-exposed firms, while Panel (b) shows the cumulative return response for REE-exposed (red) and non-REE-exposed firms (blue) separately. The specification includes firm fixed effects and five days of lagged returns as controls, with standard errors clustered by firm and by time. In Panel (a), time fixed effects are also included. Shaded areas correspond to 95% confidence intervals.

Importantly, the negative response of non-exposed firms suggests that rare earth supply shocks propagate beyond direct input-cost effects. This indicates that these shocks may transmit through broader supply-chain linkages or macro-financial channels, affecting firms that do not directly use rare earths as inputs.

3.2 Distinguishing Between Trade Restriction and Production Shocks

Next, I examine whether the effects of rare earth supply shocks on firm-level share prices differ depending on the underlying nature of the shock. Specifically, I distinguish between trade restriction shocks, which primarily reflect policy actions that constrain rare earth exports or imports, and production shocks, which correspond to events directly affecting mining output or processing capacity. These two categories are exhaustive and mutually exclusive within my identified set of supply shocks.

To estimate these heterogeneous effects, I extend the baseline local projection framework to allow for separate shock series for each type of event. I first estimate:

$$Ret_{i,t+h} = \alpha_i + \delta_t + \beta_h^{TR}\big(\text{Shock}_t^{TR} \times \mathbb{1}_i^{\text{REE}}\big) + \beta_h^{PR}\big(\text{Shock}_t^{PR} \times \mathbb{1}_i^{\text{REE}}\big) + \boldsymbol{\gamma_h' Ret_{i,t-1:t-5}} + u_{i,t+h} \tag{3}$$

which is analogous to Equation (1) but separates the interaction between rare earth exposure and each shock type. The coefficients β_h^{TR} and β_h^{PR} capture the differential cumulative return response of rare earth–exposed firms relative to non-exposed firms following trade restriction and production shocks, respectively.

To compare how these shocks affect both exposed and non-exposed firms, I also estimate:

$$\begin{aligned} Ret_{i,t+h} = {} & \alpha_i + \theta_h^{TR}\,\text{Shock}_t^{TR} + \theta_h^{PR}\,\text{Shock}_t^{PR} \\ & + \beta_h^{TR}\big(\text{Shock}_t^{TR} \times \mathbb{1}_i^{\text{REE}}\big) + \beta_h^{PR}\big(\text{Shock}_t^{PR} \times \mathbb{1}_i^{\text{REE}}\big) \\ & + \boldsymbol{\gamma_h' Ret_{i,t-1:t-5}} + u_{i,t+h} \end{aligned} \tag{4}$$

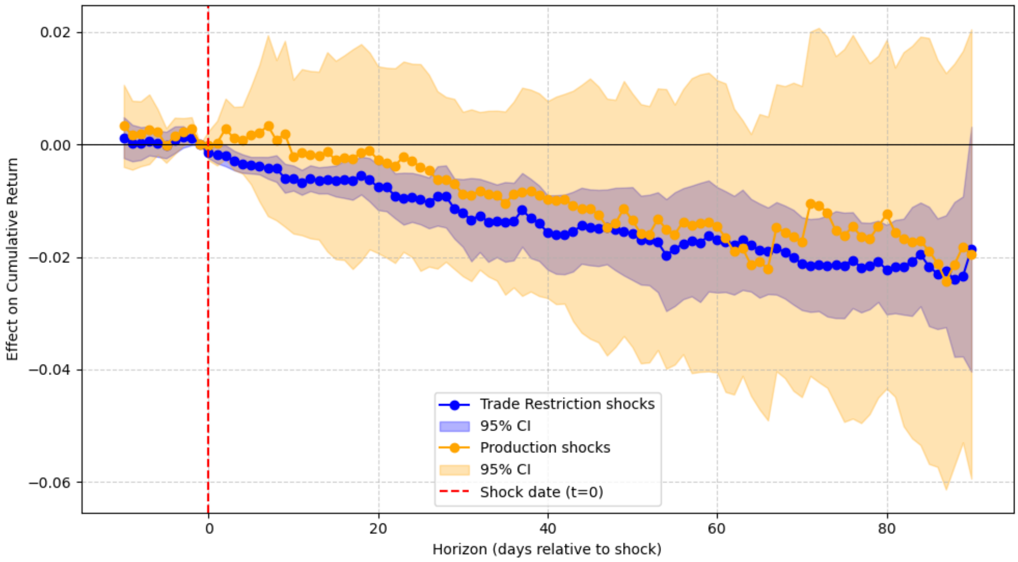
which mirrors Equation (2) but distinguishes between trade- and production-driven shocks. The parameters θ_h^{TR} and θ_h^{PR} represent the effect of each shock type on non-exposed firms, while $(\theta_h^{TR} + \beta_h^{TR})$ and $(\theta_h^{PR} + \beta_h^{PR})$ capture the corresponding effects on exposed firms. Both specifications include firm fixed effects and five lags of daily returns, and standard errors are two-way clustered by firm and by day.

Figure 4a plots the impulse responses of the cumulative return differential between rare-earth-exposed and non-exposed firms in response to each shock type (β_h^{TR} and β_h^{PR}). Both types of shocks lead to a decline in the relative cumulative returns of exposed firms compared to non-exposed firms, consistent with the interpretation that increases in rare earth prices—regardless of their source—negatively affect firms that are more reliant on rare earth inputs. The magnitudes of the two responses are broadly similar, but the effect of production shocks is less statistically significant at most horizons, suggesting lower market salience or weaker propagation compared to trade restriction shocks.

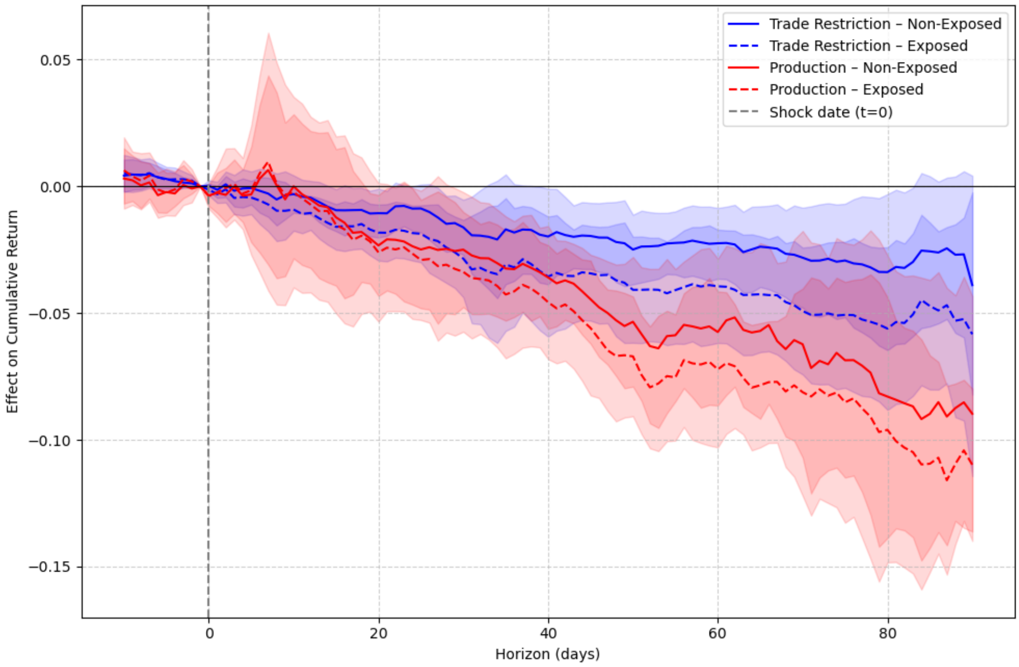
Figure 4b presents the corresponding impulse responses for both exposed and non-exposed firms under each shock type. The responses confirm that, on average, rare earth supply shocks are adverse for all firms, with share prices falling following increases in rare earth prices. However, the decline is consistently larger and more persistent for rare-earth-exposed firms, indicating that exposure amplifies the negative impact of supply disruptions. While production shocks are estimated with wider confidence intervals, their average magnitudes are somewhat larger than those of trade restriction shocks, implying that when production-related disruptions do occur, they can generate particularly strong equity market reactions. It is important to note, however, that the shock variable is coded as $+1$ or -1, indicating only the expected direction of the price change rather than its size. Consequently, the larger estimated effects of production shocks could reflect the fact that these events tend to coincide with larger underlying changes in rare earth prices, which in turn generate stronger equity market responses.

Overall, these results indicate that while both trade restriction and production shocks depress firm valuations, the former are more clearly perceived by investors

Figure 4: Impulse Responses to Rare Earth Trade Restriction and Production Shocks



(a) Share price differential between exposed and non-exposed firms in response to REE trade restriction shocks (β^h_{TR} in blue) and REE production shocks (β^h_{PR} in orange). The IRFs are based on Equation (3).



(b) Share price response of non-exposed (θ_h) and exposed ($\theta_h + \beta_h$) firms to trade restriction and production shocks (Equation (4)).

Notes: Panel (a) shows the cumulative return differential between exposed and non-exposed firms in response to trade restriction and production shocks, while Panel (b) shows the cumulative return response for REE-exposed and non-REE-exposed firms separately. In Panel (b), the effect of trade restriction shocks on non-exposed firms is θ^h_{TR} (blue solid line), and on exposed firms is $\theta^h_{TR} + \beta^h_{TR}$ (blue dashed line); the effect of production shocks on non-exposed firms is θ^h_{PR} (red solid line), and on exposed firms is $\theta^h_{PR} + \beta^h_{PR}$ (red dashed line). All specifications include firm fixed effects and five days of lagged returns as controls, with standard errors clustered by firm and by time. Panel (a) additionally includes time fixed effects. Shaded areas represent 95% confidence intervals.

as disruptive and persistent, whereas production-related events yield less precisely estimated but occasionally larger responses.

3.3 Effect of Shocks by Industry

Finally, I investigate whether the impact of rare earth supply shocks differs systematically across industries. This analysis allows me to identify which sectors are most sensitive to changes in rare earth availability and to assess whether the effects observed at the aggregate firm level are concentrated in specific parts of the production chain.

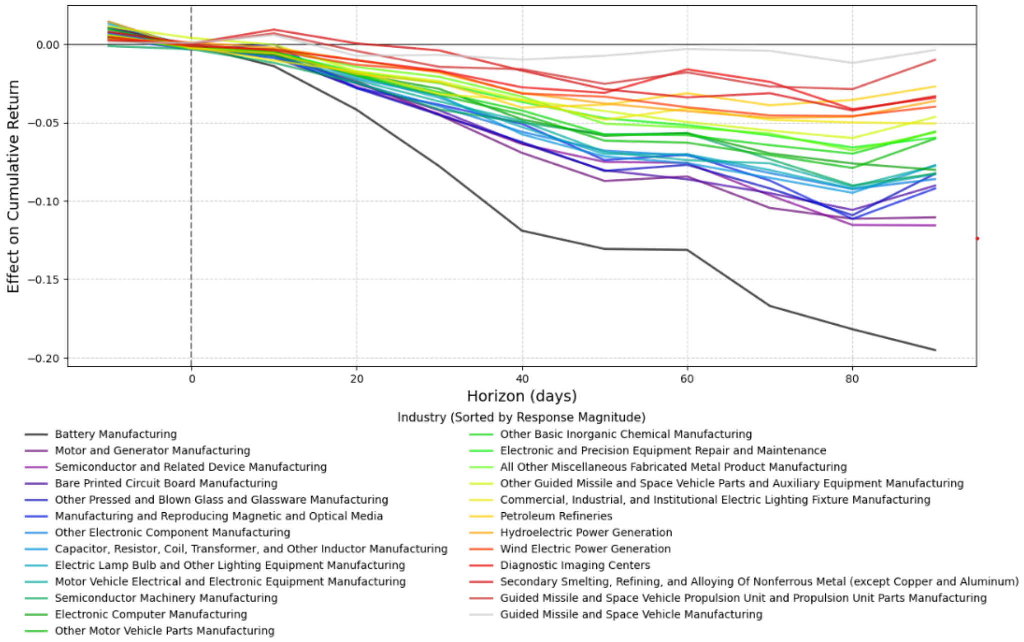
For each industry $s \in S$, I estimate the following local projection specification:

$$Ret_{i,t+h} = \alpha_i + \beta_{s,h}\,\text{Shock}_t + \boldsymbol{\gamma'_{s,h} Ret_{i,t-1:t-5}} + \varepsilon_{i,t+h} \tag{5}$$

where $Ret_{i,t+h}$ is the cumulative return of firm i between $t-1$ and $t+h$, $Shock_t$ is the rare earth supply shock, and $\beta_{s,h}$ measures the average cumulative return response of firms in industry s to a one-unit increase in the supply shock variable. The specification includes firm fixed effects and five lags of returns, and standard errors are two-way clustered by firm and time. Equation 5 is estimated separately for each industry in my sample.

Figure 5 plots the estimated impulse responses of cumulative returns to rare earth supply shocks for each industry, while the corresponding industry-level impulse responses with 95% confidence intervals are reported in Appendix A.1. The figure reveals substantial heterogeneity across industries in both the magnitude and persistence of the response to rare earth supply shocks. As expected, industries that are intensive users of rare earths—such as Battery Manufacturing, Semiconductors and Related Device Manufacturing, Electronic Component Manufacturing, and Motor Vehicle Parts Manufacturing—display the largest and most persistent declines in cumulative returns following a negative supply shock (i.e., an increase in rare earth prices). The response of Battery Manufacturing firms is particularly pronounced, with the largest estimated decline in cumulative returns among all industries, reflecting the heavy reliance of battery production on rare earth elements such as neodymium, dysprosium, and lanthanum. These effects are statistically significant across several horizons, consistent with the interpretation that rare earths constitute critical inputs for these industries and that price increases directly erode expected profitability.

Figure 5: Impulse Responses to Rare Earth Supply Shocks by Industry



Notes: The figure plots industry-specific impulse responses of cumulative firm-level returns to rare earth supply shocks, estimated separately for each industry using the local projection specification in Equation (5). Each regression includes firm fixed effects and five lags of daily returns. Standard errors are two-way clustered by firm and by time.

By contrast, industries with less direct dependence on rare earth inputs, such as Basic Inorganic Chemical Manufacturing and Petroleum Refineries, exhibit smaller and less persistent responses that are generally not statistically significant. Military-related and defense-oriented manufacturing industries also show relatively muted and statistically insignificant effects. This may reflect the specific characteristics of these sectors: military demand is often more stable, less sensitive to short-term cost shocks, and heavily supported by government procurement, which can insulate firms from input price volatility. In addition, some defense-related firms may have longer-term supply contracts or access to strategic stockpiles that mitigate the immediate financial impact of supply disruptions.

It is important to note that my selection of industries was based on an *ex ante* assessment of which sectors plausibly use rare earths as critical inputs, rather than on a quantitative input–output analysis of material flows. While this introduces some uncertainty about the precise degree of rare earth dependence within each category, the uniformly negative coefficients across all industries provide reassurance that the chosen set of industries is indeed systematically exposed to rare earth shocks.

Taken together, the results suggest that the sensitivity of industries to rare earth supply shocks depends on both their direct material intensity and their ability to absorb or pass through higher input costs. High-tech and clean energy industries, particularly Battery Manufacturing, but also semiconductors, electronics, and motor vehicles, are not only rare-earth-intensive but also operate in globally integrated supply chains with limited short-run substitutability, which likely amplifies their responsiveness. In contrast, more traditional industrial or defense-oriented sectors appear relatively insulated, either because of longer production cycles, procurement structures, or the strategic nature of their demand. Overall, these results reinforce the earlier finding that rare earth supply shocks have broadly negative effects on firm valuations, but the degree of exposure and persistence of the response varies markedly across industries.

4 Conclusion

This paper studies how investors price rare earth supply disruptions. To address this question, I construct a news-based measure of exogenous rare earth trade-restriction and production shocks using AI-assisted classification of rare earth-related news and estimate their dynamic effects on the share price returns of exposed and non-exposed firms.

The main finding is that negative rare earth supply shocks lead to significant and persistent declines in the equity returns of rare earth-exposed firms relative to non-exposed firms. The effect is present on impact and grows over time, with the differential in cumulative returns reaching approximately 2 percentage points after 90 days. Both exposed and non-exposed firms experience declines in returns following adverse shocks, although the effect is substantially stronger for exposed firms.

Distinguishing between production and trade-restriction shocks, I find that both types reduce the excess returns of rare earth-exposed firms, with trade-restriction shocks producing more precisely estimated effects. The most affected industries include battery manufacturing, motor and generator production, semiconductor manufacturing, and circuit board production.

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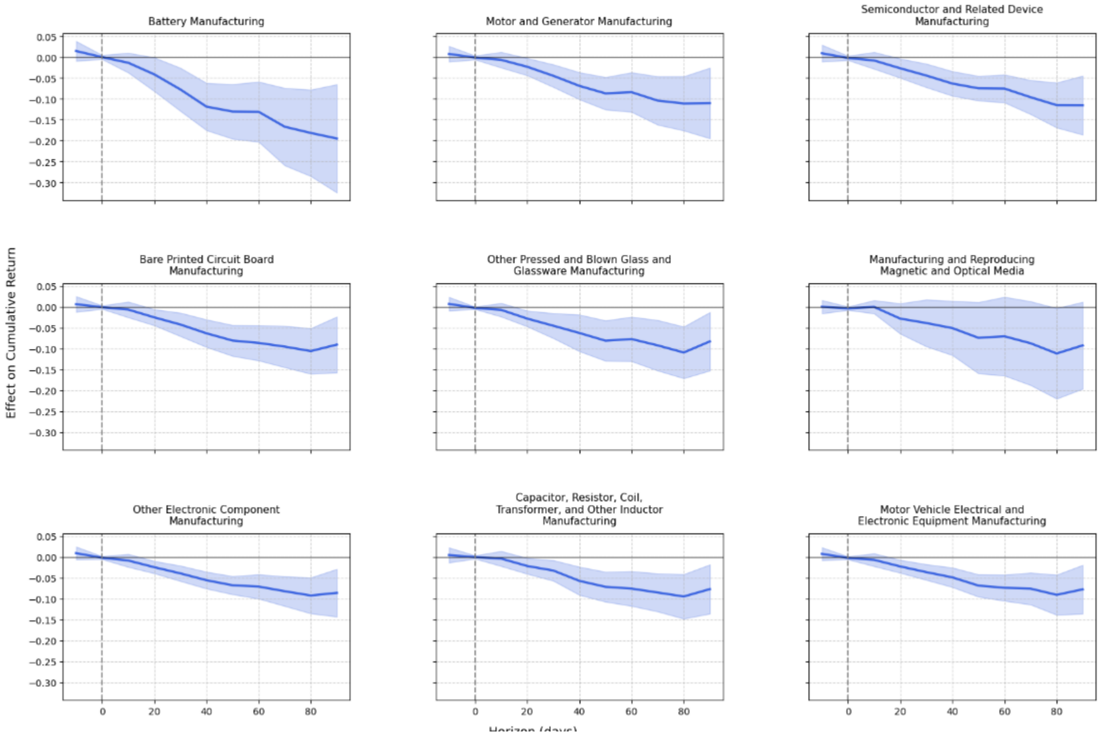
A Additional Results

A.1 Impulse Responses by Industry


Battery Manufacturing

Motor and Generator Manufacturing

Semiconductor and Related Device Manufacturing

Bare Printed Circuit Board Manufacturing

Other Pressed and Blown Glass and Glassware Manufacturing

Manufacturing and Reproducing Magnetic and Optical Media

Other Electronic Component Manufacturing

Capacitor, Resistor, Coil, Transformer, and Other Inductor Manufacturing

Motor Vehicle Electrical and Electronic Equipment Manufacturing

Figure 6: Impulse Response by Industry.

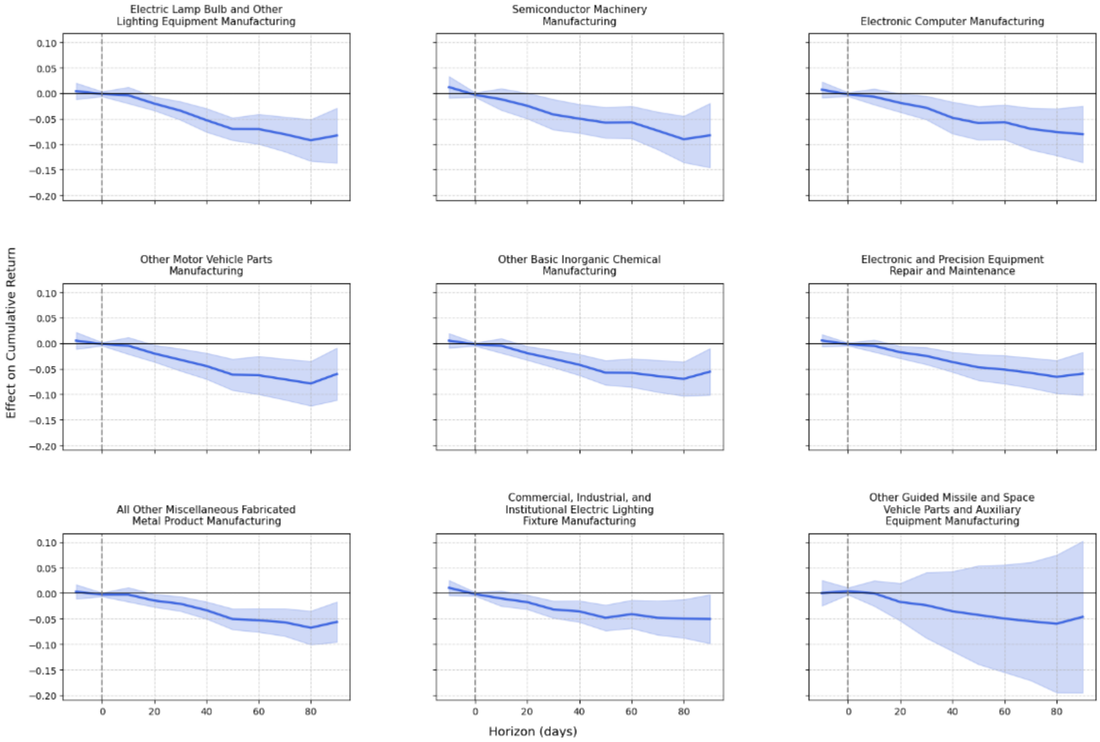


Figure 7: Impulse Response by Industry.

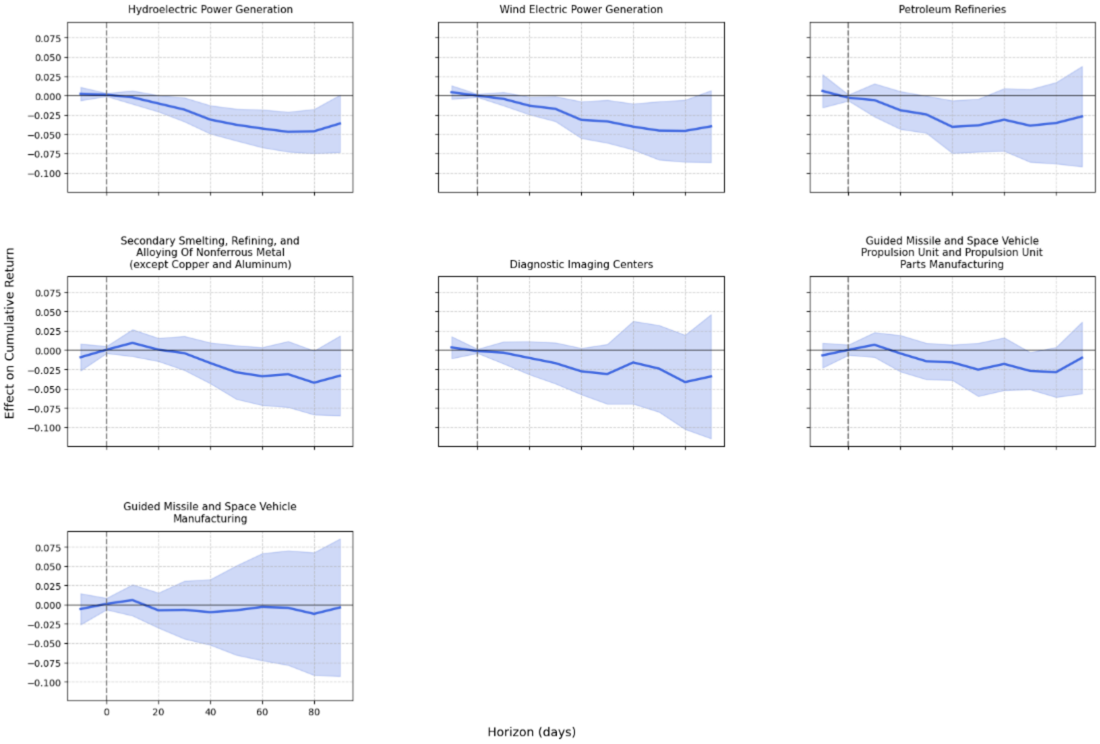


Figure 8: Impulse Response by Industry.

B Data Appendix

B.1 AI Article Classification Prompt

The following prompt was used for the AI-based classification of rare earth news articles:

> You are a researcher classifying news articles related to rare earths and critical minerals. For each article, do two things:
>
> 1. **Classify it as one of:**
>   - **Supply** – if it discusses production, mining, reserves, exports, trade restrictions, new projects, supply chain disruptions, or upstream industry factors.
>   - **Demand** – if it discusses consumption, downstream usage, EVs, batteries, magnets, clean energy, defense/military demand, procurement, or technology-sector needs.
>   - **Unrelated** – if it is not clearly about rare earths or critical minerals (e.g., minor company news, irrelevant geopolitical events, or pure commentary/editorials with no new event).
> 2. **Write a single concise headline-style blurb** (approximately 8–12 words) summarizing the main news event if there is one.
>   - Example: "China halts rare earth exports to U.S."
>   - If a longer description is unavoidable, one short full sentence is allowed.
>   - If there is no real event (only commentary or editorial), write: "No clear event."
>
> Only classify *breaking news* that is relevant to the rare earth or critical mineral industry.

B.2 Rare Earth Tangential Industries

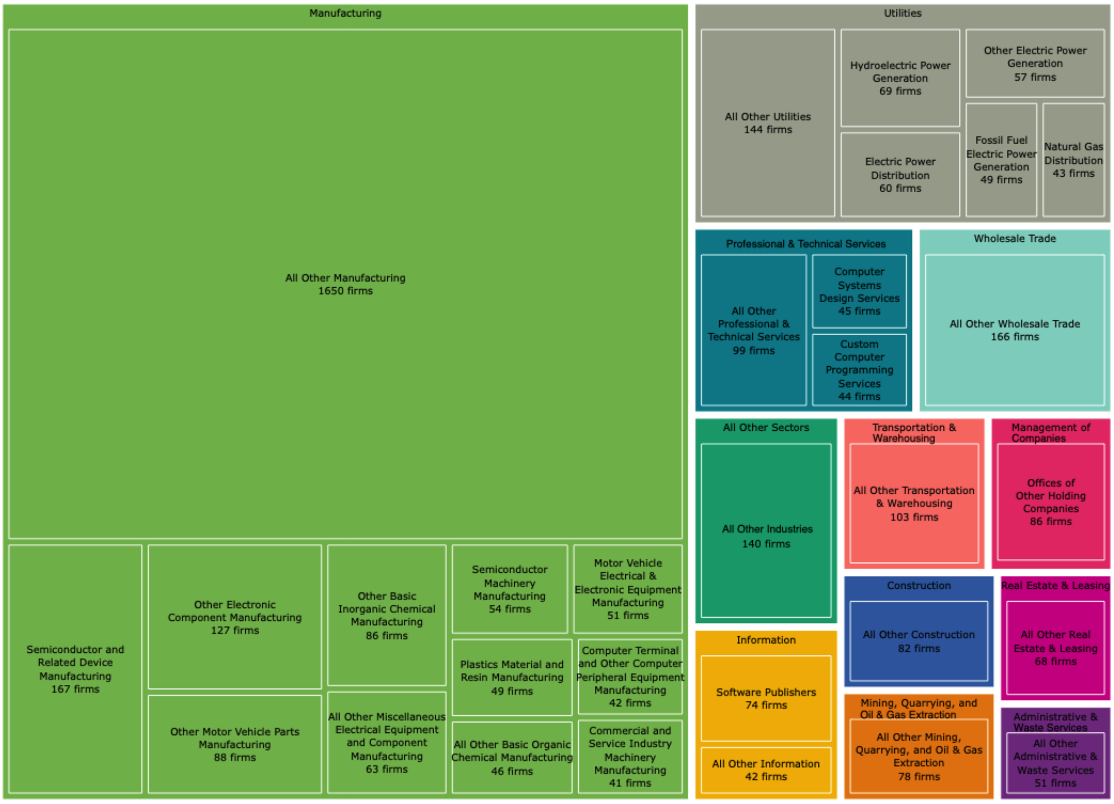


Figure 9: NAICS Rare Earth-Exposed and Tangential Industries