

A satellite view of Earth at night, showing the curvature of the planet and the glowing lights of cities and continents. The lights are concentrated in the lower half of the image, creating a stark contrast with the dark blue and black of the night sky and the unlit parts of the Earth's surface.

Does Human Capital Efficiency Drive Market Valuation?

——The Paradox of AI Boom and Mass Layoffs
in Tech Stocks (2021–2024)

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Motivation & Research Question

Why are tech giants laying off thousands while AI stocks soar?

- The AI revolution (e.g., ChatGPT, Blackwell) fueled massive market gains.
- Simultaneously, firms like META, AMZN, and INTC announced large-scale layoffs.

→ **Key question: Does workforce reduction drive value... or did AI**

- NVIDIA's market cap $\uparrow 12\times$ (to \$4.3 trillion)
- Intel's market cap $\downarrow 25\%$
- Meta and Amazon laid off $>100,000$ workers — yet stock prices surged

Integrated Dataset


We built a multi-source panel dataset covering 10 major tech firms:

- **Stock prices:** Daily returns (Yahoo Finance, 2021–2024)
 - **Workforce & valuation:** Annual employee counts & market cap (SEC filings, annual reports)
 - **Events:**
 - ✓ **Layoffs** (Layoffs.fyi + verified news)
 - ✓ **AI milestones** (product launches, model releases, earnings calls)
-  **All data collected from original sources — no Kaggle / UCI / defaults**

Technical Pipeline

All analysis is code-first and reproducible:

- **Data processing:** Python (pandas, yfinance, BeautifulSoup)
- **Static visualizations:** Matplotlib, Seaborn, Plotly (exported as PNG/GIF)
- **Interactive frontend:** Raw HTML/CSS/JavaScript + d3.js v5
- **No GUI tools:** Zero use of Tableau, Power BI, or Excel

 Full pipeline reproducible via Jupyter notebooks (notebooks/) and versioned logs

Key Findings

- **AI-focused firms (NVDA, MSFT) outperformed layoff-heavy peers by $>2\times$ in cumulative returns (2022–2024).**
- **Market cap per employee rose sharply for AI leaders—even as headcount grew.**
- **No positive correlation between layoffs and shareholder value; some layoff firms underperformed.**
- **Return distributions differ significantly ($p < 0.01$): AI cohort shows higher median & lower volatility.**

Visualization Highlights

- **Animated Bubble Plot: Tracks efficiency vs. returns over time**
- **Annotated Time Series: Links NVDA's +900% surge to Blackwell launch**
- **4-Year Trend Grid: Reveals structural divergence across 10 companies**
- **Interactive Scroll Narrative: 11-section story blending data + context ([open index.html](#))**

Limitations & Reflection

Limitations

- Limited to 4 years of fundamental data (2021–2024)
- Employee counts are year-end snapshots; intra-year layoffs smoothed
- Layoff timing based on public announcements (actual dates may vary)

Reflection

- “This project taught us that writing robust data pipelines in code is more valuable than off-the-shelf dashboards—and that clean, well-engineered data reveals insights no black-box model can.”

Conclusion

- The “layoff paradox” reflects strategic divergence, not universal optimization
- AI investment—not headcount reduction—drives recent market outperformance
- Our end-to-end code-first workflow — from SEC filings to interactive narrative — exemplifies core data science principles: reproducibility, programming proficiency, and insight through engineering.



Thank You!

Repository:

<https://situwaner-q.github.io/tech-stock-analysis/>