

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/>