FINAL REPORT

Stock Behavior & Economic Interactions: A Quantitative Analysis. Time Series, Risk, Macro & Microeconomic Insights

1. Project Objectives & Firms Explained

This project analyzes the financial behavior and economic sensitivity of selected companies from the Software & Consumer Electronics and E-commerce sectors, spanning the period from 2015 to 2024. The analysis focuses on both large-cap (e.g., Apple, Microsoft, Amazon, eBay) and mid-cap firms (e.g., RingCentral, Universal Display Corp (OLED), Wayfair and Etsy) to assess differences in performance, risk, and resilience.

Part 1: Financial Time Series Analysis

The first section evaluates stock prices, returns, volume, and volatility using time series methods. It compares individual companies within each sector and across market caps. Key metrics include daily and cumulative returns, volatility, skewness, kurtosis, and Sharpe ratio. Advanced techniques such as the CAPM and GARCH models are applied to understand residual risk, volatility regimes, and factor exposures over time.

Further, the analysis explores behavioral changes under different market regimes—for instance, comparing how a company like Dell (hypothetical) behaves in high- vs. low-volatility environments relative to Apple. Correlations within industries and stock price reactions to major events are also examined to understand sector-specific dynamics. The Fama-French 5-Factor Model will also be taken into consideration to examine how different market capitalizations or sectors behave in relation to the identified factors.

Part 2: Economic Context

Macroeconomics

Interest rate sensitivity varies sharply by sector. Tech firms like Apple and Microsoft show strong positive reactions to rising rates, benefiting from economic expansion and business investment. In contrast, e-commerce firms

such as Wayfair and Etsy respond negatively, as higher rates weaken consumer borrowing and discretionary spending.

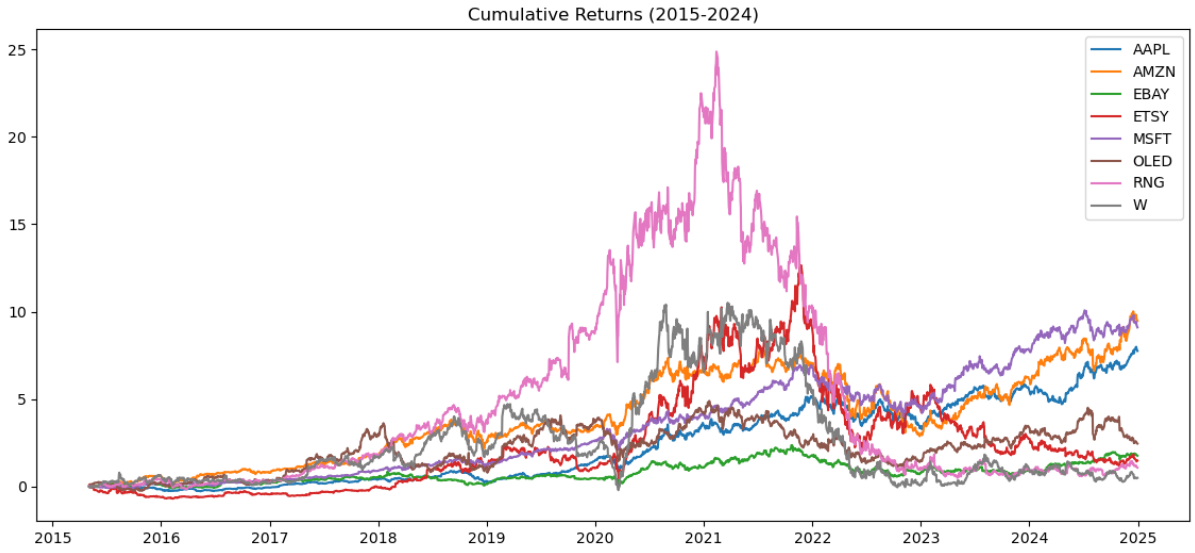
Large-cap companies generally display more stable, positive responses due to diversification and financial strength. Mid-caps, however, are more volatile, with rate sensitivity ranging widely based on their niche focus and limited flexibility.

Microeconomics

Firms with strong pricing power show more stable and positive long-term returns. They can protect margins during inflation or downturns by passing costs to consumers. In contrast, firms lacking pricing power are more vulnerable during economic shocks. For example, RingCentral surged during COVID-19 demand for remote tools but declined sharply post-pandemic due to competitive pressure and cost structure.

2. **Time Series Analysis**

1. Daily vs Cumulative Return Analysis



Methodology: We computed **daily percentage returns** from adjusted closing prices and derived **cumulative returns** normalized to 1 for all stocks and the S&P 500. This allowed us to examine both short-term fluctuations and long-run growth paths.

Findings:

Beyond traditional risk-return metrics and beta sensitivity, our analysis examines how each stock behaved across the entire return path from 2015–2024 — including cumulative growth, drawdowns, recovery strength, and

directional alignment with peers. Mid-cap stocks such as RNG, ETSY, and W demonstrated explosive rallies during the 2020–2021 liquidity surge but suffered steep declines afterward, with incomplete recoveries through 2024. This boom-bust pattern suggests greater exposure to speculative capital, lower investor confidence, and structurally weaker business resilience. In contrast, large-cap software firms like AAPL and MSFT exhibited more consistent growth, shallower drawdowns, and stronger post-shock recoveries — reinforcing their status as long-duration, stable-return assets. Correlation analysis further highlights market integration differences. Large-cap stocks showed stronger pairwise correlations, indicating that their returns reflect broader market sentiment and macroeconomic cycles. Mid-cap firms, by contrast, displayed weaker correlation with both peers and sector ETFs, suggesting more idiosyncratic performance and higher sensitivity to firm-specific or niche sector disruptions. This lower macro integration implies less predictable behavior during systemic events, underscoring the higher risk profile of mid-cap investments.

2. Descriptive Risk Metrics

Ticker	Mean Daily Return	Daily Volatility	Skewness	Kurtosis	Sharpe Ratio
AAPL	0.001054	0.017980	-0.009294	5.402136	0.058610
AMZN	0.001175	0.020464	0.182213	5.096254	0.057412
EBAY	0.000596	0.018906	-0.160751	7.008367	0.031500
ETSY	0.001057	0.037090	0.438409	8.043792	0.028496
MSFT	0.001095	0.016980	0.057010	7.470482	0.064498
OLED	0.000962	0.030186	0.510742	9.204800	0.031858
RNG	0.000867	0.033776	0.430501	8.215147	0.025659
W	0.001240	0.046713	0.753524	10.008437	0.026542

Methodology: We evaluated **mean daily returns**, **volatility**, **skewness**, **kurtosis**, and **Sharpe ratios** to understand distribution behavior and return efficiency.

Findings:

- Large-cap stocks delivered better risk-adjusted returns (Sharpe ratios > 0.05), with lower volatility and more normal return distributions.

- Mid-cap firms showed higher volatility and kurtosis, reflecting frequent extreme price movements.
- Positive skew in some mid-caps indicates upside bursts, but low Sharpe ratios suggest inefficient returns relative to risk.

3. CAPM Regression and Beta Analysis

	Alpha	Beta	p-value Alpha	p-value Beta	Residual Risk (Std of Residuals)
AAPL	0.000471	1.194848	0.050420	0.000000e+00	0.011844
AMZN	0.000612	1.153576	0.055859	2.414354e-278	0.015754
EBAY	0.000169	0.874005	0.605455	3.810130e-171	0.016110
ETSY	0.000373	1.400332	0.583334	1.294316e-108	0.033530
MSFT	0.000504	1.211761	0.013203	0.000000e+00	0.010006
OLED	0.000248	1.462941	0.628865	2.949971e-191	0.025237
RNG	0.000196	1.373577	0.747155	6.841599e-128	0.029983
W	0.000291	1.944252	0.728023	1.105537e-134	0.041201

- **Methodology**:
  We conducted CAPM regressions by regressing each stock's daily returns on market returns (S&P 500) to estimate alpha (excess return), beta (systematic risk), and the standard deviation of residuals (firm-specific risk). To assess how market sensitivity evolved over time, we computed rolling CAPM beta using a 252-day window. This allowed us to analyze regime-specific shifts and beta behavior during major macroeconomic phases such as the COVID-19 shock and the 2022 rate-tightening cycle.

- Mid-cap stocks such as Wayfair, Etsy, and RingCentral exhibit high beta and high residual risk, yet deliver no statistically significant alpha. This contradicts the foundational risk-return principle in CAPM, where higher systematic risk should be compensated with excess return. The lack of alpha despite elevated risk levels suggests inefficient pricing, likely driven by speculative valuation during certain periods.
- Residual risk measures the portion of a stock’s return volatility that is not explained by market movements. In our analysis, mid-cap stocks, especially in the e-commerce segment, display consistently high residuals. This indicates substantial firm-specific risk, which may stem from inconsistent financial performance, lower investor transparency, and limited analyst coverage. Such information asymmetry weakens predictability and increases noise in return behavior.
- A clear difference in risk profiles emerges across sectors. Large-cap software stocks like Apple and Microsoft exhibit the lowest residual risk, reflecting

stable earnings, strong institutional ownership, and macro alignment. Conversely, e-commerce firms are more exposed to shifts in consumer demand, external disruptions (e.g., logistics, inflation), and sentiment-driven volatility, making their return paths more unstable and less explained by market dynamics.

- Beta is statistically significant across nearly all stocks, while alpha is not. This suggests that market factors explain the majority of return variability, whereas consistent excess returns are rare. The result aligns with the theory of market efficiency, indicating that systematic risk is priced in, but long-term outperformance is difficult to sustain.

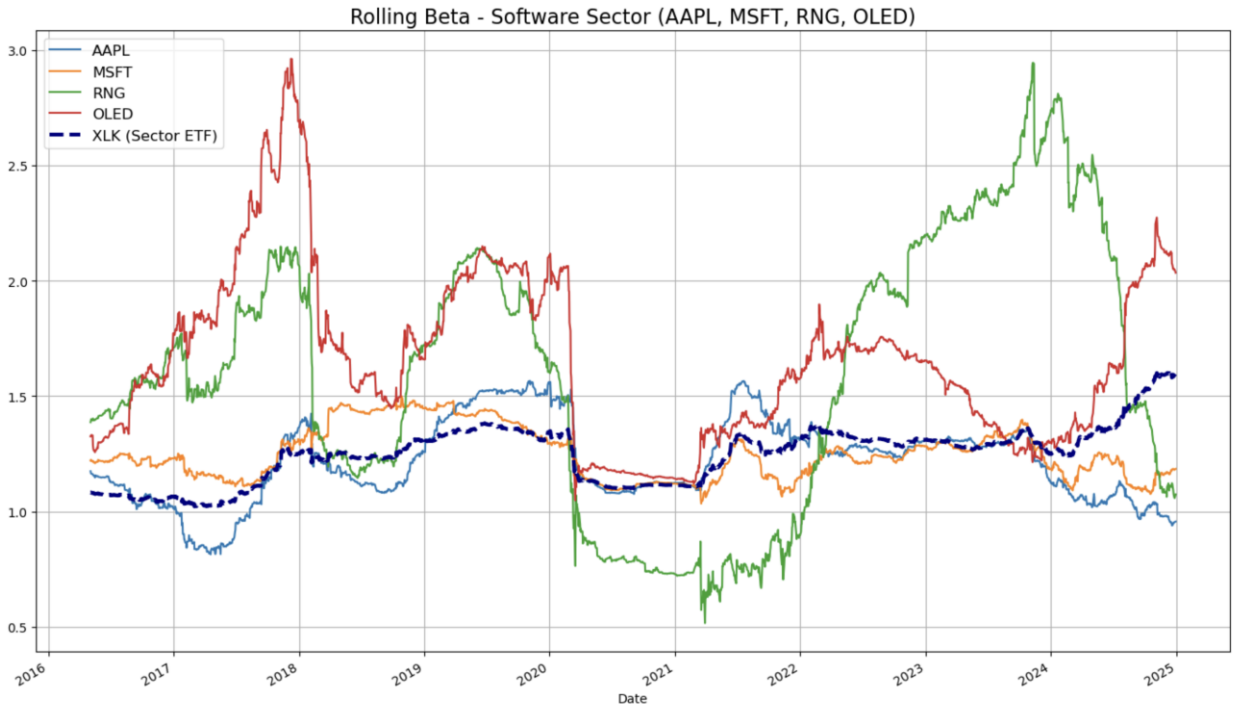
4. Long-Term Return Path & Market Integration

Methodology: We tracked **cumulative returns** alongside **pairwise correlation analysis** to assess return path quality and macro alignment over time.

Findings:

- Large-caps (AAPL, MSFT) showed smooth upward trajectories and strong correlation with each other and with the market.
- Mid-caps displayed more fragmented paths and weaker correlation with peers or sector ETFs, suggesting greater firm-specific risk.
- Sector fundamentals influenced macro response: software stocks were more stable, while e-commerce stocks exhibited cyclical and demand-driven volatility.

5. Risk Exposure Over Time



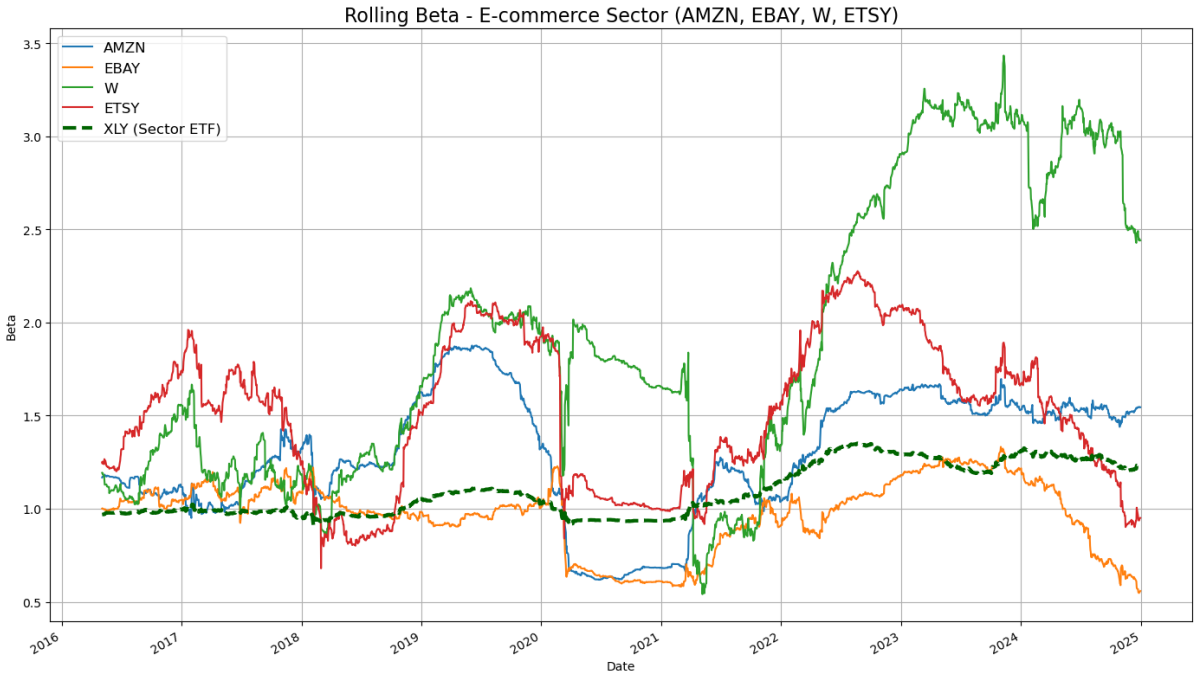
Methodology: We used rolling beta over a 10-year window to observe **how market sensitivity evolved**, especially through COVID and the tightening cycle.

- EBAY's rolling beta fell below 1.0 during the 2020–2021 COVID period, even as other large-cap stocks saw increasing beta. This suggests that EBAY behaved more defensively, likely due to its consistent revenue model and lack of speculative growth narratives. The market may have reclassified EBAY as a mature, low-growth platform, less responsive to macro momentum compared to other e-commerce peers.
- Microsoft's beta dipped below 1.0 in 2022 during the Fed's rate hikes and the broader tech sector correction. Despite elevated market volatility, MSFT maintained stable performance, reflecting investor confidence in its business fundamentals. The firm acted as a "safe tech" asset, providing downside protection while remaining macro-aligned.
- Wayfair and Etsy experienced a sharp post-COVID beta collapse between 2022 and 2024, falling from over 2.5 to levels near or below 1.0. These companies were major beneficiaries of the 2020–2021 e-commerce boom, but as macro conditions tightened, investor sentiment shifted and these stocks decoupled from the market. Their beta decline reflects a loss of market influence and increasing reliance on firm-specific growth narratives, which ultimately underperformed.
- RingCentral and OLED demonstrated frequent beta fluctuations between 2020 and 2023. These shifts correspond with volatile investor sentiment, earnings surprises, and sector-specific disruptions such as supply chain

shocks. The unstable beta trajectory in these mid-cap names reflects low liquidity and greater exposure to idiosyncratic shocks, reinforcing their higher residual risk and weaker market integration.

- A comparison of rolling beta trends shows that large-cap beta dips are typically tied to investor trust during systemic stress, such as in the case of MSFT and EBAY. In contrast, mid-cap beta collapses, particularly in Wayfair and Etsy, represent speculative unwinding and a breakdown in market-driven pricing. This divergence underscores the structural distinction between large-cap firms with stable macro relevance and mid-cap firms more vulnerable to firm-specific volatility.
- It is important to note that rolling beta captures co-movement over a historical window and does not always reflect directional alignment in real time. For example, RingCentral maintained a positive rolling beta, indicating it moved with the market over the observed window. However, in practice, it diverged from market recoveries while still participating in downturns. This asymmetry highlights a situation where beta may overstate a stock's exposure to market upside, exposing investors to downside risk without a corresponding rebound. Such behavior emphasizes the need to interpret beta in the context of both rising and falling market conditions.

6. Directional Behavior of Rolling Beta



Methodology: We investigated periods where rolling beta remained positive, yet the stock's return trajectory appeared to diverge from the direction of the overall market. This was done by comparing rolling beta values with actual return paths of both the

stock and the S&P 500, focusing on periods of market stress and recovery—such as the 2022 tightening cycle and the post-COVID rebound.

Findings and Interpretation: Some stocks, particularly RingCentral (RNG), maintained a consistently positive rolling beta, yet deviated from market direction in key phases—especially after 2021. This apparent contradiction highlights an important limitation in beta interpretation: while beta measures co-movement magnitude over a historical window, it does not necessarily reflect directional alignment at every moment. For example, during broad market declines, RNG exhibited high sensitivity and declined more sharply than the index, consistent with its elevated beta. However, during periods of market recovery, RNG failed to rebound in tandem with the broader market, despite still exhibiting a high rolling beta. This behavior reflects a breakdown in upside sensitivity.

The divergence suggests that while the stock continues to be influenced by market downturns, its positive beta overstates its ability to participate in rallies. This can occur due to deteriorating investor sentiment, firm-specific risks, or changes in the perceived relevance of the business model—factors that decouple the stock from aggregate market recovery even if past co-movement remains statistically present. Rolling beta, in this case, does not adjust for asymmetry between downside exposure and upside participation.

Implication:
This phenomenon exposes investors to downside risk without commensurate recovery potential, reducing the strategic value of positive beta in portfolio construction. It underscores the need to disaggregate rolling beta by market regime—specifically analyzing whether a stock's beta during downturns mirrors its behavior during recoveries. This distinction is especially critical for mid-cap stocks with higher volatility and lower market integration, where firm-specific disruptions can override systematic relationships.

Conclusion

This report demonstrates that **firm size and sector** play a defining role in long-term return behavior, risk pricing, and market integration.

- **Large-cap software stocks** offer stable, macro-aligned performance with predictable risk-adjusted returns.
- **Mid-cap e-commerce stocks**, while occasionally explosive, present higher residual risk and lower return efficiency, particularly during macro regime shifts.

- CAPM and rolling beta analysis provide valuable tools to track how a firm's **systemic relevance evolves**, especially in times of stress or transition.

7. Fama-French 5-Factor Model

Column1	Mkt_RF	SMB	HML	RMW	CMA
AAPL	1,22359198	-0,17148	-0,52883	0,476543	0,273317
MSFT	1,18064336	-0,38993	-0,3332	0,309893	-0,36145
RNG	1,11759889	0,607835	-0,84125	-1,16233	-0,79747
OLED	1,3501349	0,662699	-0,51737	-0,03806	-0,15415
AMZN	1,02976044	-0,3049	-0,37052	-0,01578	-1,05772
EBAY	0,86676791	0,130069	-0,2969	0,080082	0,195868
W	1,65250669	1,155546	-0,82983	-0,4916	-1,08029
ETSY	1,2029945	0,753907	-0,87205	-0,35404	-0,72436

We use Fama-French 5-Factor Model to evaluate stock returns of the companies and understand the sources of risk and return in a portfolio or stock performance beyond what is explained by the market alone. We will make an interpretation on how different the beta reflects on different cap sizes (large cap vs mid cap), and different industries (software & electronics vs e-commerce).

We observe that in the market factor, mid cap companies have higher coefficients than large cap ones, which indicates that the mid caps have more market sensitivity, in the other words, they are more easily impacted by the market or their industries' performance. This is reasonable due to the fact that mid-cap companies often exhibit higher sensitivity to market movements compared to large-cap firms due to several structural characteristics. They tend to be more growth-oriented, actively pursuing expansion strategies that make them more vulnerable to shifts in economic conditions and investor sentiment. Unlike large multinationals, mid-caps are typically less diversified in terms of products and geographic reach, which makes their cash flows more exposed to market fluctuations. Additionally, they may carry higher financial leverage or operational risk, resulting in more volatile earnings that amplify their reactions to market changes. Lower liquidity relative to large-cap stocks means that the mid-caps can experience larger price swings during periods of broad market movement, contributing further to their higher market beta.

SMB also shows aspiring comparison stories. All mid cap companies, and eBay have positive SMB coefficients, which is predictable because a positive SMB coefficient typically suggests a tilt toward small-cap stocks, as smaller companies historically

outperform larger ones over the long term due to higher risk and growth potential. In this case, all mid-cap companies and eBay have positive SMB coefficients, which aligns with expectations because mid-cap companies, while larger than small-caps, are still smaller than large-cap firms and thus often exhibit characteristics closer to small-caps in terms of growth and risk exposure. eBay despite being defined as a large-cap company, has a positive SMB coefficient because it barely passed the 10 billion market cap from 2015 to 2024, which means it has closer market cap to the mid-caps than those trillion market cap of Amazon, Apple and Microsoft. Apparently, it has much lower coefficients than the mid-caps considering its predominant market cap towards them. Its positive SMB coefficient of 0.130069 reflects a slight tilt toward small-cap behavior, likely due to its growth-oriented business model in e-commerce, which can mirror the risk-return profile of smaller firms.

With regards to other factors, all stocks have a negative HML beta, especially the mid cap companies, suggesting a strong growth stock profile (beta less than 0). The HML factor in the Fama-French model captures the value premium, where a positive HML beta indicates a tilt toward value stocks (high book-to-market ratio), while a negative HML beta reflects a preference for growth stocks (low book-to-market ratio). Growth stocks, often characterized by higher market valuations relative to their book value, tend to reinvest earnings into expansion rather than paying dividends, a trait common in tech-driven or e-commerce companies like those in this dataset. In profitability (RMW), it is also apparent that the mid-caps reflect weaker or volatile earnings than the large-caps. This observation stems from the inherent characteristics of mid-cap firms, which often operate in growth phases with higher investment in expansion, research, or market penetration, leading to fluctuating profitability margins. E-commerce mid-caps, such as ETSY, W, and eBay, demonstrate more aggressive investment strategies, as reflected in their negative CMA (Conservative Minus Aggressive) betas in the Fama-French 5-factor model. This divergence highlights a strategic split influenced by company size and sector. E-commerce mid-caps' aggressive investment is a response to competitive pressures in a fast-evolving digital market, where staying ahead requires bold moves, as seen during the 2020 e-commerce boom. Meanwhile, software large-caps' moderate approach reflects their maturity, allowing them to balance innovation with stability - e.g., MSFT's steady cloud investments versus ETSY's rapid platform scaling. However, this difference also implies differing risk profiles: mid-caps' aggressive strategies may yield higher returns in growth phases but increase vulnerability to economic downturns, while large-cap companies' moderation demonstrates resilience, though potentially at the cost of slower growth.

8. GARCH Volatility Model

The GARCH(1,1) model results across the eight stocks provide key insights into their return dynamics and volatility behavior. Across all companies, the mean return (mu) is positive and statistically significant (except for OLED, where it is only marginally significant at the 10% level). This suggests that over the period studied, these stocks experienced a small but consistent average daily return. For example, AMZN and AAPL have relatively higher mean returns compared to others, indicating stronger daily performance during the sample period. The constant mean model used here simplifies interpretation by assuming returns are centered around a stable average.

The GARCH(1,1) model for AAPL shows a statistically significant mean return (mu) of approximately 0.135% per day, with a p-value well below 0.01, suggesting a small but positive average daily return. The volatility parameters—omega (constant), alpha[1] (ARCH term), and beta[1] (GARCH term)—are all significant. The relatively small alpha[1] = 0.05 and large beta[1] = 0.93 indicate that AAPL's volatility is persistent and heavily influenced by past volatility rather than recent shocks. This implies that volatility clusters over time and tends to decay slowly, which is common for large, stable tech firms.

Meanwhile, MSFT's daily return is slightly lower than AAPL's at around 0.112%, but still statistically significant. Its volatility dynamics differ: alpha[1] = 0.20 and beta[1] = 0.70, both significant. This configuration suggests that MSFT's volatility responds more to recent market shocks (alpha) than AAPL's, though there is still substantial persistence (beta). Compared to AAPL, MSFT appears to react more quickly to new information, making its short-term volatility more sensitive but its long-term memory slightly shorter.

RNG has a higher average daily return of approximately 0.152%, significant at the 5% level. The volatility model shows a relatively large omega, higher than in AAPL and MSFT, which suggests a higher baseline volatility. The alpha[1] = 0.20 and beta[1] = 0.70 values, both significant, indicate that RNG's volatility is strongly influenced by recent shocks and shows moderate persistence. As a smaller-cap tech firm, RNG's risk-return profile reflects more reactive and volatile behavior compared to the large-cap stocks.

OLED's mean return of about 0.096% is not statistically significant (p = 0.0857), suggesting no clear daily trend. However, its volatility components are well-identified: alpha[1] = 0.05 and beta[1] = 0.85. The high beta indicates strong persistence in volatility, similar to AAPL. A larger omega compared to the previous stocks suggests higher baseline volatility. Overall, OLED exhibits high volatility persistence but lacks a statistically clear average return over the sample period.

For EBAY, the volatility model shows strong significance in both the alpha (0.0500) and beta (0.8500) coefficients, with very low p-values, indicating that past shocks and past volatility have a statistically significant effect on current volatility. The high beta suggests that volatility is highly persistent—large shocks to volatility today are likely to carry over into the future. The omega parameter is also significant, implying a solid base level of volatility in EBAY's returns. Together, these parameters suggest EBAY's return volatility is well-captured by the GARCH process.

In the case of Walmart (W), the GARCH parameters show a different dynamic. The omega and alpha parameters are not statistically significant at the 5% level, and the wide confidence intervals suggest uncertainty in the estimation of those parameters. However, the beta coefficient remains statistically significant, indicating that volatility persistence is still present, albeit less reliably than for EBAY. This might suggest that Walmart's returns are less driven by short-term volatility clustering and more by long-term volatility persistence, with some uncertainty in the contribution of recent shocks.

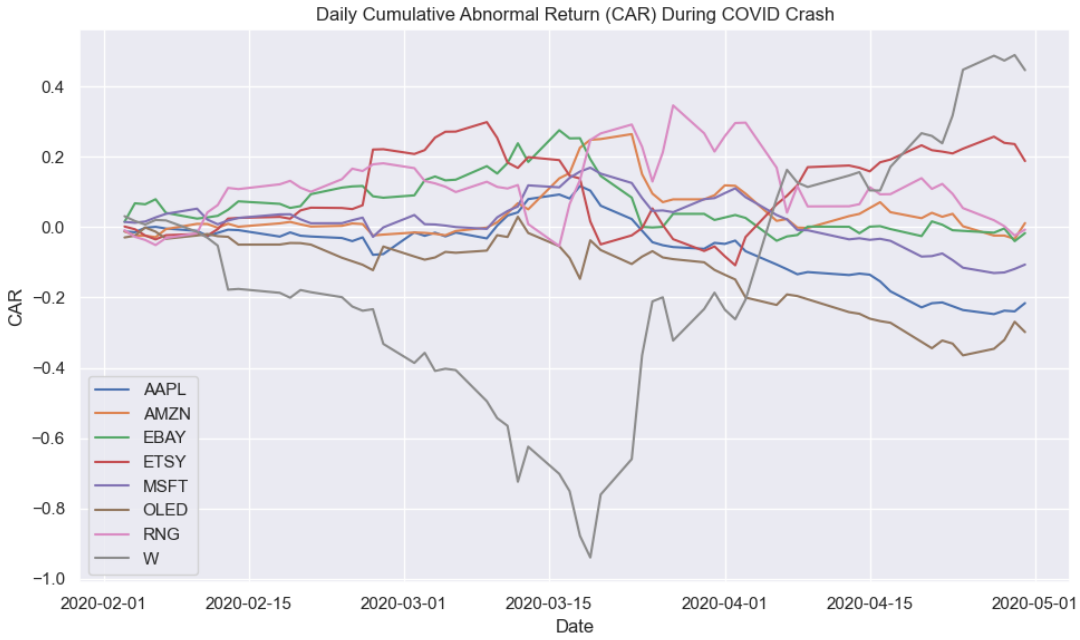
Etsy (ETSY) displays a volatility pattern similar to EBAY, with both alpha and beta highly significant, pointing to robust short-term and long-term volatility effects. The relatively higher alpha (0.1023) compared to EBAY indicates that recent return shocks play a larger role in determining current volatility. The omega parameter is also significant, indicating a solid baseline level of variance. Among the three companies, Etsy shows the strongest responsiveness to recent market shocks, potentially reflecting the higher-risk nature of its stock. This makes its volatility dynamics more reactive and pronounced, important for risk management and option pricing.

Conclusion: We observe that between 2015 and 2024, mid-cap stocks were more volatile than large-cap stocks due to several structural and market-based factors. Their lower market capitalization and smaller balance sheets made them more sensitive to macroeconomic shocks and shifts in investor sentiment. Mid-cap firms also faced higher idiosyncratic risk, where company-specific events such as earnings surprises or operational setbacks had outsized effects due to less business diversification. In addition, these stocks typically experienced lower liquidity, resulting in sharper price swings during large trades. Limited access to capital during periods of financial stress further heightened their vulnerability, as they lacked the robust credit access enjoyed by large-cap peers. Finally, elevated growth expectations among investors led to more pronounced market corrections when mid-cap firms failed to meet anticipated performance targets.

Meanwhile, e-commerce stocks tend to be more volatile than software and consumer electronics stocks due to their heightened sensitivity to economic and

operational factors. Their revenues are closely tied to discretionary consumer spending, which fluctuates with economic cycles, and they operate in intensely competitive markets with low margins, making them more vulnerable to pricing pressures. High fixed costs from logistics, warehousing, and fulfillment create significant operational leverage, amplifying profit swings when revenues change. Moreover, e-commerce firms are more exposed to supply chain disruptions—such as those seen during COVID-19 and geopolitical tensions—which can severely impact inventory and delivery efficiency. Unlike software companies with recurring subscription revenues and stable B2B contracts, e-commerce lacks predictable cash flows, and with low brand loyalty and minimal switching costs, consumer behavior remains unpredictable, further increasing volatility.

9. Stock Performance during COVID-19



During the COVID-19 pandemic, e-commerce companies like eBay, Amazon, and Etsy experienced strong positive abnormal returns, benefiting from the surge in online shopping driven by lockdowns and social distancing measures. These firms, categorized as digital, remote, and delivery-focused, saw increased investor optimism, reflecting the shift in consumer behavior towards online purchasing. Microsoft and Apple showed mild negative to flat returns, reflecting resilience; OLED and RingCentral remained stable with neutral market response. In contrast, Wayfair (W), a consumer discretionary stock heavily reliant on supply chains, initially faced sharp losses due to concerns over supply chain disruptions and potential cutbacks in consumer spending.

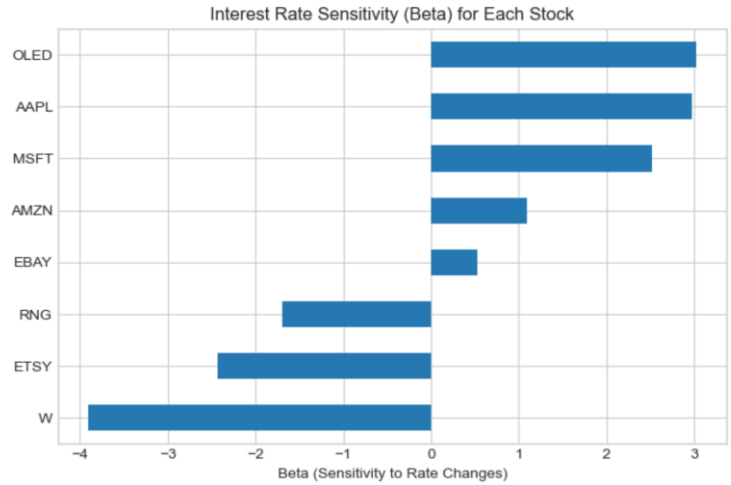
However, Wayfair eventually rebounded as the surge in home shopping during lockdowns boosted its sales, helping it recovers from early losses.

During the early stages of the COVID-19 pandemic, market-wide panic led investors to indiscriminately sell assets - including potential strong performers like Wayfair - to de-risk, raise cash, or respond to margin calls. As a mid-cap company in the discretionary spending space, Wayfair was initially seen as vulnerable, with fears that consumers would cut back on large home-related purchases amid income uncertainty. However, lockdowns sparked a surge in home shopping, as people sought to upgrade their living spaces, driving a dramatic increase in Wayfair's sales. The company delivered strong earnings surprises in Q1 and Q2 of 2020, with robust revenue and customer growth that defied initial concerns. This performance, combined with its positioning in a home-focused digital retail niche, helped Wayfair emerge as a "pandemic winner," attracting investor attention as a business poised to thrive in a stay-at-home economy.

10. Macroeconomics and Microeconomics

10.1 Macroeconomics:

	Alpha	Beta (Rate Sensitivity)	p-value	R-squared
AAPL	0.001022	2.979137	0.000009	0.008078
AMZN	0.001166	1.093231	0.153191	0.000840
EBAY	0.000583	0.534193	0.449986	0.000235
ETSY	0.001073	-2.433421	0.079354	0.001267
MSFT	0.001068	2.518083	0.000072	0.006470
OLED	0.000884	3.023423	0.007198	0.002970
RNG	0.000868	-1.693830	0.179880	0.000740
W	0.001277	-3.902716	0.025455	0.002054



This analysis focuses on the differential impact of interest rate changes across two major sectors: Software & Consumer Electronics and E-commerce. In the Software & Consumer Electronics sector, firms show strong positive sensitivity to rising interest rates. Data indicates statistically significant and high beta values for Apple (β = 2.98, p = 0.000009), Microsoft (β = 2.52, p = 0.000072), and Universal Display Corp (OLED) (β = 3.02, p = 0.0071), the highest in the dataset. This trend

aligns with economic fundamentals: rising interest rates typically accompany economic expansion—characterized by strong GDP growth, increased employment, and healthy corporate profits. During such periods, tech firms benefit from greater business investment in infrastructure, cloud computing, and hardware upgrades. Moreover, consumer electronics spending tends to remain strong, driven by confidence rather than dependence on cheap credit.

In contrast, the E-commerce sector, particularly mid-cap firms, displays strong negative sensitivity. Wayfair ($\beta = -3.9$, $p = 0.025$) and Etsy ($\beta = -2.43$, $p = 0.079$) show the lowest betas in the dataset, with Wayfair's being statistically significant. These firms often focus on non-essential goods and operate on thin margins. As interest rates rise, borrowing costs for consumers increase, reducing discretionary spending and negatively impacting sales. Additionally, e-commerce firms heavily reliant on credit-sensitive consumer behavior are more vulnerable in tightening monetary environments.

Economic Insight: The stark divergence between these sectors is rooted in their structural economic drivers. Tech companies gain from capital investment and broad economic growth, while e-commerce firms are more dependent on consumer credit and discretionary spending. This explains the opposing reactions to interest rate movements and highlights the importance of understanding sector-level economic linkages when evaluating market sensitivity.

Moreover, this section explores how companies of different sizes—large cap and mid cap—respond to interest rate changes, highlighting key structural and financial differences that shape their behavior.

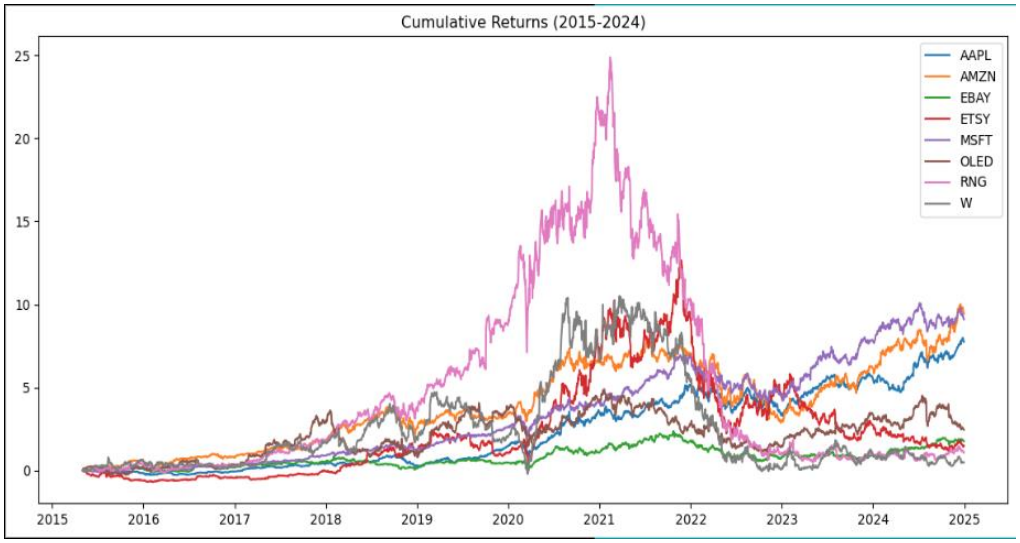
Large-cap firms generally exhibit positive but low-volatility sensitivity to interest rate changes. Data shows Apple ($\beta = 2.98$, $R^2 = 0.008$), Microsoft ($\beta = 2.52$, $R^2 = 0.006$), Amazon ($\beta = 1.09$, $R^2 = 0.0008$), and eBay ($\beta = 0.53$, $R^2 = 0.0002$) all have either positive or neutral betas, with minimal variability. These firms are typically well-diversified across products, regions, and customer segments, which helps buffer them against macroeconomic shocks. Additionally, their strong financial positions—marked by ample cash reserves and low leverage—allow them to absorb rising costs or pass them onto consumers. As a result, large-cap companies tend to benefit from broad macroeconomic trends more than they suffer from monetary tightening.

In contrast, mid-cap firms demonstrate high variability and polarized outcomes. OLED ($\beta = +3.02$), RingCentral ($\beta = -1.69$), Etsy ($\beta = -2.43$), and Wayfair ($\beta = -3.9$) represent a wide beta range from +3.0 to –4.0, the most extreme values in the dataset. These companies are often narrowly focused on specific products or markets and generally lack the financial flexibility and pricing power of their large-cap peers. Consequently, mid-cap performance tends to be more volatile and highly sensitive to

shifts in interest rates—either positively or negatively—depending on how rate changes affect their niche.

Economic Insight: The disparity between large and mid-cap firms is rooted in structural scale and financial resilience. Large caps manage rate shocks effectively through diversification and capital strength, while mid caps, due to their focused operations and limited financial buffers, amplify the impact of monetary changes. This difference underscores the importance of firm size in assessing risk exposure and market behavior during shifting economic conditions.

10.2 Microeconomics: Pandemic-driven demand surge followed by post-COVID revaluation



Between 2020 and early 2021, RingCentral (RNG) experienced a sharp surge in cumulative returns, driven by pandemic-induced demand for remote communication solutions. As COVID-19 lockdowns took hold, businesses worldwide rapidly adopted VoIP, video conferencing, and cloud-based collaboration tools—core services in RingCentral's portfolio. This sudden spike in demand led to significant growth in the company's revenue, user base, and market valuation, as investors anticipated sustained momentum in the remote work sector.

However, this surge was followed by a steep and prolonged decline. Despite its scalable, subscription-based model, RingCentral's business depended heavily on high customer acquisition costs and long-term enterprise contracts within an increasingly competitive SaaS landscape. As pandemic pressures eased and market saturation increased, growth expectations recalibrated, revealing structural challenges in

maintaining profitability and expansion. This case illustrates how microeconomic factors—such as cost structure and competitive positioning—can drive dramatic shifts in stock performance during periods of external shocks.

3. Reference

French, Kenneth R. Fama/French 5 Factors (2x3) [Daily]. Tuck School of Business at Dartmouth. Accessed May 12, 2025. https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.