To: Alex Lee
From: Brenda Hagerty, Investment Associate
Date: 10/27/2025
Subject: Investment Recommendation

Dear Alex,

Following our recent discussion about strengthening your portfolio with a stock that performs steadily across market cycles. I've completed an in-depth analysis of Apple, Intel and Kroger. This report translates the statistical findings into actionable insights, highlighting how each company differs in returns, volatility, and interaction with the broader market.

The table summarises monthly returns and key metrics for each stock from 2015 to 2020. This document starts with key figures and data working up to the beta estimates you requested, gradually building understanding.

Descriptive Statistics	SP 500 Returns	AAPL*	INTC*	KR*
Arithmetic Mean	0.9%	2.7%	0.9%	0.4%
Geometric Mean	0.8%	2.3%	0.7%	0.1%
Standard Deviation	4.3%	8.4%	7.1%	7.9%
Beta	1.0	1.3	0.8	0.3
Coefficients of Variation (CV)	4.6	3.1	7.7	18.0
R^2	1.0%	0.4%	0.2%	0.0%

Market Terms:

- Arithmetic Mean is the average monthly return on a stock.
- Geometric Mean is the compounding rate of return for a stock, after accounting for market volatility.
- Standard Deviation, the consistency of returns of an asset, month over month. A lower value indicates consistent performance, higher signal volatility and increased risk.
- The CV helps us understand the risk/unit of return. The lower the better for efficient risk-taking.
- The infamous ß from most of our conversation is a measure of how much the stock moves relative to the overall market. Marrying risk, return, and market behaviour, if the ß >1, say 1.2, it amplifies market swings 1.2x while ß<1 cushions it.
- R^2, a tricky but important metric, shows how much a stock's behaviour is explained by market movements. I.e. 1.0 or 100% R^2 means the stock's returns can be perfectly explained by the market. A low R^2 indicates weak correlation with the market and could be dominated by company-specific factors.

Now that we've got our technical terms covered, let's interpret findings and what these patterns could mean for you. Analysing the data, clear patterns emerge in how each stock responds to market movements and risk.

Apple consistently delivered the highest average monthly return (2.7%) and displayed the strongest sensitivity to market movements (β 1.27). Despite Apples volatility, it maintained the most efficient risk-to-return ratio (CV=3.1), indicating it rewarded investors well for the risk taken.

Intel showed a more balanced profile, with an average monthly return of 0.9% ß of 0.8, confirming it moves in the same direction as the market but to a slightly lesser degree of volatility. Its R^2 of about 0.2% implies that roughly one-fifth of its return variability is market-driven, the rest comes from company-specific factors, presumably product launches or supply chain, showing a healthy mix of growth potential and risk control.

Kroger, by contrast, was the most defensive with a ß of 0.3, it's safe to assume that it has very low sensitivity in tandem with the market. But, with a low mean return (0.4%) and CV of 18.0 shows that this is a classic low-risk, low-reward stock, unlike the tech stocks both which display higher ß and tighter links to market cycles. Its R^2 of 0.03 reinforces it's idiosyncratic.

I understand that currently you are looking for a stock that has low risk, valuing consistency, resilience, and steady returns over extreme swings. When viewed together, these stocks offer a diversification risk spectrum, but let's look at how each of them could impact your current portfolio ß of 1.

Apple offers the highest historical return (2.7%), driven by brand positioning, brand equity and innovation pipeline. Its ß amplifies market gains in bullish periods, making it a powerful growth stock, yet vulnerable to low periods. Though volatile, its low CV shows risk-adjacent growth while its R^2 is market-driven, showing its predictability. Hence, for you, Apple may introduce more volatility than desired.

Intel's ß (0.76) positions it as a medium-risk stock, aligning with your objectives. It moves closely with the market, holding up better when markets dip while recovering during highs. Its R^2 indicates a balance of market exposure and company-specific performance, showing adaptability and resilience. The main caveat, its dependency on product launches or competitive peers may slow returns during tech lulls.

Kroger is the most defensive, with a ß of 0.33, implying minimal market sensitivity. Its steady consumer demand cushioning portfolio losses during bear markets. However, a low mean return and high CV make it a low reward compensation for volatility. Being idiosyncratic, while good for diversification, constrains portfolio growth in bull markets.

Post analysis, Apple offers higher growth but greater volatility, while Kroger is stable but lacks meaningful return potential. Intel combines the best of both - steady growth yet resilience through market crashes. Overall, Intel aligns with your ask, fitting for a long-term, cycle-resilient investment strategy.

Simply, this recommendation is both strategic and practical, helping your portfolio compound consistently while avoiding volatile risk. Intel can presumably sustain over time while maintaining diversification, making it an appealing suggestion for you.

This analysis comes with its limitations - first, it's based on historical data, and current valuations should be reviewed to ensure the risk-return profile remains favourable. Past performance may not always accurately predict future outcomes, considering how market or company dynamics evolve. Second, the CAPM model captures only a two-dimensional relationship - market risk versus return and doesn't reflect other factors like industry trends or market sentiment shifts.

TECHNICAL REPORT

Source: WFS Case Study - Yahoo Finance

Sample - 72 months (2015 to 2020)

Variables:

R_j = Return on the asset of interest, respectively

R_m = Return on overall market (S&P 500)

R_f = Risk-free return.

CAPM

AAPL vs S&P500

Residuals:

Min	1Q	Median	3Q	Max
-0.2216895674	-0.0335654204	-0.0063796789	0.0414136990	0.1427839442

Coefficients:

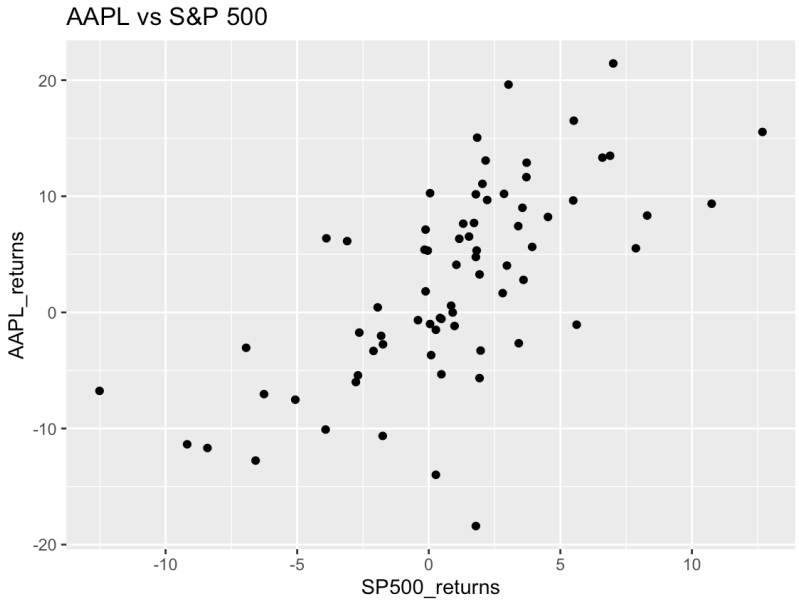
	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.0149876204	0.0076808831	1.95129	0.055025
SP_500	1.2682651949	0.1749535234	7.24915	4.3797e-10 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.0636926886 on 70 degrees of freedom

Multiple R-squared: 0.428805721, Adjusted R-squared: 0.420645803

F-statistic: 52.5502471 on 1 and 70 DF, p-value: 4.3796721e-10



$\hat{R} = 0.01499 + 1.2683\ R_m$ ($R^2 = 0.43$, $p < 0.001$).

The regression results show the β is 1.27, which is statistically significant at the 0.1% level*, showing greater sensitivity and higher systematic risk than the market.

INTC vs S&P500

Residuals:

Min	1Q	Median	3Q	Max
-0.2460751556	-0.04570837593	0.00860884898	0.04211293625	0.1755920474

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.00222825924	0.00771542967	0.28881	0.77358
SP_500	0.75584203962	0.17574041773	4.30090	5.4087e-05 ***

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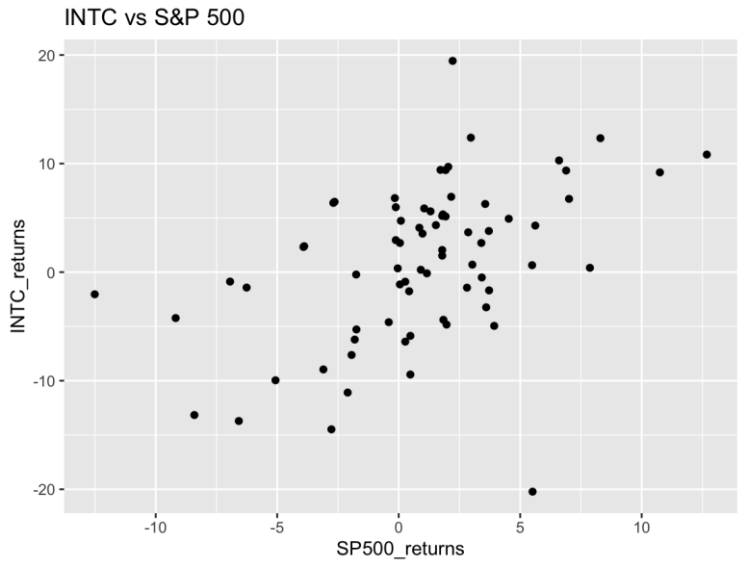
Residual standard error: 0.0639791614 on 70 degrees of freedom
Multiple R-squared: 0.20901939, Adjusted R-squared: 0.197719667
F-statistic: 18.4977446 on 1 and 70 DF, p-value: 5.40868469e-05



$\hat{R} = 0.0022 + 0.7558\ R_m$ ($R^2 = 0.21$, $p < 0.001$).

Intels' β of 0.76, statistically significant at the 0.1% level*, indicating this stock is less sensitive to market fluctuations. On average market changes by 1%, lead to change in Intels return by ~ 0.76%, reflecting a low level of systematic risk.

KR vs S&P500

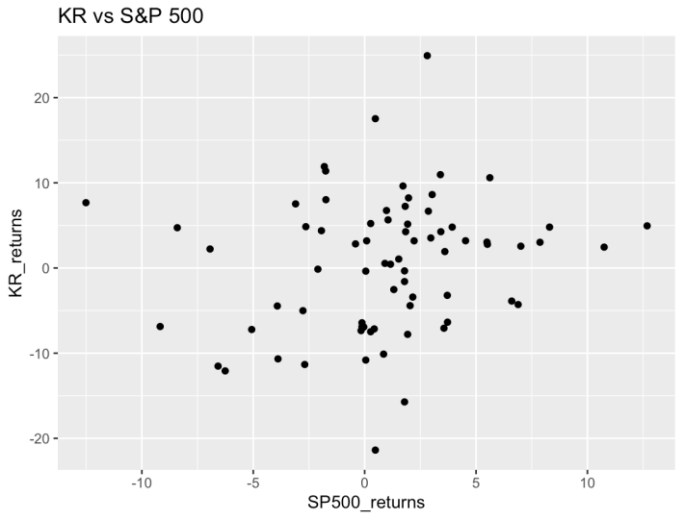
Residuals:

Min	1Q	Median	3Q	Max
-0.2167179760	-0.0630031863	0.0042010129	0.0504073963	0.2385575218

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.0013060614	0.0094576841	0.13810	0.89056
SP_500	0.3358155462	0.2154251190	1.55885	0.12354

Residual standard error: 0.0784265716 on 70 degrees of freedom
Multiple R-squared: 0.0335498311, Adjusted R-squared: 0.0197434001
F-statistic: 2.43001476 on 1 and 70 DF, p-value: 0.123541764



$\hat{R} = 0.0013 + 0.3358\ R_m$ ($R^2 = 0.03$, $p = 0.124$).

Krogers ß of 0.34 and p-value of 0.124 indicate it's not statistically different from 1 at the 5% significance level. Hence, there is insufficient evidence to conclude that Krogers returns differ significantly from the market. Meaning its relationship with market movements is weak and statistically insignificant.

Justification for Hypothesis β = 1 for your report:

H_o: $\beta_1 = 1$ (Stock risk similar to S&P 500)
H_a: $\beta_1 \neq 1$ (Stock risk not similar to S&P 500)

Testing whether an investment ß differs from 1 is preferable over 0 because it's rare for a publicly traded stock to be independent of the broader market. Even the most conservative stocks can have some correlation. Hence, testing whether ß differs from 0 often yields statistically significant results, providing little insight into the nature of that relationship. This test shows how sensitive the stock is relative to the market, helping make better decisions.

Comparison with old data:

Metric	Period	S&P 500	APPL	INTC	KR
Arithmetic Mean	1999-2004	0.1%	3.1%	1.1%	-1.1%
	2015-2020	0.9%	2.7%	0.9%	0.4%
Geometric Mean	1999-2004	-0.0%	1.6%	-0.2%	-1.6%
	2015-2020	0.8%	2.3%	0.7%	0.1%
Standard Deviation	1999-2004	4.6%	**16.6%**	**14.6%**	9.0%
	2015-2020	4.3%	**8.4%**	**7.1%**	7.9%
Beta	1999-2004	1.00	1.81*	**2.05*** **	**0.50***
	2015-2020	1.00	1.27	**0.76**	**0.34**
R-square	1999-2004		0.25	0.41	0.07
	2015-2020		0.43	0.21	0.03

Our comparison of data from 1999-2004 vs. 2015-2020 reveals a fundamental sector shift towards sector-wide maturation toward stability and balanced risk. The SD of returns was halved, for Apple and Intel from ~15-16% to ~7-8%

Most notable is the change in market sensitivity (ß). Intel transformed from an aggressive high ß = 2.05 stock to a defensive one (ß 0.76), signifying cushioning in its risk character. In contrast, Kroger maintained its low ß across both periods (~0.5 to 0.34), consistently behaving as a defensive stock, largely insulated from market volatility.

AI Declaration

I acknowledge the use of ChatGPT in giving me the main idea for my technical report. The complete project was written based on the whole team effort. On my side, I used ChatGPT outputs as one of the sources to follow up, then developed into my own conclusion after clarifying.

-Linea Ngyuyen

Appendix:

* 0.1% when $p < 0.001$; 1% when $p < 0.01$; 5% when $p < 0.05$

Apple - AAPL, Kroger – KR, Intel - INTC