**TO:** Alex Lee

**FROM:** WAITE FIRST SECURITY TEAM 7

**DATE:** October 24, 2022

**SUBJECT:** Recommendation regarding stock investment

Hi Alex,

Greetings for the day!

As per our last conversation, you are looking to invest money in one of the stocks from Apple, Intel, and Kroger. You also mentioned that you are looking for a stock that does well in an up or down market. Based on that, I have analyzed these stocks by considering your investment objectives. Please find the analysis table below as you asked me to prepare.

Sample size: 72 Months

Sample time frame: 2015:2020

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **SP500** | **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% |
| **Coefficient of Variations** | 4.6 | 3.1 | 7.7 | 17.9 |
| **Estimated investment Beta** | 1.0 | 1.3 | 0.8 | 0.3 |
| **R2** |  | 42.9% | 20.9% | 3.3% |

Alex, please find below the explanation of each analysis term:

First, the arithmetic mean gives the average monthly return of each stock, but it ignores the compounding. As for the Geometric mean, it indicates an actual mean compound rate of return. The geometric mean is always less than the arithmetic mean unless the returns are the same each month. Then the standard deviation and the coefficients of variation are both a means of calculating risk. The standard deviation measures an overall investment risk in the stock. The Coefficients of variation measure risk per unit of return in the stock. And subsequently, as you know, the investment betas are used to measure the volatility of the stock compared to the market (SP500 in this case). For example, it is assumed that when the AAPL’s beta is 1.3, it is 30% more volatile than the SP500. Finally, the R-Squares measure can be interpreted as the percentage of the stock movements that the movements of SP500 can explain.

After studying all the values from the above table, we found some key findings. Apple has the highest average compounding rate of return at 2.3% per month, while Kroger has only a 0.1% monthly return. Apple and Kroger have more risk of investment in the stock than Intel stock. The beta value of Apple is 1.3, which means that apple is 30% more volatile compared to the market, whereas Intel and Kroger are less volatile. The beta and R-square values of Kroger are near 0, so it can be inferred that Kroger is not likely to have a linear relationship with SP500, and its risk has little to do with the overall market’s risk. There must be other factors that contribute to the volatility of Kroger, such as internal company events and management...

Alex, based on your investment objectives and the above key findings, I recommend you invest in Intel stock because it has low investment risk and is less volatile. It has the lowest volatility because it has the lowest standard deviation out of all the stocks, and its beta value is 0.8, which makes it the closest to the SP 500 index, and, therefore, the least risky (volatile). It also has a good return on investment compared to Kroger stock. And as you wanted, Intel stock is doing well in both the up and down market. I would also like to add some personal research I did; Intel stocks have a chip shortage in semiconductors that will shift the pricing power to chip producers in the short term and boost their margins. Alex, after all the research and information, we know that Intel would be your best option.

However, the above analysis has few risks because we both know it is impossible to predict the market; SP 500 can go up and down. Also, I used the last five years of stock data for this analysis; hence we cannot predict the future price based on limited data. The major limitation of the CAPM model is that it is reflected in the model’s input and assumptions. It rests on these assumptions: stock markets are competitive and efficient and dominated by risk-averse, rational investors. Moreover, the model relies on the market's return, which can be described as the sum of the capital gains and dividends, while the market return can be negative. And these returns may not represent the future market. Although CAPM is still a great tool, it must be used carefully, just like any other analytic method.

**Technical report:**

The data of Apple, Intel, and Kroger is obtained from Yahoo Finance over 2015-2020, and the sample size is six years of monthly total return.

In this data, the variables like SP500, APPL, INTC, and KR indicate the stock of standard and poor 500 indexes, Apple, Intel, and Kroger, respectively.

Here are the estimated capital asset pricing models (CAPM) and their scatter diagrams:

For APPL:

Residuals:

Min 1Q Median 3Q Max

-0.221680 -0.033586 -0.006432 0.041447 0.142864

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.014990 0.007682 1.951 0.055 .

returnSP500 1.267978 0.174963 7.247 4.42e-10 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.0637 on 70 degrees of freedom

Multiple R-squared: 0.4287, Adjusted R-squared: 0.4205

F-statistic: 52.52 on 1 and 70 DF, p-value: 4.417e-10

Chart, scatter chart

Description automatically generated

For INTC:

Residuals:

Min 1Q Median 3Q Max

-0.246104 -0.045701 0.008608 0.042116 0.175596

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.002229 0.007716 0.289 0.773

returnSP500 0.755605 0.175730 4.300 5.43e-05 \*\*\*

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Signif. codes: 0 ‘\*\*\*’ 0.001 ‘\*\*’ 0.01 ‘\*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.06398 on 70 degrees of freedom

Multiple R-squared: 0.2089, Adjusted R-squared: 0.1976

F-statistic: 18.49 on 1 and 70 DF, p-value: 5.43e-05

Chart, scatter chart

Description automatically generated

For KR:

Estimate SLR Model for KR:

Residuals:

Min 1Q Median 3Q Max

-0.216701 -0.063025 0.004182 0.050406 0.238551

Coefficients:

Estimate Std. Error t value Pr(>|t|)

(Intercept) 0.001303 0.009458 0.138 0.891

returnSP500 0.335476 0.215401 1.557 0.124

Residual standard error: 0.07843 on 70 degrees of freedom

Multiple R-squared: 0.03349, Adjusted R-squared: 0.01968

F-statistic: 2.426 on 1 and 70 DF, p-value: 0.1239

Chart, scatter chart

Description automatically generated

Hypothesis test beta differs from 1:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Estimated** | **Std. error** | **t value (beta = 1)** | **p value (>|t|)** | **Reject H0 (beta = 1)** |
| **AAPL** | 1.27 | 0.17 | 1.53 | 0.13 | Not reject H0 (not statistically significantly different from 1 at 5%) |
| **INTC** | 0.76 | 0.18 | 1.4 | 0.16 | Not reject H0 (not statistically significantly different from 1 at 5%) |
| **KR** | 0.33 | 0.22 | 3.8 | 0.0003 | Reject at 0.001 (statistically significantly different from 1 at 0.1%) |

By looking at the above table, a beta of 1 means that a stock mirrors the market's volatility and will move in the same direction as the SP500 with the same amount. Testing whether the investment beta gives us an idea of how well the stock performs compared to the market, while testing the beta differs from 0 shows the information on the relationship of the individual stock with SP500.

Compared to the older data:

Analysis of the old stock return data from the year **1999-2004:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | S&P 500 | Apple | Intel | Safeway |
| Arithmetic Mean | 0.1% | 3.1% | 1.1% | -1.1% |
| Geometric Mean | -0.0% | 1.6% | -0.2% | -1.6% |
| Standard Deviation | 4.6% | 16.6% | 14.6% | 9.0% |
| Beta | 1.00 | 1.81\* | 2.05\*\*\* | 0.50\* |
| R2 |  | 0.25 | 0.41 | 0.07 |

\*\*\*p < 0.001, \*\* p < 0.01, \* p < 0.05

Analysis of the new stock return data from the year **2015-2020**:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | SP500 | 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% |
| Coefficient of Variations | 4.6 | 3.1 | 7.7 | 17.9 |
| Estimated investment Beta | 1.0 | 1.3 | 0.8 | 0.3 |
| R2 |  | 42.9% | 20.9% | 3.3% |

By comparing the old stock data with the new stock data, we can conclude that the compound rate of return from recent data did a little better for the overall market and other stocks. Looking at the past data, the market's overall risk is nearly the same (with a standard deviation of 4.6% and 4.3% for the SP500 in 1994-2004 and 2015-2020, respectively). The volatility of the return of AAPL and INCT tends to reduce. For example, the standard deviation for AAPL was 16.6% in the older period, while it was 8.4% recently. INTC experienced the same pattern. However, looking at the difference between AAPL and INTC, judging by the beta value, we can see that INTC reduced the risk from 2.05 to only 0.8 during the period. This value for AAPL was reduced but with a much slower speed (from 1.81 to 1.3). With the same criteria, I would recommend AAPL over INTC, judging by their return compared to the risk. AAPL performed better with a much higher rate of return, while INTC had a negative compound rate of return. Although the standard deviation of INTC is slightly lower than AAPL in the same period, it did have a more extensive beta.

(Words count: 1052 excluding R outputs, tables, and references)

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