A Stock Has A Beta Of 2.57 And An Expected Return Of 28.0%. The T-bill Rate Is 7.6%. Calculate The Portfolio

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Understanding how to calculate the expected return of a portfolio is a fundamental aspect of investment analysis, especially for investors aiming to optimize their asset allocation. When given specific data points such as a stock's beta, its expected return, and the risk-free rate (represented here by T-bills), investors can utilize various financial models to determine the appropriate portfolio composition. This article provides a comprehensive guide to calculating the expected return of a portfolio, emphasizing the importance of beta and risk premiums in such calculations.

Understanding Key Financial Concepts

Before diving into calculations, it's crucial to understand the core concepts involved in portfolio expected return estimation.

Beta: A Measure of Systematic Risk

Beta (β) quantifies a stock's sensitivity to market movements. A beta of 1 indicates that the stock's price moves in line with the overall market. A beta greater than 1 suggests higher volatility than the market, whereas less than 1 indicates lower volatility.

- Beta of 2.57 signifies that the stock is significantly more volatile than the average market, implying that it tends to amplify market movements.

Expected Return and the Capital Asset Pricing Model (CAPM)

The CAPM provides a theoretical framework to determine the expected return of an asset based on its systematic risk:

$$
E(R_i) = R_f + \beta_i \times (E(R_m) - R_f)
$$

Where:
- $E(R_i)$ = Expected return of the asset
- R_f = Risk-free rate (T-bill rate)
- β_i = Beta of the asset
- $E(R_m)$ = Expected return of the market

This model emphasizes the relationship between risk and return, implying that higher risk (beta) should be compensated with higher expected returns.

Calculating the Expected Return of the Stock

Given data:
- Beta (β) = 2.57
- Expected return of the stock ($E(R_i)$) = 28.0%
- T-bill rate (R_f) = 7.6%

The goal is to find the expected market return ($E(R_m)$) based on the provided data or to understand how the stock's return relates to market expectations.

Using the CAPM formula rearranged:

$$
E(R_i) = R_f + \beta_i \times (E(R_m) - R_f)
$$

Plugging in the known values:

$$
28.0\% = 7.6\% + 2.57 \times (E(R_m) - 7.6\%)
$$

To find $E(R_m)$:

$$
28.0\% - 7.6\% = 2.57 \times (E(R_m) - 7.6\%)
$$

$$
20.4\% = 2.57 \times (E(R_m) - 7.6\%)
$$

$$
E(R_m) - 7.6\% = \frac{20.4\%}{2.57}
$$

$$
E(R_m) - 7.6\% \approx 7.93\%
$$

$$
E(R_m) \approx 7.6\% + 7.93\% = 15.53\%
$$

Interpretation:

- The expected market return based on this stock's parameters is approximately 15.53%.
- The high beta indicates high systematic risk, which is compensated with a high expected return of 28%.

Constructing the Portfolio: Determining Asset Weights

To calculate the overall expected return of a portfolio, we need to determine the weights of individual assets within it. Typically, investors aim to balance risk and return by adjusting these weights.

Suppose the investor is considering a portfolio composed of:
- The high-beta stock (with beta = 2.57)
- A risk-free asset (T-bills at 7.6%)

The key question: What proportion of the portfolio should be invested in the stock versus the risk-free asset to achieve a desired return or risk profile?

Using the Capital Market Line (CML)

The CML demonstrates the risk-return trade-off of efficient portfolios combining the risk-free asset and the market portfolio. The formula for the expected return of a portfolio combining these two assets is:

$$
E(R_p) = R_f + \frac{\sigma_p}{\sigma_m} \times (E(R_m) - R_f)
$$

Where:
- $E(R_p)$ = Expected return of the portfolio
- R_f = Risk-free rate
- σ_p = Portfolio standard deviation
- σ_m = Market standard deviation

Note: Since the specific standard deviations are not provided here, a more straightforward approach involves the concept of leveraging or deleveraging the portfolio based on beta.

Calculating Portfolio Beta and Expected Return

The beta of the portfolio (β_p) is the weighted sum of individual asset betas:

$$
\beta_p = w_s \times \beta_s + w_f \times \beta_f
$$

Where:
- w_s = weight of the stock in the portfolio
- $\beta_s = 2.57$
- w_f = weight of the risk-free asset (T-bills)
- $\beta_f = 0$ (since risk-free assets have zero beta)

The sum of weights:

$$
w_s + w_f = 1
$$

The expected return of the portfolio:

$$
E(R_p) = w_s \times E(R_s) + w_f \times R_f
$$

Given that:

- $E(R_s) = 28.0\%$
- $R_f = 7.6\%$

Suppose the investor aims to achieve a specific portfolio expected return—for example, matching the stock's expected return (28%) or a lower/higher target.

Example: Constructing a Portfolio with a Desired Expected Return

Scenario 1: Portfolio expected return is 20%

Using:

$$
E(R_p) = w_s \times 28.0\% + (1 - w_s) \times 7.6\%
$$

Set:

$$
20\% = w_s \times 28\% + (1 - w_s) \times 7.6\%
$$

Solve for w_s:

$$
20\% = 28\% \times w_s + 7.6\% - 7.6\% \times w_s
$$

$$
20\% - 7.6\% = w_s \times (28\% - 7.6\%)
$$

$$
12.4\% = w_s \times 20.4\%
$$

$$
w_s = \frac{12.4\%}{20.4\%} \approx 0.608
$$

Interpretation:
- Invest approximately 60.8% of the portfolio in the stock.
- Remaining 39.2% in T-bills.

Portfolio beta:

$$
\beta_p = 0.608 \times 2.57 + 0.392 \times 0 = 1.565
$$

This portfolio has a beta of approximately 1.565, indicating it is more volatile than the market.

Example: Targeting the Market Portfolio

If an investor wishes to construct a portfolio with a beta equal to the market (i.e., beta = 1), they can solve:

$$
\beta_p = w_s \times 2.57 + (1 - w_s) \times 0 = 1
$$

$$
w_s \times 2.57 = 1
$$

$$
w_s = \frac{1}{2.57} \approx 0.389
$$

Portfolio composition:
- About 38.9% in the stock.
- About 61.1% in T-bills.

Expected return:

$$
E(R_p) = 0.389 \times 28\% + 0.611 \times 7.6\% \approx 10.89\% + 4.65\% = 15.54\%
$$

This aligns with the previously calculated expected market return, confirming the consistency of the model.

Implications for Investors

Understanding the relationship between beta, expected return, and asset allocation empowers investors to make informed decisions. Here are some key takeaways:

- High-beta stocks like the one discussed (beta = 2.57) offer the potential for higher returns but come with increased risk.
- Risk-free assets such as T-bills provide stability but lower returns.
- Portfolio construction involves balancing these assets to match the investor’s risk appetite and return objectives.

Risk-Return Tradeoff

Investors seeking higher returns must accept higher systematic risk, often achieved through leveraged positions in high-beta stocks. Conversely,

Frequently Asked Questions

What does a beta of 2.57 indicate about the stock's risk relative to the market?

A beta of 2.57 indicates that the stock is significantly more volatile than the overall market; it tends to move 2.57 times the market's movements, implying higher systematic risk.

How do you interpret the expected return of 28.0% for the stock?

The expected return of 28.0% suggests that investors anticipate a high return for holding the stock, which compensates for its increased risk as indicated by its beta.

What is the significance of the T-bill rate being 7.6% in this context?

The T-bill rate of 7.6% serves as the risk-free rate in the Capital Asset Pricing Model (CAPM), used as a benchmark to evaluate the stock's additional risk premium.

How can we use the CAPM to determine the stock's expected return?

The CAPM formula is Expected Return = Risk-Free Rate + Beta × (Market Return - Risk-Free Rate). Given the expected return, beta, and risk-free rate, we can estimate the market return or analyze the stock's risk premium.

Given the stock's expected return of 28.0% and beta of 2.57, what is the market risk premium?

Using CAPM: 28.0% = 7.6% + 2.57 × (Market Return - 7.6%). Solving for Market Return: (Market Return - 7.6%) = (28.0% - 7.6%) / 2.57 ≈ 8.4%. Therefore, the market risk premium is approximately 8.4%.

If an investor wants to build a portfolio including this stock, how does the stock's beta impact their portfolio risk?

Since the stock has a high beta of 2.57, including it in a portfolio increases overall portfolio risk and volatility, especially if the portfolio is heavily weighted in such high-beta stocks.

How would you calculate the weight of this stock in a portfolio to achieve a desired expected return?

Using the weighted average return formula: Portfolio Return = w × Stock Return + (1 - w) × Other Assets Return. Rearranged, the weight w = (Desired Portfolio Return - Other Assets Return) / (Stock Return - Other Assets Return). You can adjust w based on the target return.

What other factors should investors consider when evaluating a stock with a high beta like 2.57?

Investors should consider the company's fundamentals, industry stability, economic conditions, and whether the high beta aligns with their risk tolerance, as high-beta stocks can lead to larger gains but also bigger losses.

Can the expected return of 28.0% be justified solely based on the stock's beta and risk-free rate?

Not entirely; while beta and the risk-free rate help estimate expected return via CAPM, other factors like company performance, market conditions, and investor sentiment also influence actual returns and should be considered.

Additional Resources

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Introduction

In the dynamic landscape of modern finance, understanding the relationship between risk and return is paramount for investors seeking to optimize their portfolios. The given scenario presents a stock with a notably high beta of 2.57, an expected return of 28.0%, and a risk-free rate represented by T-bills at 7.6%. This information offers a fertile ground for analyzing the stock's performance through the lens of the Capital Asset Pricing Model (CAPM), as well as exploring how such a stock might fit within a broader portfolio.

This investigation delves into the intricacies of the stock's risk-return profile, the calculation of its expected market return, and the implications for portfolio construction. We will systematically explore these aspects, providing clarity for investors, analysts, and scholars alike.

Understanding the Core Concepts: Beta, Expected Return, and Risk-Free Rate

Before embarking on calculations, it is essential to clarify the fundamental concepts involved:

Beta: A Measure of Systematic Risk

- Definition: Beta quantifies a stock's sensitivity to movements in the overall market. A beta of 1 indicates that the stock moves in tandem with the market, while a beta greater than 1 signifies higher volatility relative to the market.

- Implication of a Beta of 2.57: The stock is significantly more volatile than the market. For example, if the market increases by 1%, this stock is expected to increase by approximately 2.57%, and vice versa.

Expected Return and the Risk-Return Tradeoff

- Definition: The expected return estimates the average return an investor anticipates, factoring in risk levels.

- Given Expected Return: 28.0%, which is considerably high, aligning with the high beta.

Risk-Free Rate (T-bill Rate)

- Definition: The theoretical return on an investment with zero risk, often represented by short-term government securities.

- Given Rate: 7.6%, which is relatively high, possibly reflecting a high-inflation environment or an emerging market context.

Applying the Capital Asset Pricing Model (CAPM)

The CAPM provides a foundational framework to relate risk and return:

$$
E(R_i) = R_f + \beta_i (E(R_m) - R_f)
$$

Where:

- $E(R_i)$: Expected return of the stock

- R_f: Risk-free rate

- β_i: Beta of the stock

- $E(R_m)$: Expected return of the market

Given:

- $E(R_i) = 28.0\%$

- $R_f = 7.6\%$

- $\beta_i = 2.57$

Our goal is to estimate $E(R_m)$, the expected return of the market, based on this information.

Calculating the Expected Market Return

Rearranging the CAPM formula:

$$
E(R_m) = R_f + \frac{E(R_i) - R_f}{\beta_i}
$$

Plugging in the known values:

$$
E(R_m) = 7.6\% + \frac{28.0\% - 7.6\%}{2.57}
$$

Calculations:

1. Compute the excess return of the stock over the risk-free rate:

$$
28.0\% - 7.6\% = 20.4\%
$$

2. Divide by the beta:

$$
\frac{20.4\%}{2.57} \approx 7.94\%
$$

3. Add back the risk-free rate:

$$
7.6\% + 7.94\% \approx 15.54\%
$$

Estimated Expected Market Return: Approximately 15.54%

Implications of the Calculated Market Return

This estimated market return of roughly 15.54% suggests an environment of relatively high expected growth, especially considering the high risk-free rate. It aligns with a market that offers substantial compensation for risk, which is consistent with the high beta of the stock.

Key Takeaways:

- The stock's high expected return (28%) exceeds the market's estimated return (15.54%), reflecting its elevated systematic risk.

- Investors requiring higher returns for bearing such risk might find this stock attractive, assuming the expectation materializes.

- The high risk-free rate indicates a challenging macroeconomic environment, possibly with inflationary pressures or heightened geopolitical risks.

Constructing a Portfolio: Risk, Return, and Diversification

Given the stock's high beta and expected return, investors often consider how to integrate such assets into a diversified portfolio.

Portfolio Expected Return and Beta

Suppose an investor wants to construct a portfolio with a target expected return, $E(R_p)$, and overall beta, β_p. The portfolio's expected return and beta are calculated as weighted averages:

$$
E(R_p) = w \times E(R_{stock}) + (1 - w) \times R_{f}
$$

$$
\beta_p = w \times \beta_{stock} + (1 - w) \times 0
$$

Where:

- w: weight of the stock in the portfolio

- R_{f}: risk-free rate

- β_{stock}: beta of the stock

Example:

If an investor desires a portfolio expected return of 20%, the weight w in the stock can be calculated as:

$$
20\% = w \times 28\% + (1 - w) \times 7.6\%
$$

Solve for w:

$$
20\% = 28\% w + 7.6\% - 7.6\% w
$$

$$
20\% - 7.6\% = (28\% - 7.6\%) w
$$

$$
12.4\% = 20.4\% w
$$

\[

w = \frac{12.4\%}{20.4\%} \approx 0.6078
\]

Interpretation:

- Approximately 60.78% of the portfolio should be invested in the stock to achieve a 20% expected return.

- The remaining 39.22% would be in risk-free assets.

Portfolio Beta:

\[
\beta_p = 0.6078 \times 2.57 \approx 1.56
\]

This beta indicates the portfolio would be significantly more volatile than the market but less risky than holding the stock alone.

Risk Considerations and Limitations

While the calculations provide a quantitative foundation, real-world investing requires considering several qualitative factors:

- Market Conditions: The high beta suggests the stock is highly sensitive to market swings; during downturns, losses could be amplified.

- Economic Environment: The elevated risk-free rate hints at macroeconomic instability, which could influence future returns.

- Model Assumptions: CAPM assumes markets are efficient, investors are rational, and beta remains stable over time. Deviations can impact the accuracy of these estimations.

- Company-Specific Risks: High beta may reflect company-specific volatility unrelated to overall market movements, such as management issues or sector-specific challenges.

Conclusion: Strategic Implications for Investors

The analysis reveals that the stock's high beta of 2.57 and an expected return of 28.0% are consistent within the context of the prevailing risk-free rate of 7.6%. The derived expected market return of approximately 15.54% suggests that this stock offers a compelling risk premium for investors willing to accept substantial volatility.

Constructing a diversified portfolio incorporating this asset can help balance risk and return, enabling investors to target specific performance metrics aligned with their risk appetite. For instance, allocating around 60%

of a portfolio to this stock can achieve a targeted expected return of 20% with a beta of approximately 1.56.

However, investors must remain cognizant of the inherent risks, macroeconomic factors, and the assumptions underlying CAPM. A thorough due diligence process, combined with risk management strategies such as diversification and hedging, is essential for leveraging the potential returns of high-beta stocks.

In essence, the scenario underscores the importance of quantitative analysis in investment decision-making, providing a roadmap for integrating high-risk assets into well-structured portfolios aimed at achieving targeted financial goals.

Disclaimer: The calculations and interpretations provided are for informational purposes and do not constitute financial advice. Investors should conduct their own analysis or consult with financial professionals before making investment decisions.

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