A Stock Has An Expected Return Of 5%. What Is Its Beta? Assume The Risk-free Rate Is 6% And The Expected

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Understanding the relationship between a stock's expected return and its risk profile is fundamental in finance. When an investor encounters a scenario where a stock's expected return appears to be lower than the risk-free rate, it raises important questions about the stock's risk characteristics, particularly its beta. This article explores the question: A stock has an expected return of 5%. What is its beta? Assume the risk-free rate is 6% and the expected market return is known. We will dissect the concepts involved, introduce relevant formulas, and provide step-by-step calculations to clarify how beta relates to expected return, the risk-free rate, and the market premium.

Understanding Key Concepts: Expected Return, Risk-Free Rate, Beta, and Market Premium

Before delving into calculations, it is essential to understand the foundational concepts involved.

Expected Return

- The anticipated return an investor expects to earn from an investment over a specific period.
- It encompasses both income (dividends, interest) and capital gains.
- In the context of the Capital Asset Pricing Model (CAPM), expected return reflects the compensation for risk undertaken.

Risk-Free Rate (Rf)

- The return on an investment considered free of risk, typically government treasury bonds.
- It serves as the baseline for measuring risk premiums.
- In our scenario, Rf = 6%.

Beta (β)

- A measure of a stock's sensitivity to movements in the overall market.
- Beta indicates how much the stock's returns tend to change in response to market returns.
- A beta of 1 implies the stock moves in sync with the market.
- A beta less than 1 indicates less volatility relative to the market.
- A beta greater than 1 indicates higher volatility.

Market Premium (Expected Market Return – Risk-Free Rate)

- The additional return investors expect for taking on market risk.
- Calculated as (E(Rm) – Rf), where E(Rm) is the expected return of the market.

Applying the Capital Asset Pricing Model (CAPM)

The CAPM provides a framework to relate expected return to risk:

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

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 Data:
- $E(R_i) = 5\%$
- $R_f = 6\%$
- $E(R_m)$ (assumed or given in the context)

Note: The question implies the expected return of the stock is 5%, the risk-free rate is 6%, but the expected market return is not explicitly given. To proceed, we need to either assume a typical market return or the problem might be incomplete. Often, the expected market return is assumed to be around 8-10% in many contexts. For this article, we will assume an expected market return of 8%, which is a common approximation.

Calculating the Beta: Step-by-Step

Given the assumptions:
- $E(R_i) = 5\%$
- $R_f = 6\%$
- $E(R_m) = 8\%$

Applying the CAPM formula:

$$ 5\% = 6\% + \beta \times (8\% - 6\%) $$

Simplify:

$$ 5\% = 6\% + \beta \times 2\% $$

Rearranged to solve for beta:

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

$$ \beta = \frac{5\% - 6\%}{8\% - 6\%} $$

$$ \beta = \frac{-1\%}{2\%} $$

$$ \beta = -0.5 $$

Interpretation:

- A beta of -0.5 indicates the stock moves inversely to the market; when the market goes up, this stock tends to go down, and vice versa.
- Negative beta stocks are rare but can exist, especially in hedging strategies or specific sectors.

Implications of a Negative Beta and Expected Return Lower than Risk-Free Rate

The calculation reveals an intriguing scenario:

- The expected return (5%) is less than the risk-free rate (6%), which appears counterintuitive.
- Traditional CAPM suggests investors should not accept a return lower than the risk-free rate for taking on additional risk; otherwise, they could simply invest in risk-free assets.

Possible explanations:

- Market Anomaly or Data Error: The input data might be inconsistent or hypothetical.
- Negative Beta with a High Risk-Free Rate: Since the formula yields a negative beta, it implies inverse movement relative to the market.
- Arbitrage Opportunities: In real markets, such a scenario could suggest mispricing or arbitrage opportunities, but these are theoretical in the context of CAPM.

Key Point: If the expected return is less than the risk-free rate, the stock might be viewed as a hedge or a non-risky asset with a negative correlation to the market.

Adjusting Assumptions: What if the Market Return is Different?

Suppose the expected market return is not 8% but instead is 10%. Then:

$$ \beta = \frac{5\% - 6\%}{10\% - 6\%} = \frac{-1\%}{4\%} = -0.25 $$

This indicates the beta is less negative but still negative, reinforcing the inverse relationship with the market.

If the market return is 12%:

$$ \beta = \frac{5\% - 6\%}{12\% - 6\%} = \frac{-1\%}{6\%} \approx -0.167 $$

Again, a negative beta with a lower magnitude.

Additional Factors to Consider

While the calculation provides a theoretical beta, real-world investing involves additional considerations:

- **Market Conditions:** Economic downturns or specific sector performance can influence beta estimates.
- **Company Specifics:** Company fundamentals, sector, and industry influence risk profiles.
- **Model Limitations:** CAPM assumes markets are efficient, and beta remains stable over time, which may not hold true.
- **Alternative Risk Measures:** Other metrics like alpha, Sharpe ratio, and Sortino ratio can provide deeper insights.

Conclusion

In summary, given an expected return of 5%, a risk-free rate of 6%, and an assumed market return of 8%, the calculated beta is -0.5. This negative beta indicates an inverse relationship with the market, suggesting the stock could serve as a hedge or be negatively correlated with market movements. However, the fact that the expected return is less than the risk-free rate raises questions about the viability of such an investment and highlights the importance of context and assumptions in financial analysis.

Key takeaways:

- Beta can be calculated using the CAPM formula, provided the expected market return is known.
- A negative beta signifies inverse market movement, which is uncommon but possible.

- An expected return lower than the risk-free rate suggests the asset may have unique risk or hedging qualities.
- Always consider broader market conditions and model limitations when interpreting these metrics.

By understanding these concepts and calculations, investors and financial analysts can better assess a stock’s risk profile and make informed investment decisions.

Frequently Asked Questions

How can we determine the beta of a stock with an expected return of 5% given a risk-free rate of 6%?

Using the Capital Asset Pricing Model (CAPM), beta can be calculated if the market risk premium and the expected return are known. Since the expected return is lower than the risk-free rate in this case, the beta would be negative, indicating an inverse relationship with the market.

What does a negative beta imply for a stock with an expected return of 5% when the risk-free rate is 6%?

A negative beta suggests the stock tends to move inversely to the market. Given the expected return is below the risk-free rate, it indicates the stock may serve as a hedge or have defensive characteristics, but in practice, such scenarios are rare and may imply market anomalies or modeling assumptions.

Is it possible for a stock with an expected return of 5% to have a positive beta if the risk-free rate is 6%?

Typically, yes. However, in this scenario, since the expected return is lower than the risk-free rate, the beta would likely be negative or undefined, depending on the market return assumptions. For a positive beta, the expected return generally needs to be higher than the risk-free rate.

What assumptions are necessary to calculate the beta of a stock with the given data?

You need assumptions about the expected market return, the market risk premium, and the validity of the CAPM model. Additionally, the data implies the stock's expected return is less than the risk-free rate, which is unusual and may challenge standard CAPM assumptions.

Given the information, what is the approximate beta of the stock?

Since the stock's expected return (5%) is less than the risk-free rate (6%), the beta would be negative. Without specific market return data, the exact beta cannot be calculated, but it would be less than zero, indicating an inverse relationship with market movements.

Additional Resources

Beta: Deciphering Its Role in Stock Expected Returns and Risk Assessment

In the complex world of investment analysis, understanding the relationship between a stock’s expected return and its risk profile is paramount. One of the key metrics investors and analysts rely on is beta, a measure that captures a stock's sensitivity to market movements. When faced with a scenario where a stock has an expected return of 5%, and the risk-free rate is 6%, the question naturally arises: What is its beta? Let's delve into this intriguing puzzle, unpacking the foundational concepts, the relevant models, and the calculations that can guide us toward an answer.

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

Before tackling the specifics, it’s essential to clarify the core components involved:

The Expected Return

- Definition: The anticipated profit or loss from an investment over a certain period, expressed as a percentage.
- In Our Scenario: The stock's expected return is 5%. This figure reflects investors' consensus on the future profitability of the stock, considering both dividends and capital appreciation.

The Risk-Free Rate

- Definition: The return on an investment with zero risk, typically associated with government treasury securities (e.g., U.S. Treasury bills).
- In Our Scenario: The risk-free rate is 6%. Interestingly, this suggests that a completely riskless investment offers a 6% return, which is higher than the stock’s expected return, hinting at some unusual market conditions or assumptions.

Beta: The Measure of Systematic Risk

- Definition: Beta quantifies how much a stock’s returns move in relation to the overall market. A beta of 1 indicates perfect correlation with the market; less than 1 indicates less sensitivity; greater than 1 indicates higher sensitivity.
- Significance: Beta is central to the Capital Asset Pricing Model (CAPM), which links expected return to risk through the formula:

$$
\text{Expected Return} = R_f + \beta (R_m - R_f)
$$

Where:
- R_f = risk-free rate
- R_m = expected return of the market portfolio
- β = beta coefficient for the stock

Applying the Capital Asset Pricing Model (CAPM)

The CAPM provides a structured approach to understanding the relationship between risk and return:

CAPM Formula Recap

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

Where:
- $E(R_i)$ = expected return of the asset (our stock)
- R_f = risk-free rate
- R_m = expected return of the market
- β_i = beta of the stock

Given the inputs, our goal is to solve for β_i.

Plugging in Known Values

- $E(R_i) = 5\%$ or 0.05
- $R_f = 6\%$ or 0.06
- R_m is unknown, which complicates direct calculation. However, the expected return of the stock being lower than the risk-free rate indicates a potential contradiction or an unusual market scenario.

Interpreting the Scenario: An Expected Return Less Than the Risk-Free Rate

In typical market conditions, the expected return on a risky asset exceeds the risk-free rate to compensate investors for taking on additional risk. Here, the expected return (5%) is less than the risk-free rate (6%), which raises several questions:

- Is this an arbitrage opportunity?

- Could the data be hypothetical or illustrative?
- Does this imply negative risk premiums?

While such a scenario is rare and perhaps unrealistic in efficient markets, it provides an interesting case to explore the relationships and implications involved.

Deriving Beta From the Given Data

Given the standard CAPM formula:

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

Rearranged to solve for beta:

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

To compute beta, we need the market return R_m. Since it isn't specified, common approaches include:

- Assuming a market return based on historical averages
- Using the concept of the risk premium
- Considering the possibility of negative or zero market risk premiums

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Scenario 1: Assuming a Typical Market Return

Historically, the average market return R_m in many developed markets hovers around 8-10%. Let's assume $R_m = 8\%$ (or 0.08).

Calculating beta:

$$
\beta = \frac{ 0.05 - 0.06 }{ 0.08 - 0.06 } = \frac{ -0.01 }{ 0.02 } = -0.5
$$

Interpretation:
A beta of -0.5 indicates the stock moves inversely to the market, with moderate negative sensitivity. When the market goes up, the stock tends to go down, and vice versa.

Scenario 2: Assuming a Higher Market Return

Suppose the expected market return is 10%:

$$
\beta = \frac{ 0.05 - 0.06 }{ 0.10 - 0.06 } = \frac{ -0.01 }{ 0.04 } = -0.25
$$

Again, a negative beta, but less pronounced.

Implications of Negative Beta

- Negative Beta stocks are rare but exist (e.g., certain hedging assets or counter-cyclical investments).
- They tend to perform inversely to the overall market, providing diversification benefits.
- Such stocks are often sought for risk management and portfolio stability.

Understanding the Anomaly: Expected Return Less Than Risk-Free Rate

The core of this analysis hinges on the unusual scenario where the expected return (5%) is less than the risk-free rate (6%). Let's explore what this implies:

1. Negative Risk Premium

- The market might be assigning a negative risk premium, meaning investors expect to earn less than the risk-free rate for holding risky assets.
- This could occur in highly distressed markets or during deflationary periods.

2. Market Inefficiency or Data Anomaly

- Real-world markets rarely exhibit such a scenario; it could be a hypothetical or simplified case for the purpose of analysis.

3. Impact on Beta Calculation

- With such data, the calculated beta becomes negative, indicating an inverse relationship with the market.

Alternative Approaches and Considerations

Given the inconsistencies, investors and analysts might consider:

1. Clarifying Market Expectations

- Is the market return \(R_m \) accurately estimated?
- Are there additional risk factors or market anomalies influencing the expected return?

2. Adjusting Assumptions

- For more realistic scenarios, assume the stock's expected return is at least equal to or higher than the risk-free rate, aligning with typical risk premiums.

3. Recognizing Limitations

- The CAPM assumes perfect markets, rational investors, and homogeneous expectations, which may not hold in all circumstances.

4. Exploring Other Risk Models

- Multi-factor models (e.g., Fama-French) might better capture the complexities affecting expected return and beta.

Summary and Final Insights

The question of "What is the beta of a stock with an expected return of 5%, given a risk-free rate of 6%?" reveals several important lessons:

- Beta is inherently linked to the expected excess return of the stock relative to the market.
- A negative beta (as derived in the assumptions) indicates an inverse relationship with the market, which could serve as a hedge or diversification tool.
- The unusual scenario where the expected return is less than the risk-free rate suggests either market anomalies, data simplification, or theoretical exploration rather than typical market conditions.

Key Takeaways:
- When applying CAPM, always verify the inputs and assumptions, especially the expected market return.
- Negative beta stocks, though rare, can be valuable components of diversified portfolios seeking counter-cyclicality.
- An expected return lower than the risk-free rate is unconventional, prompting reevaluation of

market expectations and model assumptions.

Final Remarks: Navigating Risk and Return in Investment Analysis

Understanding beta and its calculation is fundamental for investors aiming to balance risk and reward effectively. While the scenario posed presents an atypical case, it underscores the importance of context, assumptions, and market realities in financial modeling. Whether dealing with typical market conditions or exploring theoretical extremes, mastering these concepts enables more informed decision-making and strategic portfolio management.

In conclusion, the beta of the stock, under the assumptions made, is approximately -0.5, highlighting its inverse relationship with market movements. This insight, while rooted in a hypothetical scenario

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