Georgia Institute of Technology

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Computational Investing, Part I

142: CAPM For Portfolios: Removing Market Risk

Find out how modern electronic markets work, why stock prices change in the ways they do, and how computation can help our understanding of them. Learn to build algorithms and visualizations to inform investing practice.

Recall CAPM for Portfolios

h_i = % holdings in i

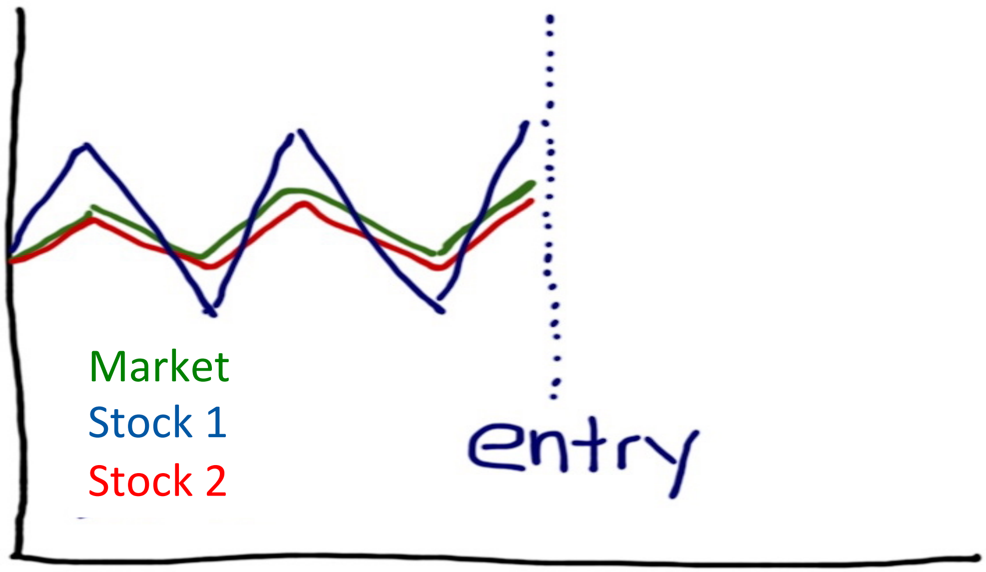
$$r_p(t) = \sum_i h_i \, r_i(t)$$

$$r_i(t) = \beta_i \, r_m(t) + \alpha_i$$

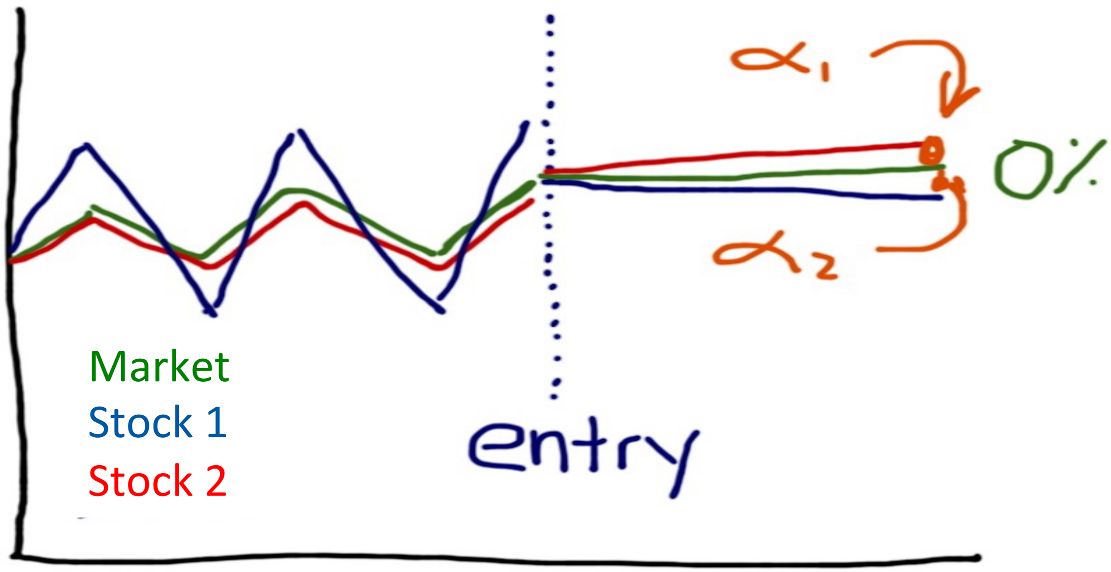
Suppose we have info on 2 stocks

- Stock 1:
  - Will go down relative to market
  - Has a Beta of 2.0
- Stock 2:
  - Will go up relative to market
  - Has a Beta of 1.0
- Plan:
  - -50% Stock 1
  - +50% Stock 2

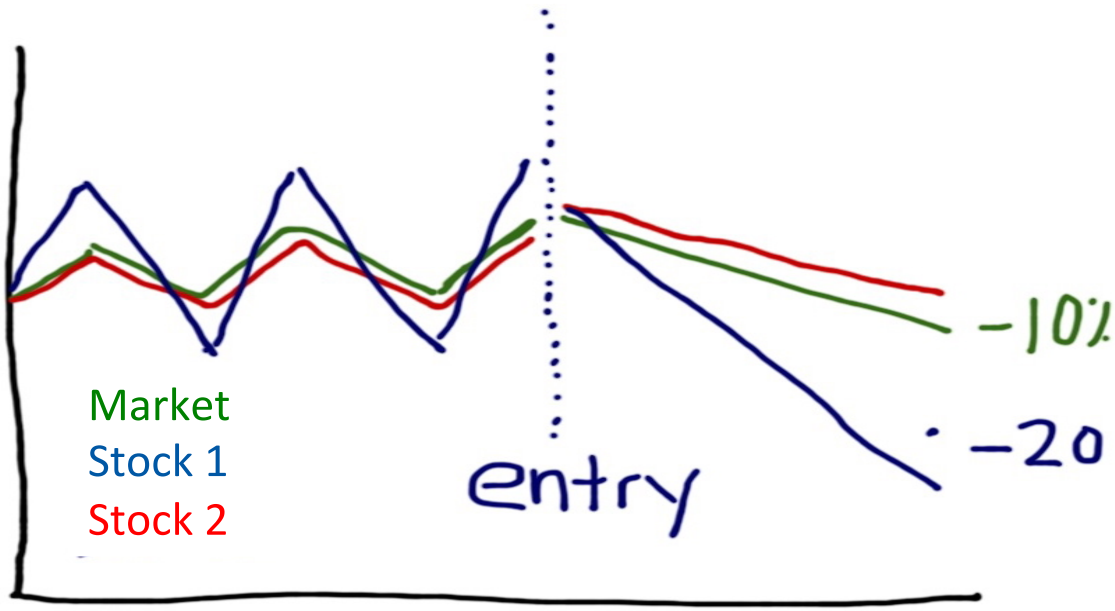
Example: Long Short



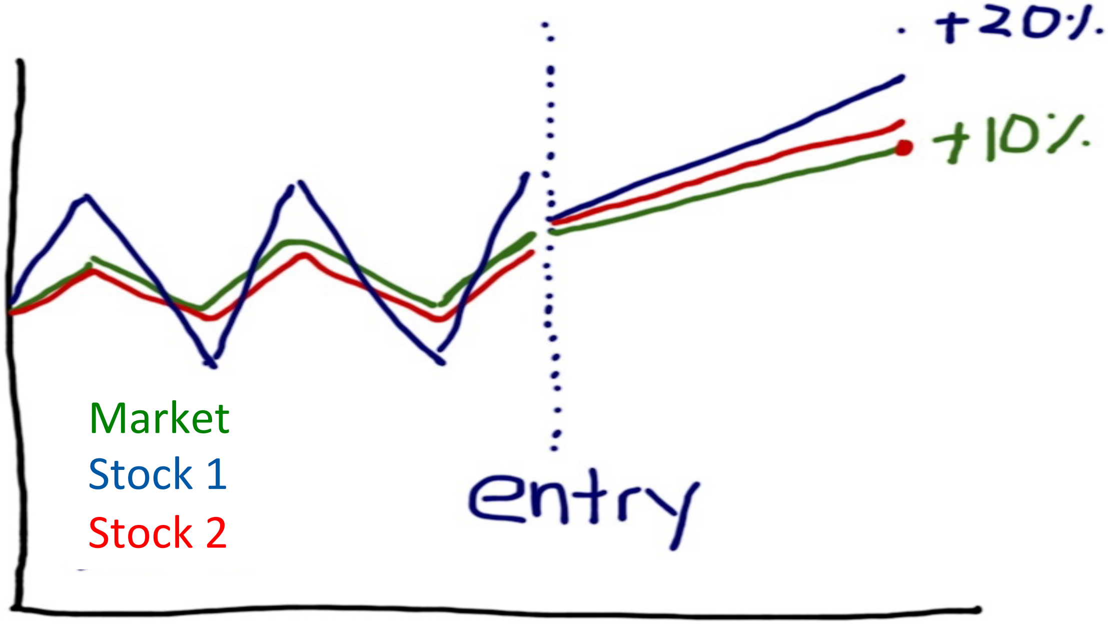
Case 1: Market is Flat: We win!



Case 2: Market Goes Down We win!



Case 3: Market Goes Up: We *LOSE*



Why did we lose?

- We have skill: Our ***alpha bets were right***
- But we shorted **high beta** stock
- Market overwhelmed our “skill”

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CAPM can help

$$r_p(t) = \underbrace{\beta_p \cdot r_m(t)}_{\text{return due to market}} + \underbrace{\alpha_p(t)}_{\text{residual return}}$$

CAPM can help

$$r_p(t) = \underbrace{\overset{\text{stddev}}{\beta_p \cdot r_m(t)}}_{\text{market risk}} + \underbrace{\overset{\text{stddev}}{\alpha_p(t)}}_{\text{residual risk}}$$

Solution

- Find weightings h_i so that portfolio beta is zero
- “Removes” market risk!

Example: Portfolio with 2 Holdings

$h_1 = -.33$, $h_2 = .66$

$\beta_1 = 2.0$ $\beta_2 = 1.0$

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Example: Portfolio with 2 Holdings

$h_1 = -.33 \quad h_2 = .66$

$\beta_1 = 2.0 \quad \beta_2 = 1.0$

$\beta_p = -.33 \cdot 2 + .66 \cdot 1$

Example: Portfolio with 2 Holdings

$h_1 = -.33 \quad h_2 = .66$

$\beta_1 = 2.0 \quad \beta_2 = 1.0$

$\beta_p = \cancel{-.33 \cdot 2 + .66 \cdot 1} \rightarrow 0$

$r_p = \cancel{\beta_p r_m} - .33\alpha_1 + .66\alpha_2$

Example: Portfolio with 2 Holdings

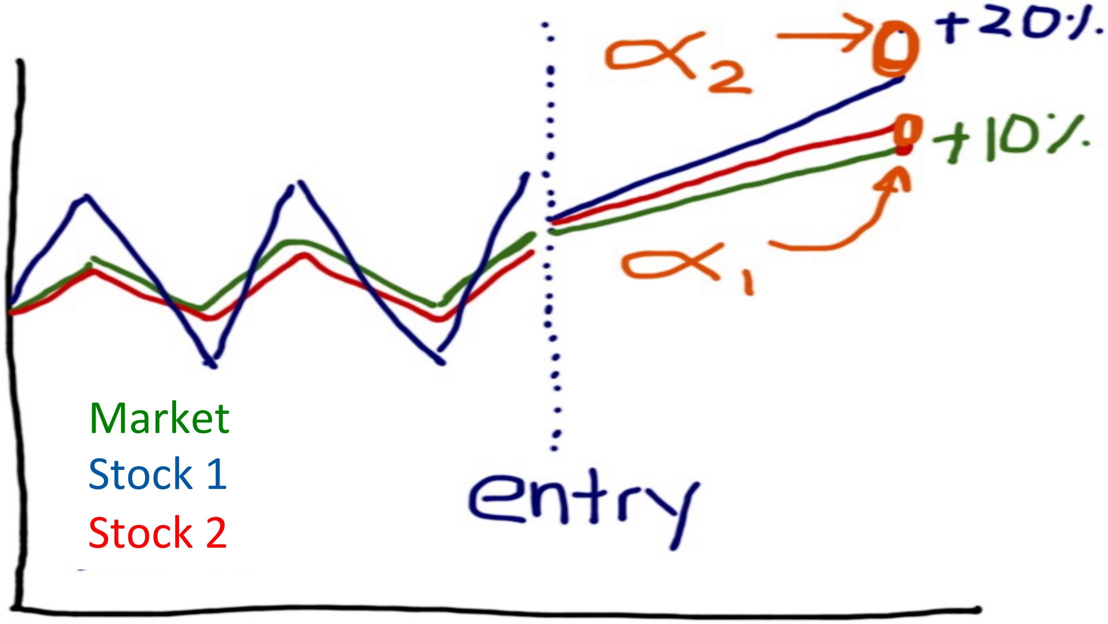
$$h_1 = -.33 \qquad h_2 = .66$$

$$\beta_1 = 2.0 \qquad \beta_2 = 1.0$$

$$\beta_p = \cancel{-.33 \cdot 2 + .66 \cdot 1} \rightarrow 0$$

$$r_p = \cancel{\beta_p r_m} \underbrace{-.33\alpha_1}_{\substack{\text{capture}\\ \text{return}\\ \text{via short}}} \underbrace{+.66\alpha_2}_{\text{Long}}$$

Example: Portfolio with 2 Holdings



Summary

- Can reduce market risk by zeroing out beta
- This is core concept for hedge funds
- Portfolio optimizers do this

Next: The Fundamental Law