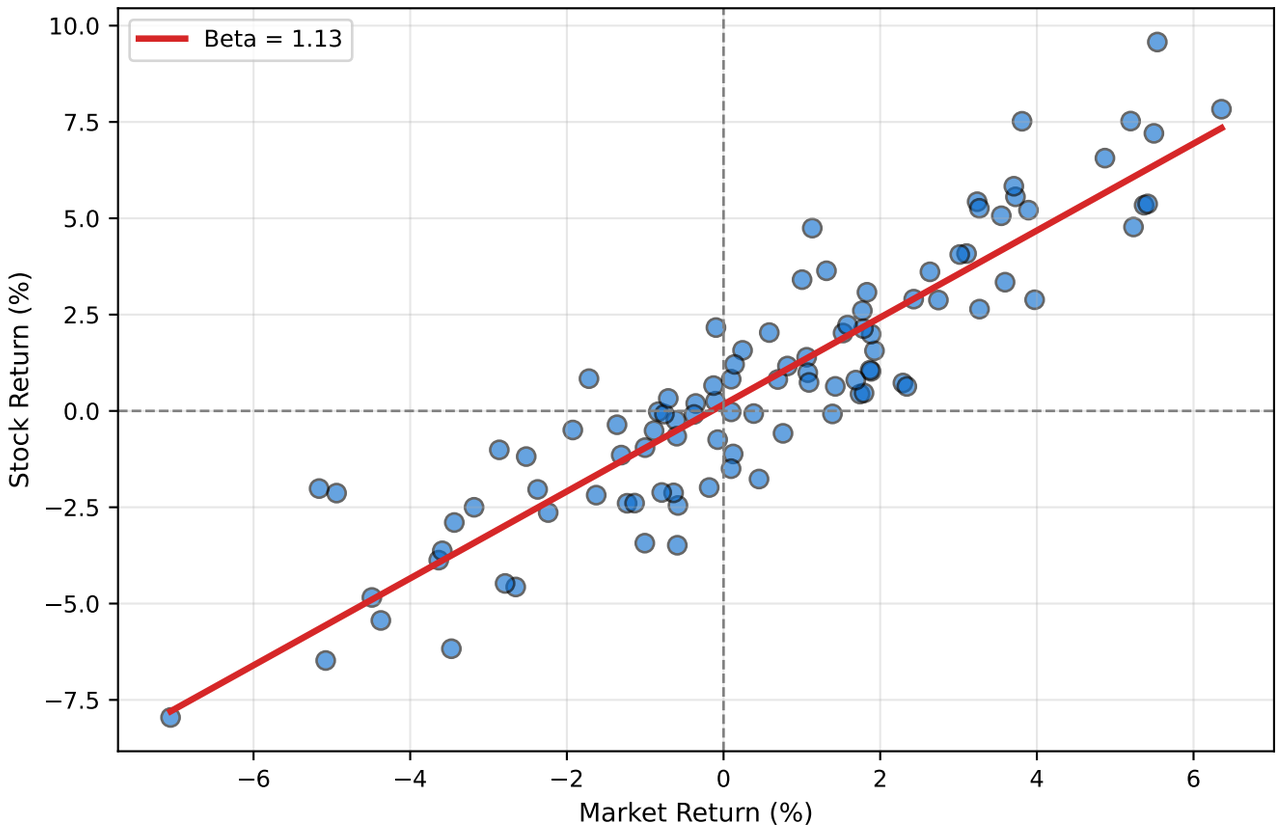
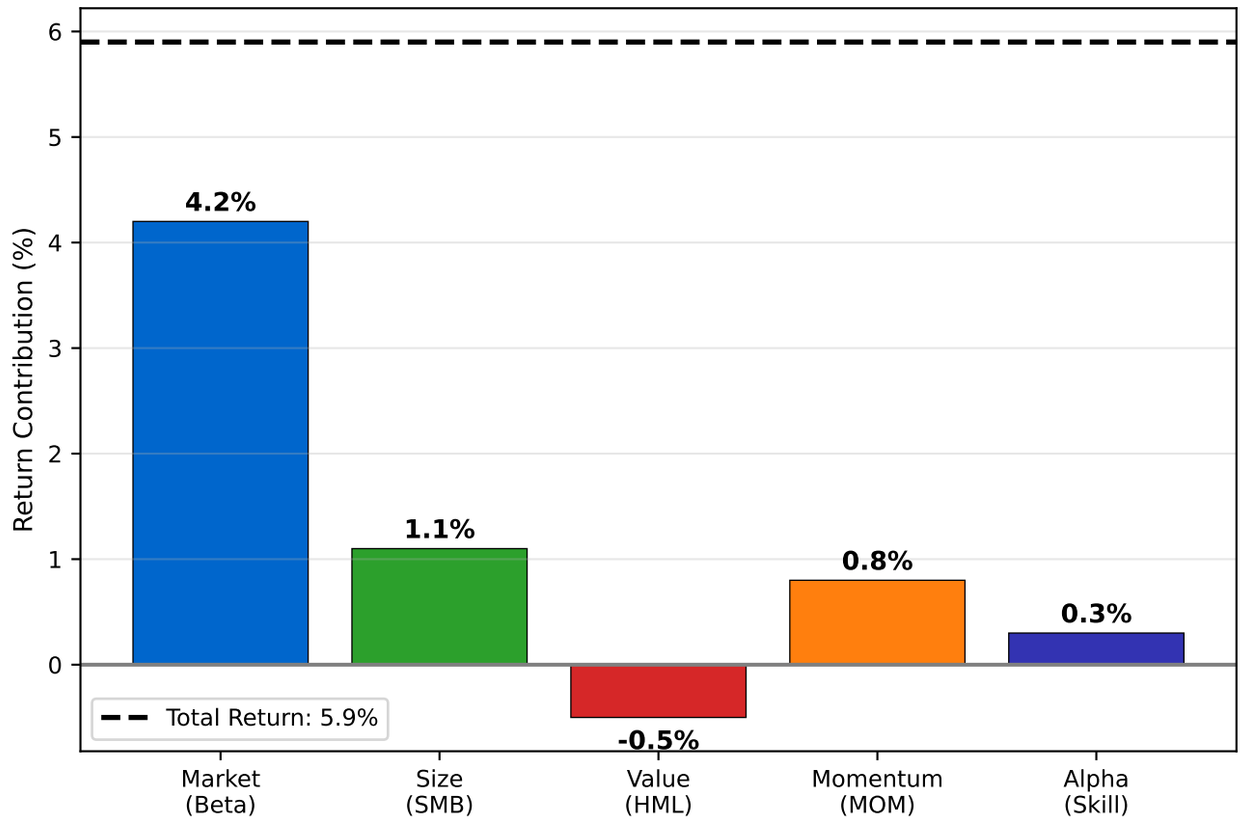
Factor Models: Understanding Return Drivers

Single Factor: CAPM



Return Decomposition by Factor



Factor Model Equations

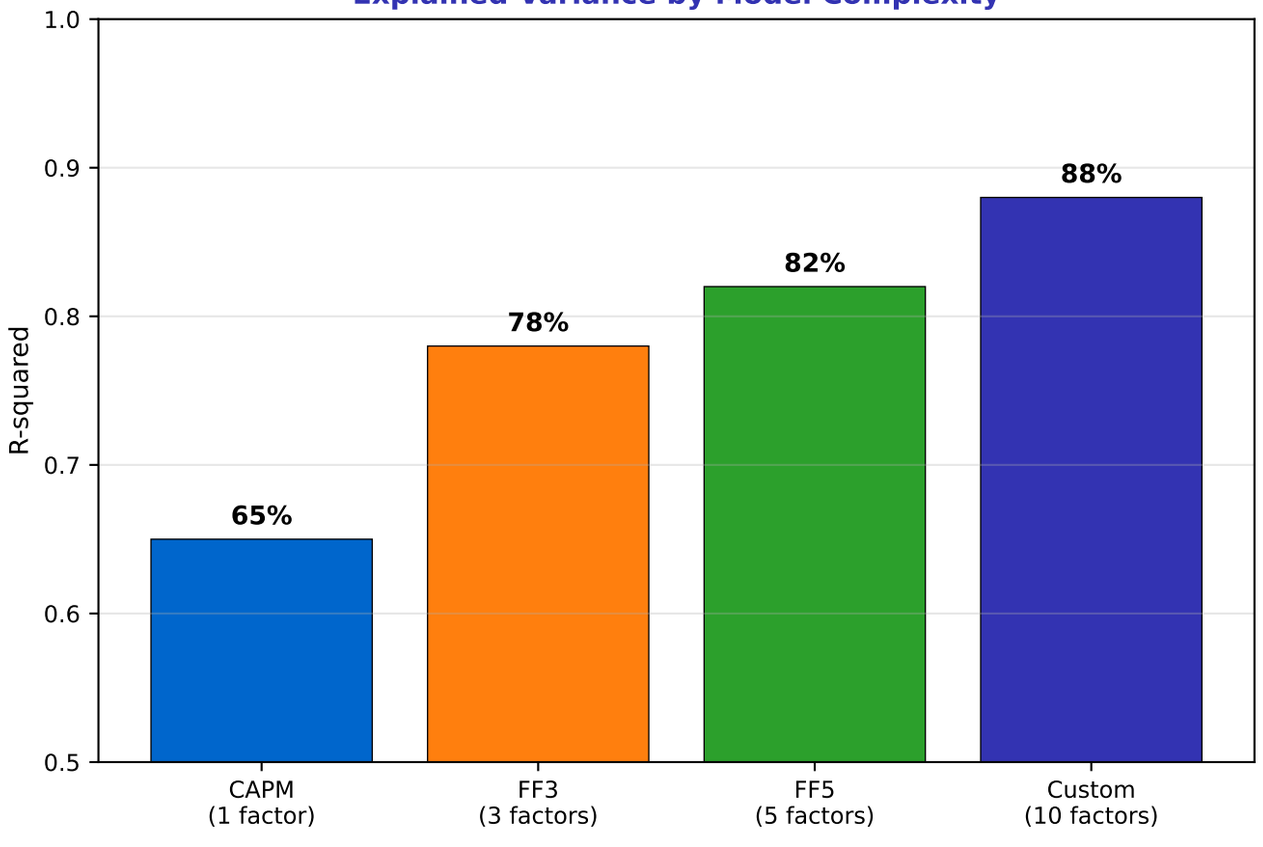
FACTOR MODEL EQUATION

$$R_i = \alpha + \beta_1 F_1 + \beta_2 F_2 + \ldots + \beta_k F_k + \varepsilon$$

Where:
- R_i = Return of asset i
- alpha = Unexplained return (skill)
- beta_k = Sensitivity to factor k
- F_k = Return of factor k
- epsilon = Idiosyncratic noise

SINGLE FACTOR (CAPM):
$R_i - R_f = \alpha + \beta(R_m - R_f) + \varepsilon$

MULTI-FACTOR (Fama-French):
$R_i - R_f = \alpha + \beta_1 MKT + \beta_2 SMB + \beta_3 HML + \varepsilon$

Key Insight:
- Factors explain SYSTEMATIC return sources
- Alpha is the unexplained residual
- Good models have high R-sq and low alpha

Explained Variance by Model Complexity