Beta × Forecast Dispersion

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Abstract

We find that a positive (negative) CAPM security market line (SML) prevails for firms with low (high) dispersion in analysts' earnings forecasts. When heterogeneous investors disagree on cash flow growth under uncertainty, our theory states that a firm's stock price is an increasing function of the interaction between market beta and belief dispersion. Using forecast dispersion to proxy for the firm-level belief distribution, Fama-MacBeth (FMB) tests show that the interaction $\beta \times D$ significantly absorbs cross-sectional mispricing, producing an estimated price of market risk compatible with the observed equity premium. Our results provide insights into the beta anomaly and "tales" of the CAPM's conditional performance.

Background

The puzzling "beta anomaly"—low (high) beta stocks earn high (low) abnormal returns relative to the CAPM—motivates a large asset pricing literature. Recent contributions find the beta anomaly is mitigated in the time series on macro announcement days (Savor and Wilson, 2014), overnight (Hendershott et al., 2020), and periods of high expected returns (Hasler and Martineau, 2021). We compliment this literature with a cross sectional resolution: across all periods, the beta anomaly is mitigated (magnified) in stocks with low (high) forecast dispersion.

In our heterogeneous beliefs model, optimistic investors' views receive a higher weight in the equilibrium price due to convexity between price and belief dispersion. We test this mechanism on measures of speculative trading, finding that intraday/overnight variation in the SML is correlated with $\beta \times D$ and informed trading predicts $\beta \times D$ resolution.

Asset Pricing Equation

For firm i, we define investor j's idiosyncratic belief ϕ_i^j relative to the signal-to-noise ratio of the stochastic cash flow C_i. We characterize C_i with drift μ_i and market risk sensitivity β_i. Assuming a single factor SDF with a constant risk-free rate and market price of risk λ (Harrison and Kreps, 1979), we show the investor's reservation price $\mathcal{P}_i^j$ is a belief augmented Gordon model:

$$\mathcal{P}_i^j = \frac{C_i}{r + \beta_i\left(\lambda - \phi_i^j\right) - \mu_i}$$

Under a linear demand rule, we show the equilibrium price is an increasing, strictly convex function of the interaction between β_i and the dispersion of ϕ_i^j in the investor population. Using forecast dispersion D_i as a proxy for the latter, this finding implies the FMB regression equation:

$$r_i^e = \lambda_0 + \lambda^{MKT} \cdot \beta_i + \lambda^{\beta\times D} \cdot (\beta \times D)_i + \varepsilon_i$$

Forecast Dispersion

We collect sell-side analysts' estimates of firm-quarter EPS from the IBES database. Forecast dispersion is measured as the variance of outstanding EPS estimates across analysts scaled by the absolute value of the actual EPS (Barron et al., 1998). We retain dispersion computations in our panel for six months or until a new quarterly value is available. To address skewness, we cross-sectionally rank firm dispersion each month to the [0,1] interval so that our proxy is measured as

$$D_{i,t} = RANK_t^{\%}\left(\frac{\sigma^2\left(Forecast_{k,i,q}\right)}{\left|Actual_{i,q}\right|}\right) \in [0,1]$$

for firm i in month t given analyst k's forecast of quarter q EPS. When interacting $D_{i,t}$ with the market risk loading β_i, we demean by the value-weighted average so that the mimicking portfolio approximates zero net investment. In FMB tests, conventional factor loadings and the interaction are lagged at least one-month so that estimated FMB prices reflect *ex ante* risk compensation relative to each factor loading and the interaction.

Portfolio Results

- Each month t, we simultaneously sort stocks into test assets on CAPM beta (deciles) and forecast dispersion (quintiles). Returns are VW.
- Fig. 1 plots mean monthly excess returns against full-sample CAPM betas for test assets in the extreme dispersion quintiles. The fitted lines are full-sample SMLs estimated *within* dispersion quintiles. Fig. 2 repeats the analysis using daily returns. Tested period is 08/86-12/22.
- Fig. 3 extends the analysis to anomaly test assets. We sort stocks into test assets on anomaly characteristics (FFC alpha, FFC idio. vol., momentum as 11-1 ret., market value of equity, book-to-market value, oper. prof., investment as Δ book assets) and forecast dispersion.

Fig. 1: Monthly Returns, Beta x Dispersion Test Assets

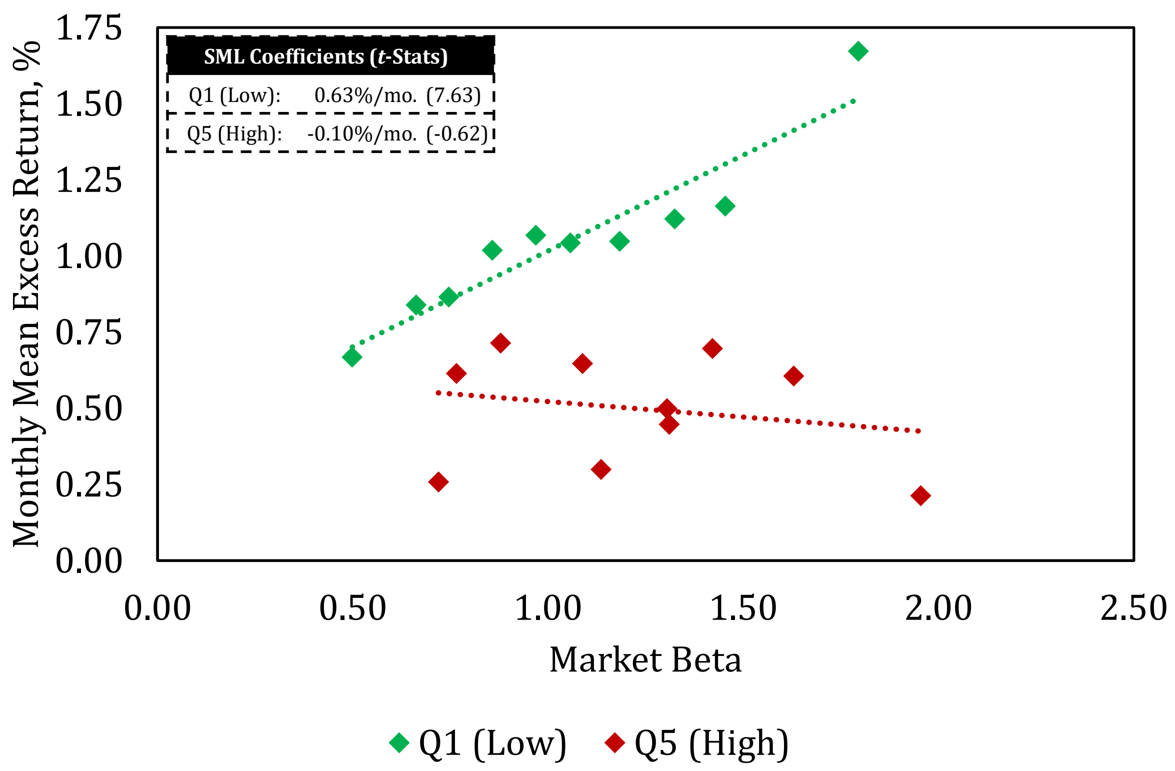


Fig. 2: Daily Returns, Beta x Dispersion Test Assets

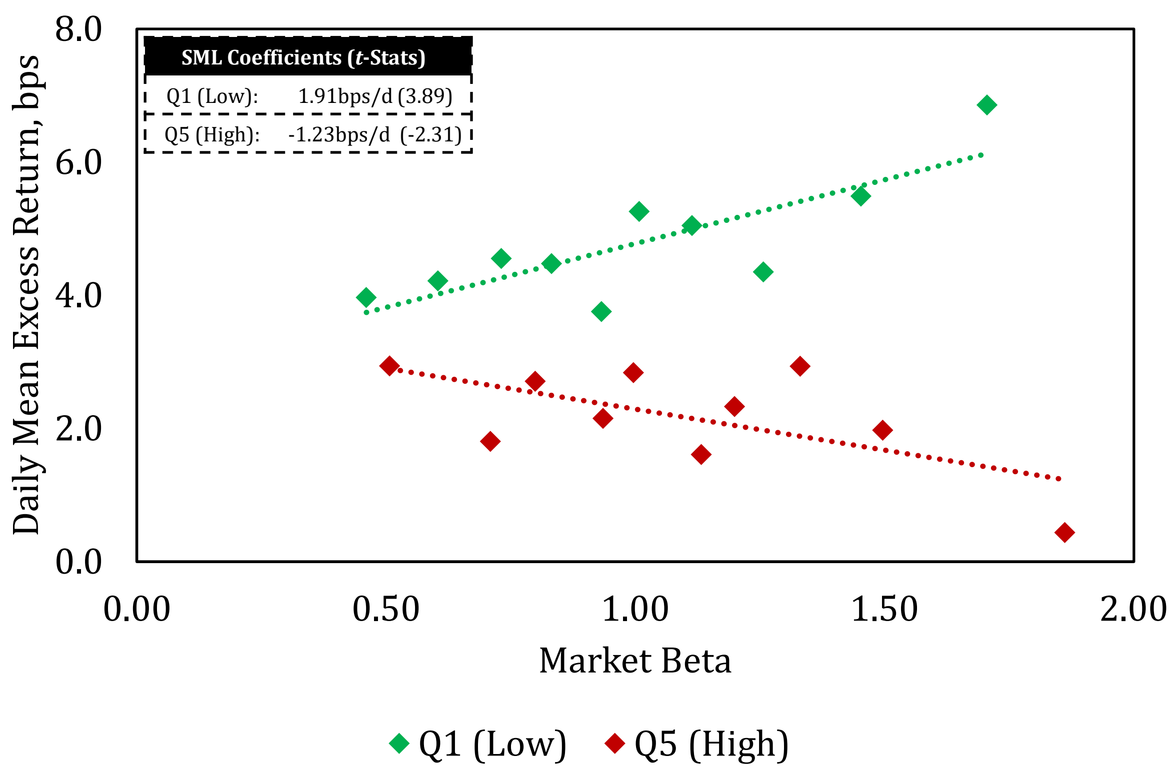
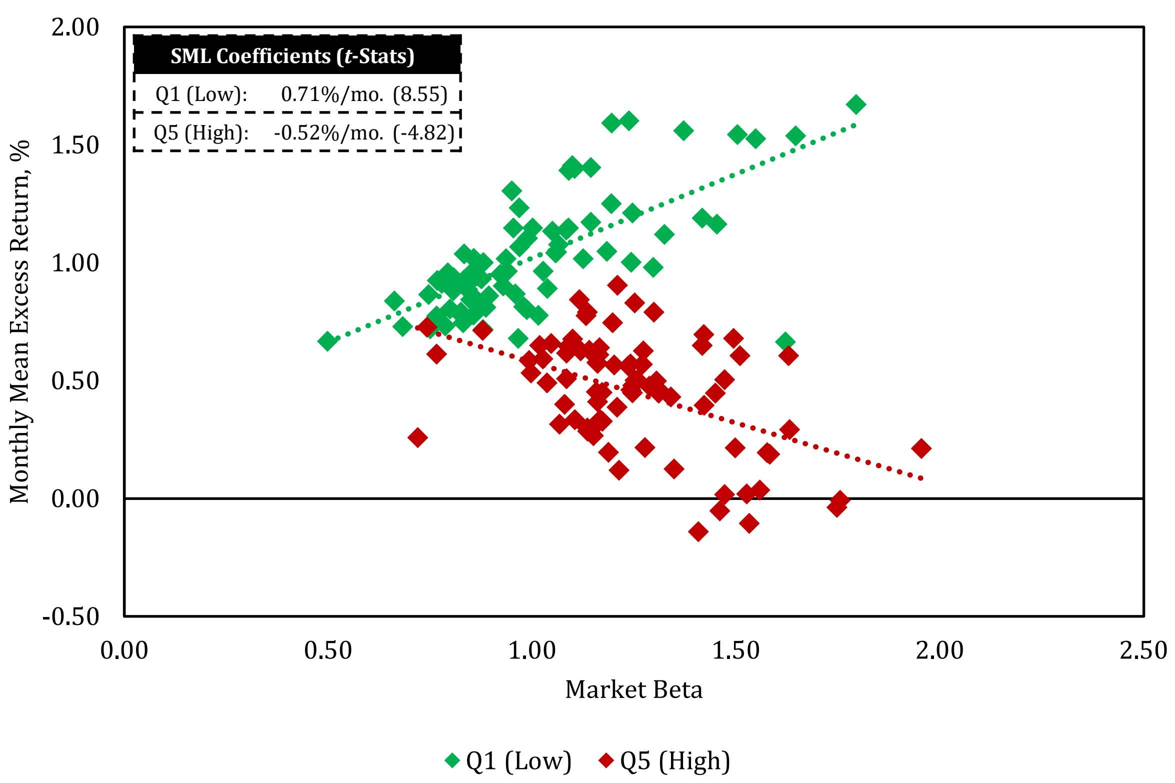


Fig. 3: Monthly Returns, Anomaly x Dispersion Test Assets



Individual Stock Results

- We computed 60-mo. rolling window factor loadings of individual stocks matched to IBES forecast data for the CAPM (MM) and Fama-French-Carhart (FFC) models. Our panel averages 2,286 firms/mo. for our sample period of 08/86-12/22. We lag factor loadings one month and use the FMB procedure with Newey-West SEs to estimate risk prices. Thus, the regression equation follows:

$$r_{i,t+1}^e = \lambda_{0,t+1} + \lambda_{t+1}^{MKT} \cdot \hat{\beta}_{i,t} + \lambda_{t+1}^{\beta\times D} \cdot \widehat{(\beta \times D)}_{i,t} + \varepsilon_{i,t+1}$$

- Tb. 1 results show FMB risk prices for the MM and FFC models with and without the $\beta \times D$ interaction. Conditional on $\beta \times D$, the FMB estimated price of market risk is highly significant and consistent with the observed equity premium during our sample period (0.68%/mo.); the price on $\beta \times D$ is highly significant and negative, consistent with our model implication that $\beta \times D$ is correlated with cross-sectional mispricing that is a function of market beta; and the intercept is insignificant, consistent with no pricing errors.

Tb. 1: FMB of Individual Stock Monthly Returns

Factor Prices (t-Stats)

	(1)	(2)	(3)	(4)
Intercept	**0.58**	0.24	**0.54**	0.18
	(2.79)	(1.04)	**(2.94)**	(0.88)
MKT	0.26	**0.63**	0.26	**0.64**
	(1.40)	**(4.04)**	(1.57)	**(4.62)**
β×D		**-0.62**		**-0.65**
		(-4.83)		**(-5.48)**
Model	MM	MM	FFC	FFC
SE's	NW(6)	NW(6)	NW(6)	NW(6)
T (Mos.)	437	437	437	437
Adj. R2	2.5%	3.1%	4.8%	5.2%
p(MKT:λ=R)	14.8%	86.8%	12.1%	89.3%

- Hendershott et al. (2020) document a significantly negative (positive) SML in intraday (overnight) returns. Recent theories and evidence (Lou et al. (2019), Lu et al. (2022)) argue that uninformed, beta-loving speculators trade on inflated private valuations during the day and overpricing is corrected by informed investors towards the market close or overnight. Consistent with this intuition and the implications of our model, we find nearly all the variation between the intraday and overnight SMLs is correlated with the $\beta \times D$ interaction. Tb. 2 results show FMB risk prices for the FFC models with and without the $\beta \times D$ interaction, estimated separately for intraday and overnight returns.

Tb. 2: FMB of Intraday vs. Overnight Returns

Factor Prices (t-Stats)

	Intraday Returns		Overnight Returns	
	(D1)	(D2)	(N1)	(N2)
Intercept	**6.10**	1.24	0.20	**3.19**
	(10.00)	(1.66)	(0.50)	**(7.02)**
MKT	**-4.51**	0.68	**3.87**	0.65
	(-4.35)	(0.65)	**(6.83)**	(1.08)
β×D		**-9.05**		**5.40**
		(-15.55)		**(16.05)**
Model	FFC	FFC	FFC	FFC
SE's	NW(10)	NW(10)	NW(10)	NW(10)
T (Days)	7,694	7,694	7,694	7,694
Adj. R2	6.3%	6.5%	2.7%	2.8%
p(MKT:λ=R)	0.2%	81.9%	91.2%	0.1%

Please refer to the AFA conference website for the latest version of the paper including references.

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