Does It Pay to Bet Against Beta? On the Conditional Performance of the Beta Anomaly

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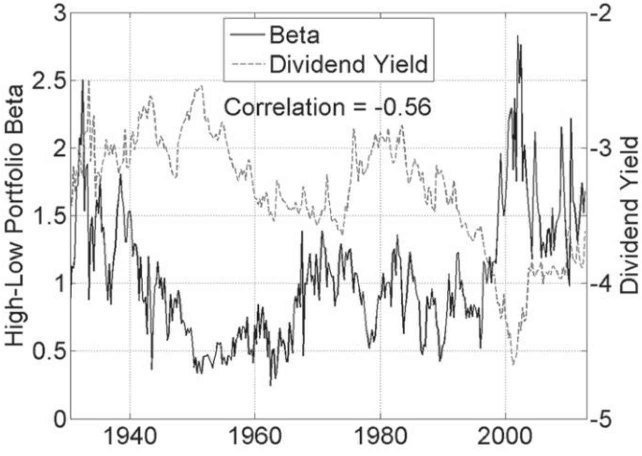
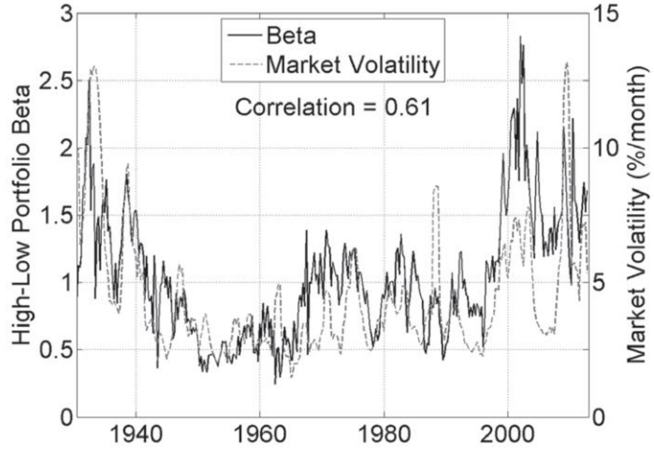
Backgrounds & Motivation

- CAPM implies that exposure to market risk should be compensated by the market risk premium. However, a number of empirical studies find that the risk- reward relation is too flat.
- “betting-against-beta” strategy
- However, portfolio betas vary systematically with the market risk premium or market volatility.



Panel A: Market Timing



Panel B: Volatility Timing

➢ We want to reconsider the evidence on the abnormal performance of beta-sorted portfolios and characterize the economic mechanisms.

Research Problem

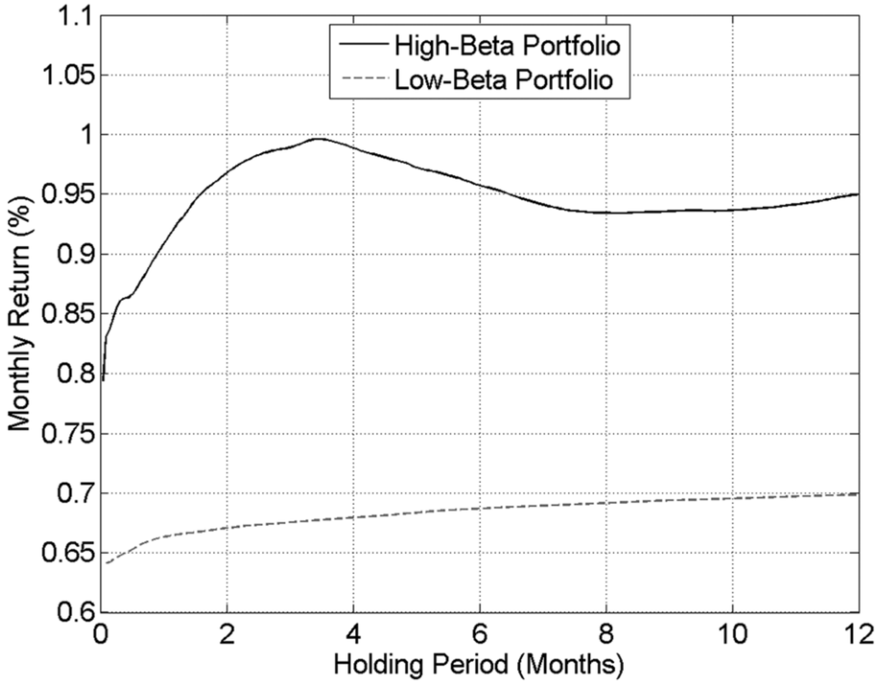
- abnormal performance of beta-sorted portfolios?
- ➢ Based on standard IV methods, conditional alphas for the HML strategy are statistically insignificant and substantially smaller in magnitude in comparison to the unconditional case.
- economic mechanisms?
- ➢ Based on the extensive literature, we propose that times of increased heterogeneity in firm-level investment opportunities, firm leverage, and heightened average idiosyncratic risk are likely to be associated with greater dispersion in betas.
- ➢ Consistent with these predictions, state variables motivated by these explanations are robust predictors of betas for the strategies of interest and are valuable in accounting for the differences in unconditional and conditional performance for the beta portfolios.

Contribution

- Our paper contributes to the asset pricing literature by reevaluating the performance of beta-sorted portfolios while properly accounting for predictable time-series variation in portfolio betas.
- We propose several theoretical explanations underlying these changes and the associated systematic trends in market risk for beta-sorted portfolios.

Data and Sample

- Sample: all NYSE, Amex, and NASDAQ common stocks with return data available on the CRSP (150 valid return observations over the prior 12 months)
- Period: July 1930 - December 2012
- Portfolio construction: sort firms into 10 groups based on past beta at the beginning of July, value weighted and held



	L	2	3	4	5	6	7	8	9	H	HL
Panel A: Mean Excess Returns											
Daily	0.35	0.55	0.54	0.68	0.77	0.74	0.68	0.71	0.63	0.50	0.15
Monthly	0.38	0.57	0.56	0.69	0.77	0.76	0.70	0.76	0.66	0.61	0.23
Quarterly	0.40	0.61	0.60	0.73	0.82	0.83	0.77	0.86	0.78	0.84	0.44

Model Design

- the portfolio beta estimate:

$$r_{i,j} = \alpha_i + \beta_{i,0} r_{m,j} + \beta_{i,1} r_{m,j-1} + \beta_{i,2} \left[\frac{r_{m,j-2} + r_{m,j-3} + r_{m,j-4}}{3} \right] + \varepsilon_{i,j}$$

$$\hat{\beta}_{i,\tau} \equiv \hat{\beta}_{i,0} + \hat{\beta}_{i,1} + \hat{\beta}_{i,2}$$

- one-step IV (IV1) method:

$$R_{i,\tau} = \alpha_i^{IV1} + (\gamma_{i,0} + \gamma_{i,1}' Z_{i,\tau-1}) R_{m,\tau} + u_{i,\tau}$$

$$\beta_{i,\tau}^{IV1} \equiv \gamma_{i,0} + \gamma_{i,1}' Z_{i,\tau-1}$$

- two-stage IV (IV2) approach:

$$\hat{\beta}_{i,\tau} = \delta_{i,0} + \delta_{i,1}' Z_{i,\tau-1} + e_{i,\tau}$$

$$R_{i,\tau} = \alpha_i^{IV2} + (\phi_{i,0} + \phi_{i,1} \tilde{\beta}_{i,\tau}) R_{m,\tau} + v_{i,\tau}$$

$$\beta_{i,\tau}^{IV2} \equiv \phi_{i,0} + \phi_{i,1} \tilde{\beta}_{i,\tau}$$

- GMM

Empirical Results - 1

impact of conditioning information on the performance of HML strategies:

- Boguth et al. (2011) $$R_{i,\tau} = \alpha_i^{IV1} + (\gamma_{i,0} + \gamma_{i,1}' Z_{i,\tau-1}) R_{m,\tau} + u_{i,\tau}$$

				$R_{m,\tau} \times$							
Case		α_i^{IV1}	$p(\alpha_i \leq \alpha_i^U)$	1	β^{LC3}	$I_{\{Q3\}}$	$I_{\{Q3\}} \times \beta^{LC3}$	β^{LC36}	DY	DS	R^2
1	L	0.09		0.47							46.8
		(0.8)		(5.2)							
	H	−0.50		2.02							84.5
		(−2.7)		(15)							
	HL	−0.59	n/a								
		(−2.3)									
3	L	−0.04		0.30	0.64	−0.23	−0.16				53.6
		(−0.4)		(2.0)	(2.6)	(−1.0)	(−0.4)				
	H	−0.33		0.64	0.69	0.86	−0.28				86.6
		(−1.7)		(2.0)	(3.8)	(1.6)	(−1.0)				
	HL	−0.28	0.011								
		(−1.1)									
5	L	−0.02		−0.02	0.44	−0.14	−0.30	0.74			55.0
		(−0.2)		(−0.1)	(1.7)	(−0.7)	(−0.8)	(2.2)			
	H	−0.32		0.49	0.66	0.88	−0.29	0.12			86.5
		(−1.8)		(0.8)	(3.3)	(1.6)	(−0.9)	(0.3)			
	HL	−0.30	0.012								
		(−1.2)									
8	L	−0.05		0.88	0.27	−0.08	−0.26	0.44	0.14	−0.10	58.9
		(−0.5)		(2.7)	(1.1)	(−0.5)	(−0.8)	(1.6)	(1.4)	(−6.1)	
	H	−0.23		−1.37	0.48	1.05	−0.46	0.32	−0.44	0.19	88.0
		(−1.2)		(−1.6)	(2.0)	(2.3)	(−1.8)	(1.0)	(−1.9)	(4.4)	
	HL	−0.18	0.003								
		(−0.7)									

Empirical Results - 1

Alpha Bias Decomposition:

- Boguth et al. (2011) $\alpha_i^U - \alpha_i^{IV1}$

	Market Timing		Volatility Timing						
Portfolio	$(1+\frac{\bar{R}^2_{m,\tau}}{\sigma^2_m})\mathrm{Cov}(\beta^{IV1}_{i,\tau}, R_{m,\tau})$	$-$	$\frac{\bar{R}_{m,\tau}}{\sigma^2_m}\mathrm{Cov}(\beta^{IV1}_{i,\tau}, R^2_{m,\tau})$	$=$	Total	$=$	α_i^U	$-$	α_i^{IV1}
L	0.00	$-$	-0.14	$=$	0.14	$=$	0.09	$-$	-0.05
H	-0.07	$-$	0.20	$=$	-0.27	$=$	-0.50	$-$	-0.23
HL	-0.07	$-$	0.34	$=$	-0.41	$=$	-0.59	$-$	-0.18

- The high-minus-low beta portfolio's exposure to market risk exhibits systematic relations with expected market returns and volatility.
- The negative bias is driven by a positive relation between the conditional beta of the high-low beta portfolio and market volatility.

Empirical Results - 1

Fama-French Model Alphas:
$$R_{i,\tau} = \alpha_i^{IV1} + \left(\lambda_{i,0} + \lambda'_{i,1} Z^{\lambda}_{i,\tau-1}\right) R_{m,\tau} + \left(\theta_{i,0} + \theta'_{i,1} Z^{\theta}_{i,\tau-1}\right) R_{smb,\tau} + \left(\eta_{i,0} + \eta'_{i,1} Z^{\eta}_{i,\tau-1}\right) R_{hml,\tau} + u_{i,\tau}.$$

				$R_{m,\tau}\times$					$R_{smb,\tau}\times$					$R_{hml,\tau}\times$					
Case		α_i^{IV1}	$p(\alpha_i \le \alpha_i^U)$	1	β^{LC3}	β^{LC36}	DY	DS	1	s^{LC3}	s^{LC36}	DY	DS	1	h^{LC3}	h^{LC36}	DY	DS	R^2
1	L	0.12		0.49					0.04					−0.12					47.9
		(1.0)		(7.3)					(0.6)					(−0.9)					
	H	−0.63		1.76					0.45					0.31					87.1
		(−4.0)		(14)					(2.0)					(1.2)					
	HL	−0.75	n/a																
		(−3.0)																	
4	L	−0.04		0.28	0.09	0.73	0.02	−0.02	0.18	−0.12	0.98	0.03	−0.09	−1.05	0.12	0.53	−0.36	−0.09	70.0
		(−0.4)		(0.8)	(0.5)	(2.5)	(0.2)	(−0.7)	(0.4)	(−1.5)	(6.8)	(0.2)	(−3.1)	(−3.0)	(0.8)	(3.2)	(−3.8)	(−2.6)	
	H	−0.30		−0.54	0.26	0.16	−0.37	0.08	1.24	0.19	0.30	0.22	−0.15	1.65	0.20	0.41	0.57	0.19	94.1
		(−3.1)		(−1.2)	(2.6)	(0.8)	(−2.9)	(1.6)	(1.3)	(1.9)	(1.8)	(0.8)	(−2.3)	(1.5)	(1.8)	(1.8)	(1.7)	(2.9)	
	HL	−0.26	0.004																
		(−1.7)																	

- Controlling for exposures to the size and value factors in the Fama-French model amplifies the measured underperformance of high-beta stocks.
- Allowing for time variation in risk exposures is important for evaluating the performance of beta-sorted portfolios using the Fama-French model.

Empirical Results - 1

$$\hat{\alpha}_i^U - \hat{\alpha}_i^{IV1} = \frac{1}{T}\left(\sum_{\tau=1}^{T}\hat{\beta}_{i,\tau}^{IV1}R_{m,\tau} - \hat{\beta}_i^U\sum_{\tau=1}^{T}R_{m,\tau}\right) + \frac{1}{T}\left(\sum_{\tau=1}^{T}\hat{s}_{i,\tau}^{IV1}R_{smb,\tau} - \hat{s}_i^U\sum_{\tau=1}^{T}R_{smb,\tau}\right) + \frac{1}{T}\left(\sum_{\tau=1}^{T}\hat{h}_{i,\tau}^{IV1}R_{hml,\tau} - \hat{h}_i^U\sum_{\tau=1}^{T}R_{hml,\tau}\right)$$

Decompose the bias in FF alphas:

	Market Factor Bias		Size Factor Bias		Value Factor Bias						
Portfolio	$\frac{\sum\beta_{i,\tau}^{IV1}R_{m,\tau}}{T} - \beta_i^U\bar{R}_{m,\tau}$	+	$\frac{\sum s_{i,\tau}^{IV1}R_{smb,\tau}}{T} - s_i^U\bar{R}_{smb,\tau}$	+	$\frac{\sum h_{i,\tau}^{IV1}R_{hml,\tau}}{T} - h_i^U\bar{R}_{hml,\tau}$	=	Total	=	α_i^U	−	α_i^{IV1}
L	0.13	+	−0.03	+	0.06	=	0.16	=	0.12	−	−0.04
H	−0.28	+	−0.03	+	−0.02	=	−0.33	=	−0.63	−	−0.30
HL	−0.41	+	0.00	+	−0.08	=	−0.49	=	−0.75	−	−0.26

- The unconditional alpha is biased by −49 basis points per month. Time variation in the market factor loading accounts for −41 basis points (84%).
- Even in a three-factor setup, the changing exposures to market risk among high- and low-beta firms account for most of the improvements obtained through conditioning.

Empirical Results - 2

portfolio beta decomposition: $\beta_\tau = \sum_{n=1}^{N_\tau} w_{n,\tau}\beta_{n,\tau}$

$$\beta_\tau = \bar{\beta}_{n,\tau} + N_\tau \mathrm{Cov}(w_{n,\tau}, \beta_{n,\tau})$$

determinants of the cross-sectional distribution of betas:

- Rm (equity premium)
- IPO activity (the proportion of IPOs in the prior 5 years)
- Investment opportunities (σBM)
- Firm leverage (σLEV: book leverage)
- Idiosyncratic Risk (IVOL: cross-sectional average of firm-level IVOL)
- Funding liquidity (σ△TED: the std of daily Treasury-Eurodollar spread innovations)

Empirical Results - 2

Empirical Tests of Beta Determinants:

		Stage 1 Beta Regression										Stage 2 Return Regression				
Case		δ_0	$\hat{R}_m$	IPO	σ_{BM}	σ_{LEV}	$IVOL$	$\sigma_{\Delta TED}$	β^{LC3}	β^{LC36}	R^2	α_i^{IV2}	ϕ_0	ϕ_1	R^2	$p(\alpha_i \leq \alpha_i^U)$
1	L	0.53										0.00		1.15	43.2	
		(24)										(0.0)		(8.2)		
	H	1.66										−0.60		1.11	77.3	
		(45)										(−2.4)		(14)		
	HL											−0.60				n/a
												(−1.7)				
2	L	0.85	0.02	0.19	−0.33	0.13	−0.03	−0.08			−0.3	−0.07	−1.63	4.32	47.3	
		(4.1)	(0.4)	(0.5)	(−1.1)	(1.0)	(−0.7)	(−0.4)				(−0.5)	(−2.4)	(3.2)		
	H	0.49	−0.30	−0.32	0.81	0.66	0.12	0.26			20.0	−0.47	−1.04	1.73	81.2	
		(1.6)	(−3.2)	(−0.5)	(1.9)	(3.1)	(1.8)	(0.8)				(−2.2)	(−1.3)	(3.5)		
	HL											−0.39				0.126
												(−1.3)				
3	L	0.27	0.03	−0.17	−0.31	0.29	0.02	0.06	0.16	0.51	14.6	−0.08	−0.05	1.39	46.0	
		(1.2)	(0.4)	(−0.4)	(−1.1)	(2.1)	(0.4)	(0.3)	(1.9)	(3.8)		(−0.5)	(−0.2)	(3.0)		
	H	−0.08	−0.25	−0.49	0.40	0.26	0.15	0.24	0.24	0.33	31.6	−0.41	−0.52	1.40	82.1	
		(−0.3)	(−2.8)	(−0.9)	(1.0)	(1.3)	(2.4)	(0.8)	(3.4)	(2.6)		(−1.9)	(−1.2)	(4.9)		
	HL											−0.33				0.096
												(−1.1)				

- Cross-sectional patterns in firm investment opportunities, leverage, and idiosyncratic risk positively forecast the high-beta portfolio beta.
- These factors produce much of the systematic variation in portfolio betas underlying the underperformance of high-beta stocks found in prior literature.

Conclusion

- The statistically significant differences in risk-adjusted performance for high-beta and low-beta portfolios are largely attributable to biases in unconditional performance measures.
- These results are an artifact of two complementary effects: (i) systematic trends in the association between market weights and firm-level betas and (ii) time-varying dispersion in the beta distribution.