

Betting against Beta or Demand for Lottery

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Most Persistent Anomaly

Security Market Line is Too Flat

- High β stocks generate negative abnormal returns
- Low β stocks generate positive abnormal returns
- Anomaly has persisted for more than 40 years
 - Black, Jensen, and Scholes (1972)
 - Blume and Friend (1973)
 - Fama and MacBeth (1973)

Betting Against Beta: Frazzini and Pedersen

- Long low- β , short high- β portfolio generates abnormal returns
- Explanation: Leverage constrained investors buy high β
 - Only way to increase expected return (can't use leverage)
 - Pension funds, mutual funds

Alternative Explanation - Lottery Demand

We propose that lottery demand causes betting against beta phenomenon

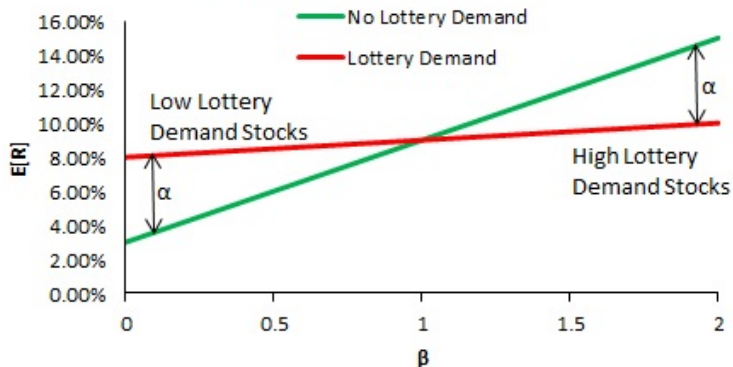
- Lottery investors want high probability of large up move
- Up moves partially driven by market sensitivity
- Lottery demanders likely to invest in high- β stocks
- Upward (downward) price pressure on high- β (low- β) stocks
- Future returns of high- β (low- β) stocks depressed (increased)

Lottery demand strong in equity markets

- Bali, Cakici, and Whitelaw (2011)
- Kumar (2009)

Capital Market Line

Security Market Line



Results

Lottery Demand Explains Phenomenon

Lottery demand proxied by *MAX*

- Average of top 5 daily returns in month

Bivariate portfolio analysis

- Controlling for *MAX*, betting against beta disappears
- No other variable explains betting against beta

Fama and MacBeth (1973) Regressions

- β positively related to returns when *MAX* included

Orthogonal Component of β to *MAX*

- Does not generate betting against beta phenomenon

Results

Lottery Demand is the Channel

Lottery demand falls predominantly on high- β stocks

- β and MAX positively correlated in cross-section

Lottery demand generates betting against beta

- Strong in high- β , MAX correlation months
- Non-existent in low- β , MAX correlation months

Concentrated in low institutional holdings stocks

- Lottery demand driven by retail investors - Kumar (2009)
- Leverage constraints by mutual and pension funds

Aggregate lottery demand

- High correlation when aggregate lottery demand high

Results

Lottery Demand Factor (FMAX)

Long High-*MAX* Stocks, Short Low-*MAX* Stocks

- Proxies for returns associated with lottery investing

FMAX explains betting against beta phenomenon

- Alpha of high-low β portfolio is zero when FMAX included

FMAX explains alpha of FP's BAB factor

- Alpha of BAB is zero when FMAX included in model

BAB factor cannot explain FMAX

- Alpha of FMAX large and significant when BAB in model

Data Sources

CRSP

- Daily and monthly stock data

Compustat

- Balance sheet data

Kenneth French's Data Library

- Daily and monthly factor returns

Global Insight

- LIBOR and U.S. Treasury bill yields

Pastor and Stambaugh (2003) Liquidity Factor

- Lubos Pastor's website

Institutional Holdings Data

- Thomson-Reuters Institutional Holdings (13F) database

Variables - Beta, Lottery Demand, Returns

Beta, Lottery Demand, and Returns

Beta (β)

- One-factor market model regression
- 12-month's of daily return data
- Require minimum of 200 daily return observations

Lottery demand (*MAX*)

- Average of 5 highest daily returns in past month

Monthly stock excess returns

- Adjusted for delisting following Shumway (1997)

Variables - Firm Characteristics

Firm Characteristics

Market Capitalization (*MKTCAP*)

- Size is log of *MktCap* (in millions)

Book-to-market ratio (*BM*): Fama and French (1992, 1993)

Momentum (*MOM*): Jegadeesh and Titman (1993)

- Return in months $t - 11$ through $t - 1$

Illiquidity (*ILLIQ*): Amihud (2002)

Idiosyncratic Volatility (*IVOL*): Ang et al. (2006)

Variables - Risk Measures

Risk Measures

Co-skewness (*COSKEW*): Following Harvey and Siddique (2000)

Total skewness (*TSKEW*): Skewness of daily returns in past year

Downside beta (*DRISK*): Ang, Chen, Xing (2006)

- Stock beta on days when market return is below average

Tail beta (*TRISK*): Kelly, Jiang (2013), Ruenzi, Weigert (2013)

- Stock beta on days in bottom 10% of market returns

We require minimum of 200 daily return observations in past year for each of the risk variables

Variables - Funding Liquidity Measures

Funding Liquidity Measures

TED spread sensitivity (β_{TED})

- TED spread is three-month LIBOR rate - 3-month T-bill rate

Sensitivity to TED spread volatility (β_{VOLTED} , 1979-2012)

- VOLTED is standard deviation of daily TED spreads in month

T-bill rate sensitivity (β_{TBILL})

- TBILL is 3-month T-bill rate

Financial sector leverage sensitivity (β_{FLEV})

- FLEV is financial sector total assets / market value of equity

Calculated using 5 years of monthly data (minimum 24 months)

Sample

Monthly Sample, Aug. 1963 - Dec. 2012

- 593 months
- U.S. based common stocks
- Traded on NYSE/AMEX/Nasdaq
- Price at end of previous month \geq \$5

Univariate Portfolios Sorted on β

Excess Returns and 4-Factor Alphas

- Portfolios Sorted on β

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low
β	-0.00	0.25	0.42	0.56	0.70	0.84	1.00	1.19	1.46	2.02	
R	0.69 (3.74)	0.78 (3.90)	0.78 (3.74)	0.77 (3.54)	0.81 (3.42)	0.73 (2.90)	0.71 (2.66)	0.65 (2.26)	0.51 (1.58)	0.35 (0.89)	-0.35 (-1.13)
FFC4 α	0.22 (2.22)	0.24 (2.77)	0.16 (2.31)	0.11 (1.59)	0.10 (1.69)	-0.02 (-0.30)	-0.05 (-0.80)	-0.11 (-1.83)	-0.18 (-2.20)	-0.29 (-2.22)	-0.51 (-2.50)

High-Low β portfolio generates negative alpha

- 0.51% per month
- Similar to FP (0.55% per month)
- Both high and low β portfolios generate significant alpha

Univariate Portfolio Firm Characteristics

Average Firm Characteristics

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)
MAX	2.52	2.37	2.52	2.66	2.82	3.01	3.22	3.50	3.90	4.61
MKTCAP	288	1,111	1,636	1,827	1,689	1,619	1,652	1,794	1,894	1,775
BM	1.10	1.04	0.95	0.90	0.86	0.83	0.80	0.76	0.72	0.65
MOM	17.03	16.33	17.15	17.50	17.99	18.77	20.37	22.63	25.83	35.74
ILLIQ	3.75	1.92	1.30	1.07	0.94	0.79	0.69	0.59	0.48	0.35
IVOL	2.01	1.80	1.83	1.88	1.95	2.03	2.13	2.27	2.47	2.79
Mkt Shr	1.92%	4.71%	7.52%	9.14%	10.16%	11.20%	12.73%	14.59%	15.17%	12.86%

- MAX, MKTCAP, MOM, IVOL positively related to β
- BM, ILLIQ negatively related to β

Univariate Portfolio Risk Measures

Average Risk Measures

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)
<i>COSKEW</i>	-4.75	-5.02	-5.34	-5.30	-5.22	-5.03	-4.89	-4.82	-4.52	-1.96
<i>TSKEW</i>	0.86	0.67	0.57	0.51	0.47	0.45	0.44	0.44	0.44	0.47
<i>DRISK</i>	0.09	0.35	0.52	0.67	0.81	0.95	1.11	1.31	1.58	2.10
<i>TRISK</i>	0.13	0.41	0.60	0.74	0.87	1.02	1.18	1.38	1.65	2.15

- *COSKEW*, *DRISK*, *TRISK* positively related to β
- *TSKEW* negatively related to β

Univariate Portfolio Funding Liquidity Measures

Average Funding Liquidity Measures

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)
β_{TED}	-2.10	-1.88	-1.60	-1.56	-1.52	-1.54	-1.53	-1.35	-0.99	-0.10
β_{VOLTED}	-11.41	-10.25	-7.82	-6.23	-5.32	-5.54	-4.89	-4.64	-3.77	-1.19
β_{TBILL}	-0.51	-0.54	-0.55	-0.56	-0.58	-0.60	-0.64	-0.71	-0.79	-0.94
β_{FLEV}	-0.54	-0.61	-0.68	-0.72	-0.76	-0.80	-0.83	-0.87	-0.88	-0.91

- β_{TED} and β_{VOLTED} positively related to β
- β_{TBILL} and β_{FLEV} negatively related to β

Univariate Portfolios Sorted on MAX

Excess Returns and 4-Factor Alphas

- Portfolios Sorted on MAX

Value	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low
MAX	0.66	1.25	1.69	2.09	2.49	2.91	3.41	4.04	4.98	7.62	
R	0.74 (4.07)	1.00 (4.95)	0.96 (4.59)	0.94 (4.25)	0.90 (3.84)	0.82 (3.29)	0.80 (2.93)	0.67 (2.29)	0.36 (1.10)	-0.40 (-1.11)	-1.15 (-4.41)
FFC4 α	0.27 (3.01)	0.42 (5.90)	0.35 (5.89)	0.30 (5.18)	0.23 (3.95)	0.12 (2.20)	0.08 (1.53)	-0.07 (-1.50)	-0.38 (-6.05)	-1.14 (-10.43)	-1.40 (-8.95)

High-Low MAX generates negative returns and alpha

- Average return is -1.15% per month
- FFC4 alpha -1.40% per month
- Both high and low MAX portfolios generate significant alpha

Bivariate Portfolios Procedure

Bivariate Dependent Sort Portfolio Analysis

Sort first on control variable

- Firm characteristic, risk measure, or funding liquidity measure

Then sort on β

- Generates dispersion in β , holds first sort variable constant

Table reports excess return for β decile portfolios

- Average across all deciles of control variable
- Results show conditional relation between β and future returns

Bivariate Portfolios - Control for Firm Characteristics

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low	FFC4 α
<i>MAX</i>	0.70	0.69	0.67	0.68	0.67	0.70	0.66	0.65	0.70	0.68	-0.02 (-0.10)	-0.14 (-0.85)
<i>MKTCAP</i>	0.62	0.69	0.78	0.77	0.80	0.80	0.73	0.70	0.56	0.35	-0.28 (-0.91)	-0.45 (-2.48)
<i>BM</i>	0.66	0.65	0.67	0.72	0.69	0.70	0.70	0.65	0.70	0.59	-0.06 (-0.26)	-0.33 (-1.87)
<i>MOM</i>	0.74	0.81	0.85	0.76	0.81	0.77	0.71	0.65	0.54	0.29	-0.45 (-1.83)	-0.63 (-3.55)
<i>ILLIQ</i>	0.68	0.78	0.79	0.80	0.78	0.79	0.76	0.67	0.56	0.24	-0.44 (-1.42)	-0.56 (-3.16)
<i>IVOL</i>	0.78	0.77	0.75	0.71	0.71	0.70	0.66	0.59	0.60	0.51	-0.28 (-1.17)	-0.41 (-2.36)

- Controlling for *MAX* explains the betting against beta effect
- Other firm characteristics fail to explain phenomenon

Bivariate Portfolios - Control for Risk

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low	FFC4 α
<i>COSKEW</i>	0.72	0.77	0.75	0.78	0.70	0.74	0.68	0.67	0.60	0.37	-0.35 (-1.23)	-0.50 (-2.60)
<i>TSKEW</i>	0.69	0.75	0.78	0.79	0.77	0.75	0.71	0.66	0.56	0.32	-0.37 (-1.24)	-0.52 (-2.63)
<i>DRISK</i>	0.77	0.76	0.73	0.79	0.72	0.71	0.67	0.60	0.62	0.42	-0.35 (-2.36)	-0.36 (-2.97)
<i>TRISK</i>	0.75	0.75	0.79	0.75	0.72	0.67	0.73	0.65	0.59	0.37	-0.38 (-1.46)	-0.45 (-2.63)

- Risk fails to explain betting against beta phenomenon

Bivariate Portfolios - Control for Funding Liquidity

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low	FFC4 α
β_{TED}	0.70	0.79	0.74	0.78	0.70	0.72	0.64	0.57	0.50	0.31	-0.40 (-1.58)	-0.54 (-2.88)
β_{VOLTED}	0.80	0.89	0.85	0.82	0.81	0.81	0.75	0.73	0.64	0.40	-0.40 (-1.18)	-0.59 (-2.22)
β_{TBILL}	0.76	0.80	0.85	0.80	0.77	0.79	0.72	0.71	0.61	0.45	-0.43 (-1.57)	-0.57 (-3.02)
β_{FLEV}	0.74	0.81	0.85	0.76	0.81	0.77	0.71	0.65	0.54	0.29	-0.34 (-1.32)	-0.52 (-2.82)

- Funding liquidity sensitivity fails to explain betting against beta phenomenon

Fama-MacBeth (1973) Regressions

Regressions with and without MAX

- Specification indicated at bottom
- Full results on next slide

	Regressions without MAX			Regressions with MAX		
	(1)	(2)	(3)	(4)	(5)	(6)
β	0.060 (0.44)	0.174 (0.97)	0.263 (1.08)	0.265 (1.93)	0.427 (2.34)	0.470 (1.90)
MAX				-0.355 (-8.43)	-0.358 (-8.49)	-0.223 (-6.16)
Firm Chars	Yes	Yes	Yes	Yes	Yes	Yes
Risk	No	Yes	Yes	No	Yes	Yes
Fund Liq	No	No	Yes	No	No	Yes

- MAX included $\rightarrow \beta$ positively related to future stock returns

Full Fama-MacBeth (1973) Regression Results

	Regressions without MAX			Regressions with MAX		
	(1)	(2)	(3)	(4)	(5)	(6)
β	0.060 (0.44)	0.174 (0.97)	0.263 (1.08)	0.265 (1.93)	0.427 (2.34)	0.470 (1.90)
MAX				-0.355 (-8.43)	-0.358 (-8.49)	-0.223 (-6.16)
SIZE	-0.176 (-4.51)	-0.180 (-4.70)	-0.101 (-2.57)	-0.165 (-4.26)	-0.168 (-4.41)	-0.102 (-2.70)
BM	0.176 (3.00)	0.176 (3.03)	0.181 (2.81)	0.189 (3.20)	0.186 (3.17)	0.173 (2.71)
MOM	0.008 (5.89)	0.008 (6.21)	0.007 (5.87)	0.008 (5.52)	0.008 (5.80)	0.007 (5.11)
ILLIQ	-0.011 (-0.64)	-0.011 (-0.64)	-0.012 (-1.13)	-0.010 (-0.60)	-0.011 (-0.64)	-0.009 (-0.79)
IVOL	-0.345 (-11.90)	-0.339 (-11.85)	-0.266 (-8.34)	0.110 (1.84)	0.117 (1.97)	-0.023 (-0.55)
COSKEW		-0.006 (-1.01)	-0.010 (-1.16)		-0.008 (-1.30)	-0.011 (-1.20)
TSKEW		-0.065 (-3.57)	-0.045 (-2.42)		-0.043 (-2.37)	-0.044 (-2.39)
DRISK		-0.053 (-0.55)	-0.240 (-1.78)		-0.097 (-1.03)	-0.260 (-1.96)
TRISK		-0.057 (-1.50)	-0.036 (-0.69)		-0.060 (-1.50)	-0.036 (-0.65)
β_{TED}			-0.005 (-0.37)			-0.005 (-0.37)
β_{VOLTED}			-0.001 (-0.35)			-0.001 (-0.39)
β_{TBILL}			0.009 (0.33)			-0.009 (-0.36)
β_{FLEV}			-0.024 (-0.80)			-0.032 (-1.15)
Intercept	2.121 (6.94)	2.144 (7.01)	1.754 (5.09)	2.076 (6.86)	2.096 (6.90)	1.827 (5.46)
n	2,450	2,450	2,931	2,450	2,450	2,931
Adj. R ²	6.56%	6.99%	6.34%	6.97%	7.37%	6.54%

Bivariate Independent Sort Portfolios

Sort Independently on β and MAX

- High-Low β portfolio gives returns driven by β
 - Conditional on MAX
- High-Low MAX portfolio gives returns driven by MAX
 - Conditional on β
- Results on next slide

Results

MAX explains betting against beta effect

- High-Low β portfolios have insignificant alphas

Lottery demand effect persists after controlling for β

- High-Low MAX portfolios have large and significant alphas

Bivariate Independent Sort Portfolio Returns

	MAX 1	MAX 2	MAX 3	MAX 4	MAX 5	MAX 6	MAX 7	MAX 8	MAX 9	MAX 10	High - Low	FFC4 α
β 1 (Low)	0.61	0.94	0.94	1.05	0.96	0.93	0.86	0.71	0.66	-0.20	-0.81 (-2.75)	-1.31 (-5.43)
β 2	0.71	1.00	0.95	0.92	0.77	0.97	1.00	0.68	0.47	-0.20	-0.92 (-3.98)	-1.23 (-5.95)
β 3	0.77	0.94	1.00	0.92	0.83	0.88	0.78	0.85	0.44	-0.55	-1.32 (-5.41)	-1.57 (-6.97)
β 4	0.92	1.03	0.92	0.88	1.00	0.75	0.65	0.75	0.24	-0.37	-1.28 (-5.60)	-1.60 (-7.43)
β 5	1.00	0.98	1.04	1.08	0.95	0.73	0.79	0.66	0.34	-0.26	-1.26 (-4.68)	-1.48 (-5.91)
β 6	1.10	1.04	1.00	0.93	0.96	0.78	0.70	0.59	0.24	-0.43	-1.50 (-5.74)	-1.82 (-6.93)
β 7	0.90	1.14	0.95	0.77	0.89	0.88	0.87	0.56	0.35	-0.22	-1.19 (-3.82)	-1.48 (-5.29)
β 8	1.38	1.10	0.94	0.82	0.85	0.81	0.85	0.72	0.41	-0.40	-1.75 (-5.54)	-2.20 (-6.39)
β 9	1.45	0.87	0.97	0.88	0.84	0.73	0.80	0.54	0.22	-0.45	-1.94 (-4.36)	-2.11 (-5.05)
β 10 (High)	0.33	1.36	1.32	1.25	0.93	0.78	0.66	0.79	0.28	-0.65	-1.05 (-1.83)	-1.58 (-2.70)
High-Low	-0.19 (-0.35)	0.40 (1.05)	0.36 (0.94)	0.16 (0.47)	-0.05 (-0.15)	-0.16 (-0.51)	-0.20 (-0.60)	0.07 (0.23)	-0.38 (-1.15)	-0.42 (-1.09)		
FFC4 α	0.00 (0.00)	-0.03 (-0.08)	0.02 (0.04)	0.05 (0.16)	-0.29 (-0.96)	-0.30 (-1.12)	-0.30 (-1.18)	0.02 (0.06)	-0.38 (-1.61)	-0.31 (-1.02)		

Univariate $\beta_{\perp MAX}$ Portfolio Excess Returns

$\beta_{\perp MAX}$ is portion of β that is orthogonal to MAX

- Run cross-sectional regression of β on MAX
- $\beta_{\perp MAX}$ is intercept plus residual

Value	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low
$\beta_{\perp MAX}$	-0.02	0.31	0.47	0.60	0.73	0.85	0.99	1.16	1.40	1.90	
R	0.45 (2.01)	0.70 (3.43)	0.71 (3.36)	0.71 (3.21)	0.74 (3.17)	0.79 (3.21)	0.77 (2.99)	0.73 (2.66)	0.61 (2.00)	0.58 (1.56)	0.13 (0.50)
FFC4 α	-0.11 (-1.12)	0.16 (2.11)	0.11 (1.58)	0.05 (0.90)	0.05 (0.91)	0.07 (1.23)	0.02 (0.40)	-0.03 (-0.56)	-0.09 (-1.17)	-0.06 (-0.49)	0.05 (0.25)

$\beta_{\perp MAX}$ unrelated to returns

- High-Low alpha of 0.05% small and insignificant
- MAX explains betting against beta phenomenon

Univariate $MAX_{\perp\beta}$ Portfolio Excess Returns

$MAX_{\perp\beta}$ is portion of MAX that is orthogonal to β

- Run cross-sectional regression of MAX on β
- $MAX_{\perp\beta}$ is intercept plus residual

Value	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low
$Max_{\perp\beta}$	-0.03	0.57	0.91	1.24	1.57	1.94	2.38	2.94	3.81	6.44	
R	0.90 (3.75)	0.91 (4.21)	0.89 (4.19)	0.85 (3.83)	0.90 (3.92)	0.82 (3.36)	0.77 (3.00)	0.61 (2.24)	0.43 (1.49)	-0.29 (-0.88)	-1.19 (-6.72)
FFC4 α	0.35 (3.85)	0.34 (5.77)	0.31 (5.68)	0.25 (4.92)	0.27 (5.19)	0.14 (2.97)	0.07 (1.41)	-0.11 (-2.22)	-0.33 (-6.11)	-1.09 (-11.99)	-1.44 (-10.62)

$MAX_{\perp\beta}$ negatively related to returns

- High-Low alpha of -1.44% large and significant
 - Similar to unconditional result (FFC4 $\alpha = -1.40\%$)
- β fails to explain lottery demand phenomenon

High and Low β , MAX Correlation Months

Univariate Portfolios for Months with High and Low Correlation Between β and MAX: $\rho_{\beta, MAX}$

- Median cross-sectional correlation is 0.29
- Low correlation months: correlation $<$ median
- High correlation months: correlation $>$ median
- Correlation measured during portfolio formation month
- Returns from month after measured correlation

High and Low β , MAX Correlation - β Portfolios

Univariate Portfolios Sorted on β

$\rho_{\beta,MAX}$	Value	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low
High	β	0.05	0.27	0.43	0.57	0.71	0.86	1.02	1.23	1.52	2.09	
	R	0.74 (2.72)	0.88 (2.86)	0.93 (2.86)	0.94 (2.65)	1.02 (2.67)	0.84 (2.07)	0.81 (1.86)	0.68 (1.42)	0.40 (0.74)	0.05 (0.08)	-0.68 (-1.34)
	FFC4 α	0.23 (1.84)	0.29 (2.56)	0.29 (3.35)	0.24 (2.52)	0.30 (3.30)	0.09 (1.14)	0.07 (0.72)	-0.05 (-0.56)	-0.23 (-1.83)	-0.49 (-2.76)	-0.72 (-2.86)
Low	β	-0.06	0.23	0.41	0.55	0.69	0.83	0.98	1.16	1.41	1.94	
	R	0.65 (3.00)	0.69 (3.07)	0.62 (2.83)	0.61 (2.68)	0.60 (2.44)	0.61 (2.39)	0.61 (2.29)	0.62 (2.15)	0.62 (1.92)	0.64 (1.54)	-0.01 (-0.02)
	FFC4 α	0.19 (1.21)	0.18 (1.32)	0.01 (0.12)	-0.03 (-0.32)	-0.10 (-1.39)	-0.12 (-1.54)	-0.17 (-2.63)	-0.18 (-2.70)	-0.17 (-1.93)	-0.08 (-0.40)	-0.26 (-0.86)

- Betting against beta effect driven by high correlation months
- Phenomenon does not exist in low correlation months

High and Low β , MAX Correlation - MAX Portfolios

Univariate Portfolios Sorted on MAX

$\rho_{\beta,MAX}$	Value	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low
High	MAX	0.61	1.19	1.67	2.12	2.54	3.00	3.52	4.18	5.15	7.71	
	R	0.84 (2.89)	1.16 (3.59)	1.11 (3.30)	1.05 (3.01)	1.01 (2.73)	0.92 (2.30)	0.89 (2.00)	0.73 (1.54)	0.28 (0.54)	-0.71 (-1.22)	-1.55 (-3.97)
	FFC4 α	0.31 (2.53)	0.56 (5.65)	0.50 (5.59)	0.45 (5.50)	0.37 (4.32)	0.25 (3.07)	0.18 (2.15)	0.00 (0.04)	-0.45 (-4.52)	-1.44 (-9.14)	-1.76 (-7.63)
Low	MAX	0.71	1.32	1.71	2.07	2.43	2.83	3.30	3.90	4.81	7.53	
	R	0.65 (3.43)	0.84 (3.96)	0.82 (3.72)	0.83 (3.59)	0.78 (3.14)	0.72 (2.84)	0.71 (2.58)	0.60 (2.03)	0.43 (1.27)	-0.09 (-0.23)	-0.74 (-2.26)
	FFC4 α	0.18 (1.63)	0.25 (2.73)	0.20 (2.41)	0.14 (1.85)	0.10 (1.31)	0.00 (-0.03)	0.00 (-0.03)	-0.15 (-2.44)	-0.32 (-3.82)	-0.87 (-7.03)	-1.05 (-5.77)

- Lottery demand effect present in both correlation regimes
- Effect not driven by relation between MAX and β

Institutional Holdings and Betting against Beta

Bivariate Portfolios Sorted on *INST* then β

	<i>INST</i> 1	<i>INST</i> 2	<i>INST</i> 3	<i>INST</i> 4	<i>INST</i> 5	<i>INST</i> 6	<i>INST</i> 7	<i>INST</i> 8	<i>INST</i> 9	<i>INST</i> 10
β 1 (Low)	0.45	0.93	0.85	0.82	0.85	0.74	0.68	0.86	0.76	0.75
β 2	0.59	1.08	0.94	0.82	0.91	0.77	0.90	0.74	0.78	0.84
β 3	0.72	0.75	0.80	0.91	0.82	0.78	0.83	0.84	0.90	0.67
β 4	0.67	0.86	0.91	0.76	0.81	0.87	0.92	0.88	0.84	0.99
β 5	0.76	0.76	0.78	0.88	0.95	0.76	0.85	0.89	0.91	0.90
β 6	0.61	0.47	0.63	0.59	0.66	0.64	0.95	0.72	0.81	0.94
β 7	0.45	0.47	0.45	0.71	0.70	0.68	0.74	0.92	0.95	1.03
β 8	0.37	0.24	0.37	0.50	0.50	0.60	1.02	0.98	0.93	1.05
β 9	-0.30	-0.27	0.17	0.20	0.24	0.58	0.65	0.77	0.92	1.21
β 10 (High)	-1.16	-0.87	-0.44	-0.31	-0.06	0.10	0.50	0.81	0.88	1.18
High-Low	-1.61 (-4.42)	-1.80 (-4.10)	-1.29 (-2.87)	-1.13 (-2.44)	-0.91 (-1.98)	-0.64 (-1.43)	-0.18 (-0.43)	-0.05 (-0.12)	0.12 (0.29)	0.43 (1.02)
FFC4 α	-1.91 (-6.88)	-1.91 (-6.00)	-1.31 (-3.59)	-1.22 (-3.15)	-1.01 (-3.07)	-0.75 (-2.77)	-0.18 (-0.64)	-0.03 (-0.10)	0.11 (0.31)	0.41 (1.17)

- Betting against beta only works in low *INST* stocks
- Not held by mutual funds, pension funds, etc.

Institutional Holdings and Lottery Demand

Bivariate Portfolios Sorted on *INST* then *MAX*

	<i>INST</i> 1	<i>INST</i> 2	<i>INST</i> 3	<i>INST</i> 4	<i>INST</i> 5	<i>INST</i> 6	<i>INST</i> 7	<i>INST</i> 8	<i>INST</i> 9	<i>INST</i> 10
MAX 1 (Low)	0.53	0.83	0.57	0.86	0.69	0.84	0.86	1.00	1.17	1.06
MAX 2	0.94	0.97	1.00	1.02	0.95	0.91	1.09	1.13	1.03	1.11
MAX 3	0.99	0.96	0.93	1.05	1.01	0.96	1.07	0.89	1.04	1.01
MAX 4	0.79	0.93	0.94	1.08	0.83	0.88	0.89	1.03	0.86	0.93
MAX 5	0.88	0.85	1.02	0.91	0.82	0.86	1.02	0.87	0.86	0.91
MAX 6	0.69	0.44	0.62	0.79	0.93	0.60	0.84	0.72	0.93	0.91
MAX 7	0.43	0.55	0.60	0.63	0.72	0.67	0.94	0.75	0.81	0.87
MAX 8	0.18	0.33	0.54	0.36	0.44	0.72	0.65	0.87	0.95	0.89
MAX 9	-0.48	-0.32	0.03	-0.13	0.22	0.34	0.44	0.72	0.50	0.94
MAX 10 (High)	-1.82	-1.12	-0.80	-0.68	-0.23	-0.26	0.21	0.46	0.56	0.92
High-Low	-2.36 (-6.54)	-1.94 (-5.32)	-1.37 (-3.01)	-1.53 (-3.71)	-0.92 (-2.09)	-1.10 (-2.71)	-0.64 (-1.67)	-0.54 (-1.42)	-0.60 (-1.72)	-0.14 (-0.41)
FFC4 α	-2.68 (-9.18)	-2.14 (-7.58)	-1.55 (-4.93)	-1.73 (-6.33)	-1.11 (-3.60)	-1.22 (-4.35)	-0.80 (-2.82)	-0.65 (-2.25)	-0.74 (-2.57)	-0.19 (-0.73)

- Lottery demand stronger in low *INST* stocks
- Consistent with retail phenomenon

Lottery Demand Factor

Lottery Demand Factor (FMAX)

- Sort stocks into 2 market capitalization groups
 - Breakpoint is median NYSE market capitalization
- Independently sort stocks into 3 *MAX* groups
 - Breakpoints are 30th and 70th percentiles of *MAX*
 - Calculated using all NYSE/AMEX/Nasdaq stocks
- FMAX factor is average return of 2 high *MAX* portfolios minus average return of 2 low *MAX* portfolios

FMAX Factor Returns

- -0.54% average monthly returns
- 4.83% monthly return standard deviation
- Newey and West (1987) t -statistic = -2.55

Factor Analysis of High-Low β Portfolio

Factor Sensitivities Using 4 Different Factor Models

- PS is Pastor and Stambaugh (2003) liquidity factor
 - Only available 1968 - 2011

	α	β_{MKTRF}	β_{SMB}	β_{HML}	β_{UMD}	β_{PS}	β_{FMAX}	N	Adj. R^2
FFC4	-0.51 (-2.50)	0.98 (13.46)	0.58 (8.26)	-0.74 (-6.36)	-0.21 (-2.68)			593	73.43%
FFC4+PS	-0.49 (-2.26)	0.98 (13.17)	0.53 (7.34)	-0.77 (-6.60)	-0.24 (-3.05)	-0.09 (-1.35)		540	74.58%
FFC4+FMAX	0.06 (0.35)	0.61 (10.31)	0.09 (1.12)	-0.30 (-4.69)	-0.19 (-4.11)		0.85 (12.49)	593	84.79%
FFC4+PS+FMAX	0.04 (0.22)	0.63 (10.50)	0.07 (0.92)	-0.32 (-4.79)	-0.21 (-4.21)	-0.03 (-0.75)	0.82 (11.72)	540	85.06%

Lottery demand factor explains alpha of High-Low β portfolio

β Decile Portfolio Alphas

Alphas of β Sorted Decile Portfolios

	(Low)	2	3	4	5	6	7	8	9	(High)	High-Low
FFC4	0.22 (2.22)	0.24 (2.77)	0.16 (2.31)	0.11 (1.59)	0.10 (1.69)	-0.02 (-0.30)	-0.05 (-0.80)	-0.11 (-1.83)	-0.18 (-2.20)	-0.29 (-2.22)	-0.51 (-2.50)
FFC4 + PS	0.23 (2.12)	0.24 (2.51)	0.16 (2.09)	0.10 (1.34)	0.09 (1.36)	-0.03 (-0.48)	-0.07 (-1.04)	-0.10 (-1.76)	-0.18 (-2.18)	-0.26 (-1.91)	-0.49 (-2.26)
FFC4 + FMAX	0.08 (0.85)	0.06 (0.83)	-0.04 (-0.66)	-0.09 (-1.64)	-0.05 (-0.92)	-0.15 (-2.56)	-0.12 (-2.01)	-0.10 (-1.69)	-0.01 (-0.17)	0.14 (1.37)	0.06 (0.35)
FFC4 + PS + FMAX	0.10 (0.92)	0.07 (0.86)	-0.03 (-0.55)	-0.09 (-1.64)	-0.06 (-1.14)	-0.16 (-2.66)	-0.15 (-2.26)	-0.11 (-1.71)	-0.03 (-0.36)	0.14 (1.23)	0.04 (0.22)

FMAX explains alpha of high- β and low- β portfolios

BAB Factor

BAB Factor

- Return of long-short beta portfolio
 - Long stocks with low beta
 - Short stocks with high beta
- Breakpoint is median beta
- Weights determined by distance from median
 - More extreme betas have higher weight
- Positive abnormal returns using standard factor models
- Data from Lasse Pedersen's website
 - Covers August 1963 - March 2012

BAB Factor Sensitivities

Factor Analysis of BAB Factor Returns

Specification	α	β_{MKTRF}	β_{SMB}	β_{HML}	β_{UMD}	β_{PS}	β_{FMAX}	N	Adj. R^2
FFC4	0.54 (3.38)	0.05 (1.06)	-0.01 (-0.09)	0.51 (5.01)	0.18 (2.87)			584	21.03%
FFC4+PS	0.57 (3.34)	0.06 (1.23)	0.02 (0.30)	0.53 (5.18)	0.20 (3.13)	0.06 (0.96)		531	23.44%
FFC4+FMAX	0.17 (1.23)	0.29 (8.22)	0.31 (5.46)	0.21 (3.49)	0.17 (4.39)		-0.55 (-11.84)	584	46.95%
FFC4+PS+FMAX	0.22 (1.39)	0.29 (7.96)	0.32 (5.29)	0.24 (3.72)	0.19 (4.43)	0.03 (0.63)	-0.54 (-11.11)	531	47.38%

FMAX factor explains returns of BAB factor

FMAX Factor Sensitivities

Factor Analysis of FMAX Factor Returns

Specification	α	β_{MKTRF}	β_{SMB}	β_{HML}	β_{UMD}	β_{PS}	β_{BAB}	N	Adj. R^2
FFC4	-0.67 (-5.12)	0.43 (8.36)	0.58 (6.39)	-0.53 (-4.59)	-0.01 (-0.19)			584	62.24%
FFC4+PS	-0.65 (-4.60)	0.42 (8.17)	0.56 (5.51)	-0.54 (-4.72)	-0.03 (-0.41)	-0.06 (-1.00)		540	62.36%
FFC4+BAB	-0.35 (-2.88)	0.46 (13.06)	0.58 (8.22)	-0.23 (-3.09)	0.09 (1.67)		-0.60 (-11.44)	584	74.64%
FFC4+PS+BAB	-0.32 (-2.32)	0.46 (12.66)	0.57 (7.35)	-0.24 (-3.11)	0.09 (1.46)	-0.02 (-0.55)	-0.59 (-10.90)	531	74.20%

FMAX factor returns not explained by BAB factor

Proxy for Risk-Factor Sensitivity?

Does *MAX* capture a factor sensitivity?

β_{FMAX}

- Sensitivity to *FMAX* factor
- Calculated using five years of monthly data

Proxy for Risk-Factor Sensitivity?

Does MAX capture a factor sensitivity?

β_{FMAX}

- Sensitivity to FMAX factor
- Calculated using five years of monthly data

Univariate Portfolio Analysis

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low
β_{FMAX}	0.17	0.49	0.71	0.90	1.09	1.28	1.49	1.77	2.15	2.99	
R	0.42 (3.08)	0.44 (2.90)	0.56 (3.60)	0.48 (2.69)	0.45 (2.31)	0.50 (2.29)	0.47 (1.94)	0.56 (1.98)	0.54 (1.73)	0.50 (1.26)	0.09 (0.25)
FFC4 α	0.02 (0.18)	0.00 (0.00)	0.07 (1.06)	-0.01 (-0.11)	-0.03 (-0.56)	-0.06 (-0.85)	-0.04 (-0.58)	0.03 (0.31)	0.00 (0.01)	-0.04 (-0.24)	-0.05 (-0.26)

Fama-MacBeth (1973) Regressions

Regressions with and without MAX

- Full results on next slide

	(1)	(2)	(3)	(4)	(5)
β_{FMAX}	-0.145 (-0.96)	0.035 (0.27)	-0.028 (-0.30)	-0.017 (-0.19)	-0.026 (-0.23)
MAX		-0.205 (-9.08)	-0.313 (-8.35)	-0.314 (-8.44)	-0.226 (-6.56)
β			0.242 (2.03)	0.434 (2.50)	0.454 (2.14)
Firm Chars	No	No	Yes	Yes	Yes
Risk	No	No	No	Yes	Yes
Fund Liq	No	No	No	No	Yes

- β_{FMAX} has no relation with future stock returns
- β remains positively related to future stock returns
- MAX remains negatively related to future stock returns

Full Fama-MacBeth (1973) Regression Results

	(1)	(2)	(3)	(4)	(5)
β_{FMAX}	-0.145 (-0.96)	0.035 (0.27)	-0.028 (-0.30)	-0.017 (-0.19)	-0.026 (-0.23)
MAX		-0.205 (-0.08)	-0.313 (-8.35)	-0.314 (-8.44)	-0.226 (-6.56)
β			0.242 (2.03)	0.434 (2.50)	0.454 (2.14)
SIZE			-0.147 (-4.15)	-0.150 (-4.26)	-0.103 (-2.92)
BM			0.174 (2.92)	0.174 (2.93)	0.156 (2.57)
MOM			0.007 (5.13)	0.008 (5.46)	0.007 (5.07)
ILLIQ			-0.015 (-1.48)	-0.016 (-1.54)	-0.009 (-0.89)
IVOL			0.057 (1.18)	0.065 (1.36)	-0.017 (-0.41)
COSKEW				-0.007 (-1.14)	-0.010 (-1.23)
TSKEW				-0.054 (-3.24)	-0.044 (-2.43)
DRISK				-0.154 (-1.50)	-0.256 (-1.96)
TRISK				-0.038 (-0.87)	-0.036 (-0.71)
β_{TED}					-0.007 (-0.60)
β_{VOLTED}					-0.001 (-0.53)
β_{TBILL}					0.003 (0.14)
β_{FLEV}					-0.031 (-1.12)
Intercept	0.767 (3.81)	1.233 (6.74)	2.032 (6.86)	2.054 (6.83)	1.843 (5.54)
α	3.194	3.194	2.592	2.592	2.931
Adj. R ²	2.74%	3.42%	7.00%	7.50%	7.47%

Characteristics of high-MAX and low-MAX stocks

Lottery stocks characterizations - Kumar (2009)

- Low prices, high idiosyncratic vol, high idiosyncratic skew

Contemporaneous Characteristics

Value	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low	t-stat
MAX	0.66	1.25	1.69	2.09	2.49	2.91	3.41	4.04	4.98	7.62	6.96	40.99
PRICE	70.76	49.56	41.76	34.49	28.79	28.40	23.30	20.25	18.41	14.99	-55.77	-5.90
IVOL	0.94	1.20	1.37	1.52	1.71	1.94	2.22	2.57	3.08	4.58	3.64	33.64
ISKEW	-0.17	0.04	0.07	0.09	0.14	0.19	0.25	0.33	0.43	0.69	0.86	33.67

Future Characteristics

Value	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	High-Low	t-stat
MAX	1.65	2.06	2.33	2.55	2.79	3.06	3.35	3.68	4.09	4.83	3.17	31.39
PRICE	72.27	50.01	42.26	34.87	29.13	28.62	23.57	20.52	18.76	15.38	-56.89	-5.89
IVOL	1.35	1.48	1.60	1.71	1.86	2.04	2.24	2.46	2.75	3.31	1.96	33.41
ISKEW	0.21	0.19	0.17	0.17	0.18	0.19	0.20	0.22	0.23	0.26	0.05	3.51

MAX captures lottery qualities of stocks

Conclusion

Conclusions

Betting against beta phenomenon is driven by demand for lottery-like assets

- Portfolio, regression, and factor analyses all indicate that lottery demand explains returns of High-Low beta portfolio
- Phenomenon exists only when lottery price pressure exerted predominantly on high- β stocks
- Both phenomena driven by low institutional holdings stocks
 - Consistent with lottery demand (retail investors)
 - Inconsistent with leverage constraints (mutual funds, pensions)

Lottery-demand not explained by betting against beta

- After controlling for beta, the lottery demand effect persists