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TRIVARIATE RESEARCH

WHAT'S THE RIGHT BETA FOR YOUR PORTFOLIO?

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BACKGROUND AND RESEARCH SUMMARY

Background: In December we wrote a detailed note about beta ([link](#)), and how there is persistent alpha destruction associated with each incremental increase in portfolio beta. Investors tend to ignore beta when the market is performing well, like it did in 2023 and 2024. But the recent price action is likely a warning sign for CIOs, Portfolio Managers, and Chief Risk Officers that the prior strong performance for high beta stocks is an increasing risk. For instance, for many generalist portfolio managers, it has been a challenge to correctly size Semiconductor positions, as betas are both high and disperse vs. history. The sell-off earlier this week is less alpha destruction and more beta than some investors may realize.

In today's work, we attempt to find the efficient frontier, or "optimal" *portfolio level* beta. We do this by analyzing the top 500 US equities for five factors beyond the market: size (top 100 vs. 401-500), growth vs. value, high-quality vs. junk, liquidity (most vs. least), and momentum (high vs. low).

The higher the beta, the lower the alpha: Across the market, there is a clear inverse relationship between beta and alpha. Lower beta stocks have higher alpha, and the higher beta stocks have lower alpha and higher volatility of beta. The pattern perfectly rank orders across beta decile for the overall market over the last 25 years.

INVESTMENT CONCLUSIONS

Factor Beta:

- 1) **Size doesn't matter:** The beta of stocks between top 100 by market cap. and 401-500, is generally not important, with the 20-year average close to zero, and always less meaningful than the beta of style and quality.
- 2) **Style matters:** For value minus growth, the beta of growth is near 20-year highs, which is not surprising given Semiconductors currently have high beta.
- 3) **Substance matters:** Junk has always been higher beta than high-quality, and was quite so post the election last November, but moderated some in December.
- 4) **Momentum has cyclical beta:** The beta of the momentum factor is very cyclical, with three-to-four-year periodicity over the last two decades. Today, the high momentum beta is quite elevated, and just off a cyclical peak.
- 5) **Liquid stocks are higher beta:** The beta of highly liquid stocks is consistently higher than the beta of low liquidity stocks and is near highs today. Liquidity and momentum betas, along with growth, are all large contributors today.

Optimal portfolio beta: We utilized our own custom optimizer and selected an optimal portfolio each month since 2005 under varying conditions. We chose to focus on three different portfolios (min-vol, max-Sharpe, max-return) to show a range of outcomes. The optimal portfolio betas over the last 20 years have oscillated between 0.65 and 1.25, with lower volatility for the Min Vol. and Max Sharpe portfolios than the Max Return approach, where the current optimal beta is high vs. history.

INVESTMENT CONCLUSIONS

Conclusion: Over the last 20 years, the “efficient frontier” or optimal beta for a median portfolio appears to be between 0.95 and 1. For a min-vol portfolio, the optimal portfolio beta appears to be 0.95. For a max-Sharpe portfolio, the optimal median beta is 0.98, and for the max-return it is 0.995.

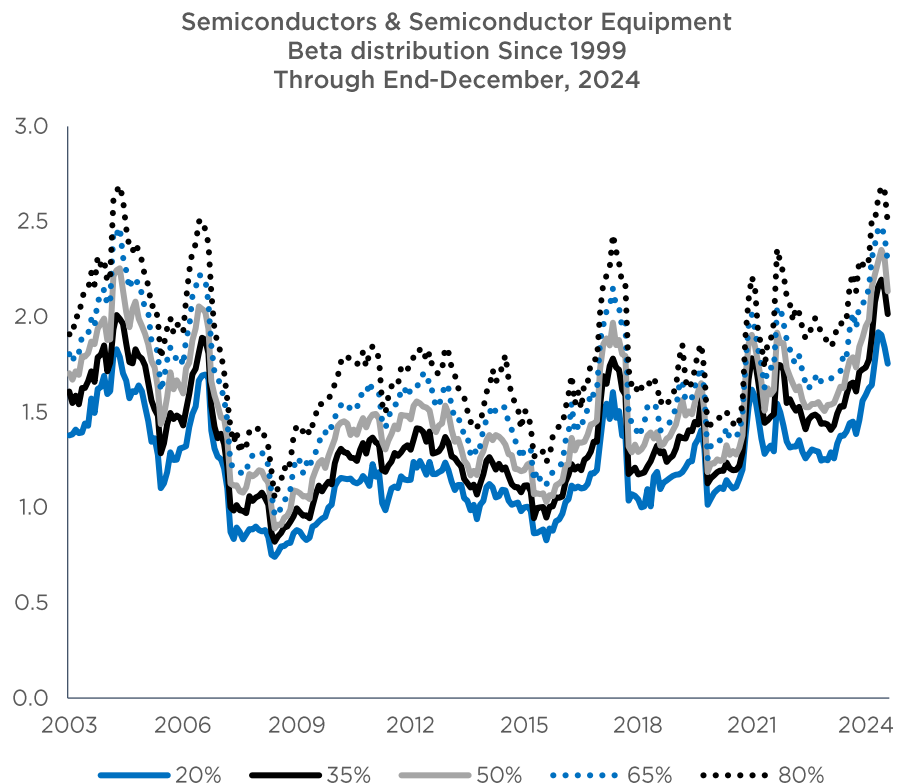
Max-Sharpe Beta’s Over Time: We also analyzed the maximum Sharpe portfolios specifically across time, looking at their beta vs. volatility and observed a positive relationship. At an annualized volatility of 10% - 25%, most of the portfolios have beta below 1. The interest rate meltdown in 2022 had the lowest optimal portfolio betas, near 0.7, and the Financial Crisis recovery in 2009, had the highest, around 1.2.

Optimal portfolio today: We show how different levels of volatility changes the optimal factor weights of liquidity, momentum, style and quality for optimal portfolios as of the **end of December 2024**. The optimal way to lower your portfolio beta is to overweight value, high-quality, and momentum, and to low liquidity stocks. **The maximum Sharpe portfolio across the distribution has a beta of 0.95 with an overweight in value and high-quality and an underweight in liquidity.**

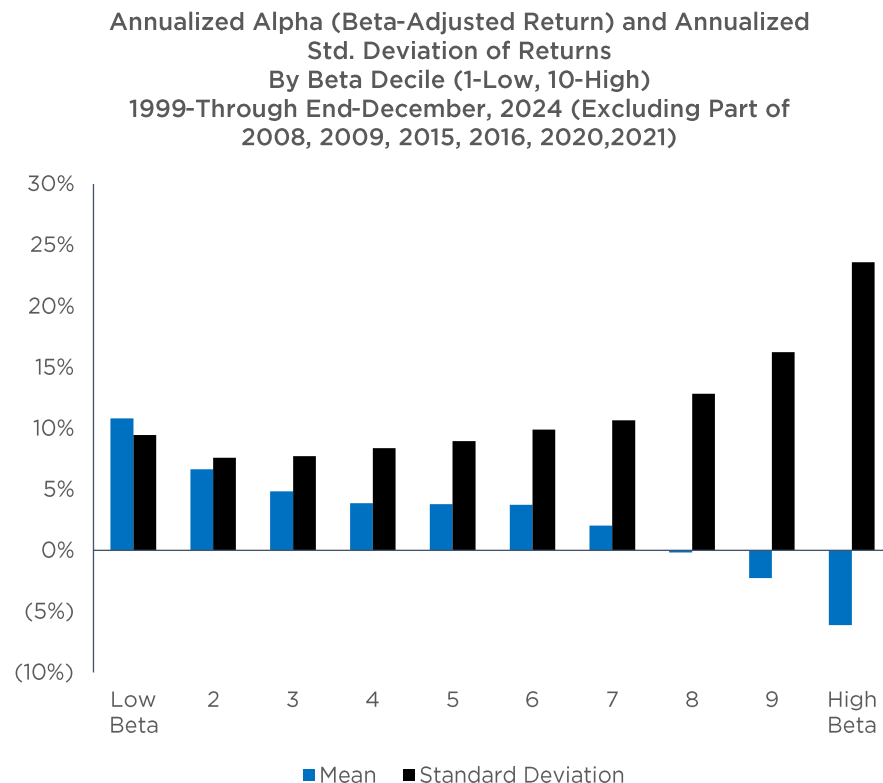
Low and high beta optimal stock ideas: On Slide 13, we show optimal high and low beta stock ideas. If you are looking to lower your portfolio beta efficiently, owning high-quality value stocks with relatively low liquidity is a prudent strategy. This list includes XOM, PM, LOW, and MDT, among others. If you want to take more risk, the optimal factor loadings would be to add to highly liquid growth stocks that are junk quality. This includes TSLA, APP, MU, and MRVL, among others. Overweighting the first group and underweighting the second, or vice-versa, would amplify the exposure to a lower or higher risk portfolio.

SEMICONDUCTOR BETAS ARE HIGH; HIGH BETA HAS NEGATIVE ALPHA

For many portfolio managers, it has been a challenge to correctly size their Semiconductors exposure, because across the distribution the betas are as high as they have ever been – higher than the TMT bubble toward the end of last year (left). The huge sell-off earlier this week is less alpha destruction and more beta than some investors may realize. Historically, there has been a very consistent and strong relationship between beta and alpha, with each decile of higher beta coming with some commensurate incremental alpha destruction (right). We removed years where the market was highly volatile, such as the Financial Crisis and COVID and their immediate recoveries, to avoid distortion.



Source: Trivariate Research



Source: Trivariate Research

MARKET HAS TO BE UP >12% FOR A LOWER BETA EXPOSURE TO HURT

The long-term betas for the mid-point of each decile (meaning the 5th, 15th, 25th percentiles and so on) are shown on the left. Five percent of stocks have a beta less than 0.30, and the median stock in the lowest beta decile has 10.8% of annualized alpha. On the contrary, only 5% of stocks have a beta higher than 2.18 historically, and the highest beta decile realizes an annual NEGATIVE alpha of 610bps. Assuming these historical betas by decile hold constant, we simulated the expected return (market assumption*beta + alpha) for various S&P500 return scenarios (right). Once the market's returns are above 12%, the higher beta is enough to offset its alpha destruction. No one has cared much about beta the last two years, because market returns have been strong. But if we get a 10% sell-off, we'd expect stocks in the highest decile of beta to be down 28% on average, with no above normal alpha destruction.

**Performance Statistics of Beta Deciles
1999 Through End-December, 2024**

Beta Decile	Annualized Alpha	Hit Rate	Median Beta
1	10.8%	67.3%	0.30
2	6.6%	62.1%	0.57
3	4.8%	59.5%	0.75
4	3.9%	56.5%	0.89
5	3.8%	56.1%	1.01
6	3.7%	54.3%	1.14
7	2.0%	50.6%	1.27
8	(0.2%)	45.4%	1.42
9	(2.3%)	43.1%	1.67
10	(6.1%)	42.8%	2.18

Source: Trivariate Research

**Implied Annual Return Under Different Assumptions
As of End-December, 2024**

Move	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
(30%)	3.4%	(9.8%)	(17.0%)	(22.3%)	(26.6%)	(30.5%)	(35.8%)	(43.0%)	(52.5%)	(72.6%)
(25%)	4.7%	(7.1%)	(13.3%)	(17.9%)	(21.5%)	(24.8%)	(29.5%)	(35.8%)	(44.1%)	(61.5%)
(20%)	5.9%	(4.3%)	(9.7%)	(13.6%)	(16.4%)	(19.1%)	(23.2%)	(28.6%)	(35.7%)	(50.4%)
(15%)	7.2%	(1.6%)	(6.0%)	(9.2%)	(11.4%)	(13.4%)	(16.8%)	(21.5%)	(27.3%)	(39.4%)
(10%)	8.4%	1.2%	(2.4%)	(4.8%)	(6.3%)	(7.6%)	(10.5%)	(14.3%)	(19.0%)	(28.3%)
(5%)	9.7%	4.0%	1.3%	(0.4%)	(1.2%)	(1.9%)	(4.2%)	(7.2%)	(10.6%)	(17.3%)
0%	10.9%	6.7%	4.9%	4.0%	3.9%	3.8%	2.1%	(0.0%)	(2.2%)	(6.2%)
5%	12.2%	9.5%	8.6%	8.3%	8.9%	9.5%	8.5%	7.1%	6.2%	4.8%
6%	12.6%	10.1%	9.3%	9.2%	9.8%	10.6%	9.6%	8.4%	7.8%	6.9%
8%	13.2%	11.2%	10.8%	11.0%	11.8%	12.8%	12.2%	11.2%	11.1%	11.3%
10%	13.8%	12.4%	12.3%	12.8%	13.9%	15.1%	14.7%	14.1%	14.5%	15.6%
12%	14.4%	13.5%	13.8%	14.5%	15.9%	17.4%	17.3%	16.9%	17.8%	20.0%
14%	15.1%	14.7%	15.3%	16.3%	17.9%	19.7%	19.8%	19.8%	21.2%	24.3%
15%	14.7%	15.0%	15.9%	17.1%	19.1%	21.0%	21.1%	21.4%	23.0%	27.0%
20%	16.0%	17.8%	19.5%	21.5%	24.2%	26.7%	27.4%	28.6%	31.4%	38.0%
25%	17.2%	20.5%	23.2%	25.9%	29.3%	32.4%	33.7%	35.7%	39.8%	49.1%
30%	18.5%	23.3%	26.8%	30.2%	34.3%	38.2%	40.1%	42.9%	48.2%	60.1%

Source: Trivariate Research

METHODOLOGY FOR STUDYING THE EFFICIENT FRONTIER OF BETA

We wanted to investigate what the right portfolio level alpha is by analyzing the beta of an optimal portfolio along the efficient frontier over time and in aggregate.

The portfolio is constructed using returns from six common risk factors which we think explains most of the market volatility over the last twenty years. To replicate factor returns, we use the S&P 500 for our **market** factor, then we use five other factors:

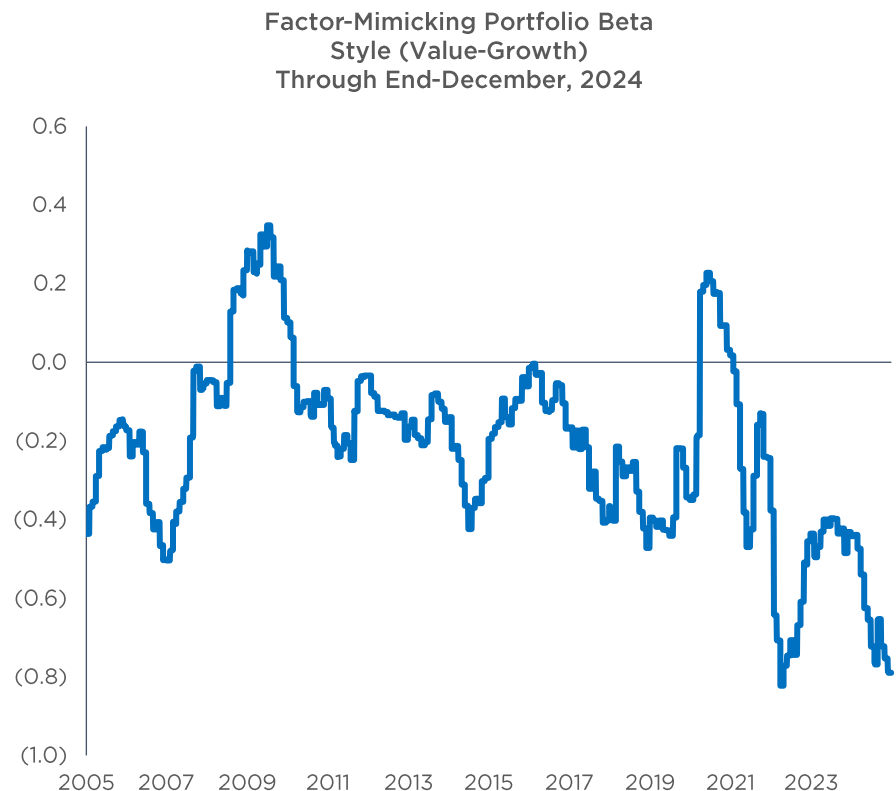
- 1) **Style:** Value minus growth
- 2) **Substance:** High quality minus junk
- 3) **Size:** Largest 100 stocks minus stocks sized 401 to 500
- 4) **Momentum:** Best performing stocks 12 minus 1 months minus worst performing
- 5) **Liquidity:** Most liquid 100 minus least liquid (shares traded divided by floated market cap.)

Except for the market factor, these factor portfolios are market-neutral, long-short portfolios with non-zero betas. We constrain the portfolio's market exposure to exactly 100% while limiting the gross exposure to other factor portfolios to a maximum of 50%. We then constructed the efficient frontier monthly starting in 2005 (approximately 250 monthly data points).

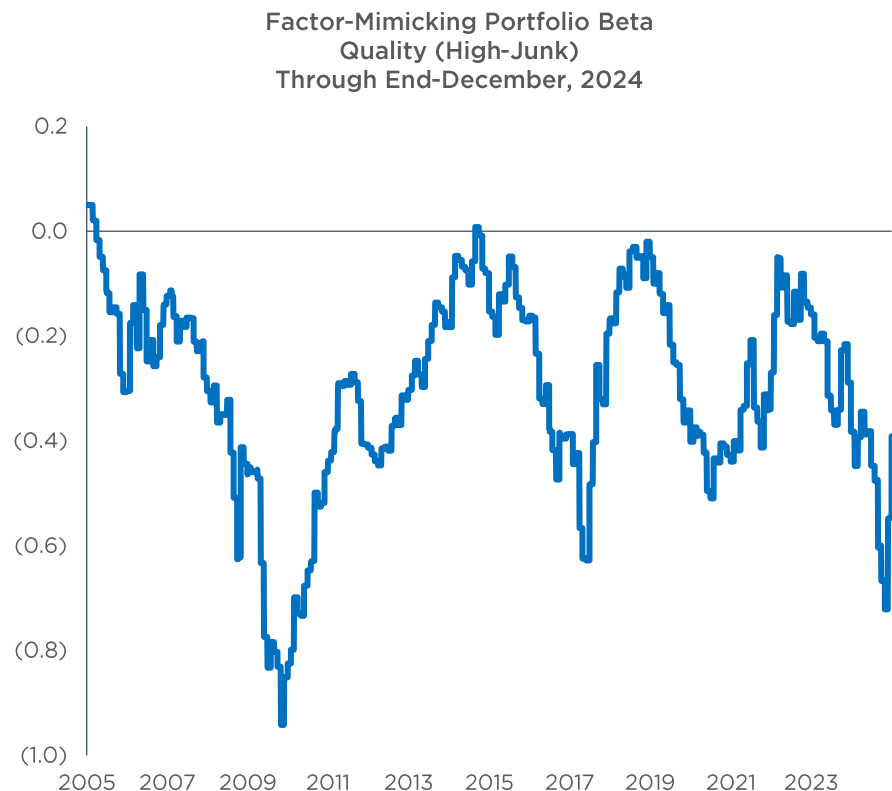
We studied the distribution of betas and contribution from each factor for efficient portfolios over time, focusing on three key portfolios along the efficient frontier: Minimum Volatility, Maximum Return, and the Maximum Sharpe (tangency) portfolio.

GROWTH BETA HAS RARELY MATTERED MORE IN 20 YEARS

Generally, the beta of the size factor is not that different between top 100 and 401-500, with the 20-year average close to zero, and always less of an impact than style and substance, so we are not showing it here. For value minus growth (left), the beta of growth is very high today, near 20-year highs. Junk has always been higher beta than quality—and was quite so post the election last November (right)—but moderated some in December.



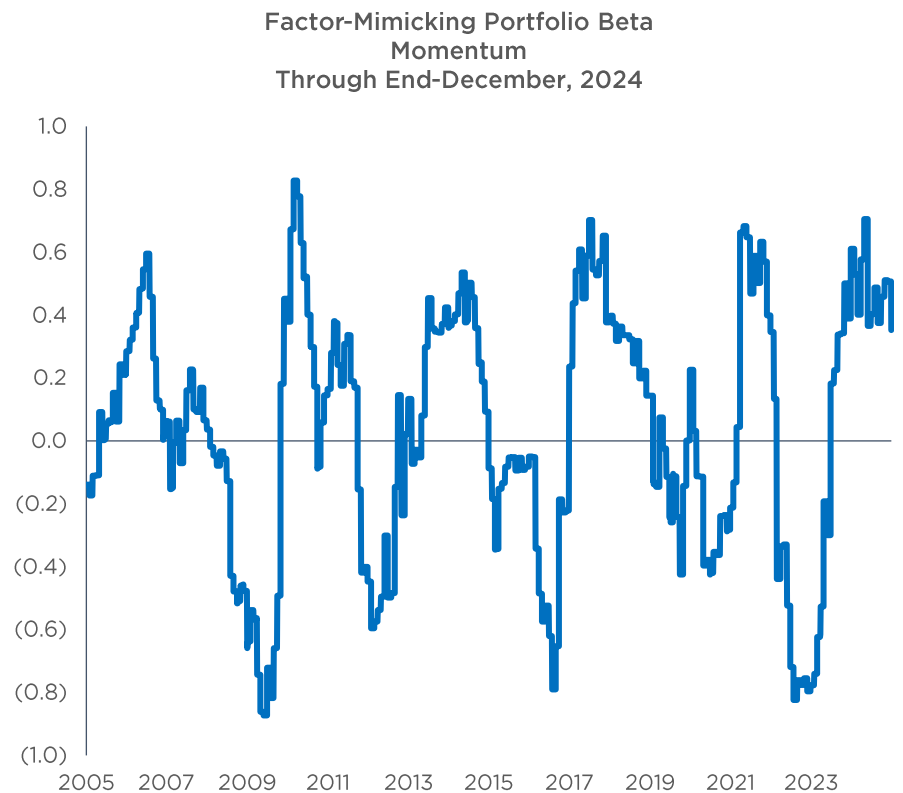
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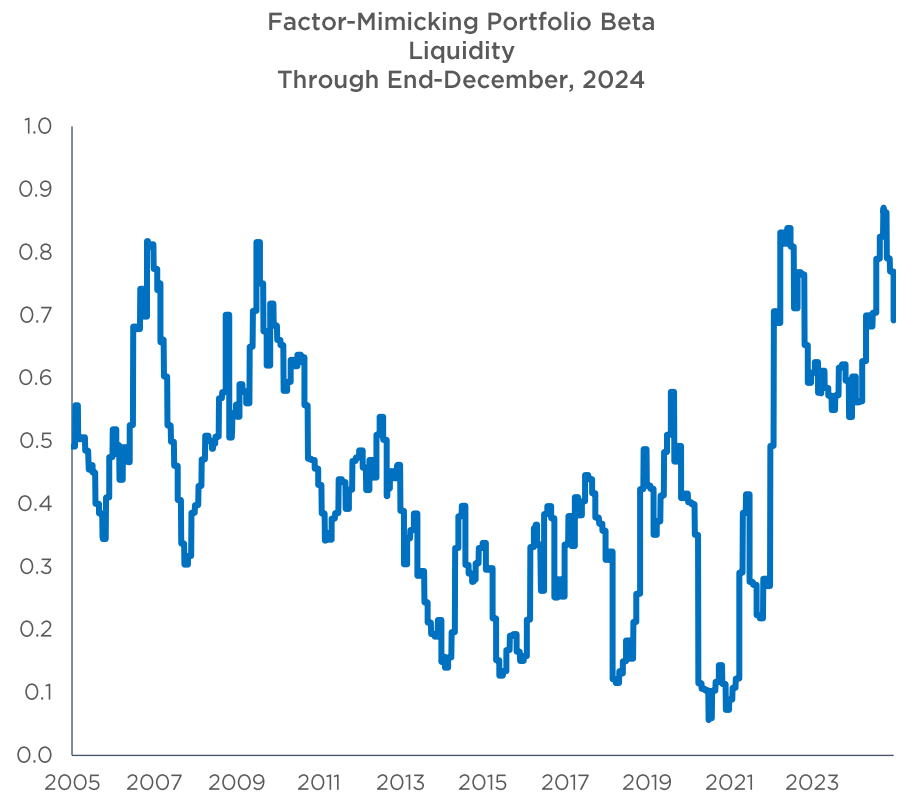
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MOMENTUM AND LIQUIDITY BETAS ARE BOTH CURRENTLY ELEVATED

The beta of the momentum factor is very cyclical, with three-to-four-year periodicity over the last two decades (left). Today, the high momentum beta is quite elevated, just past a cyclical peak. The beta of highly liquid stocks is consistently higher than the beta of low liquidity stocks (right) and is near highs today. Liquidity and momentum betas, along with growth, are all large contributors today.



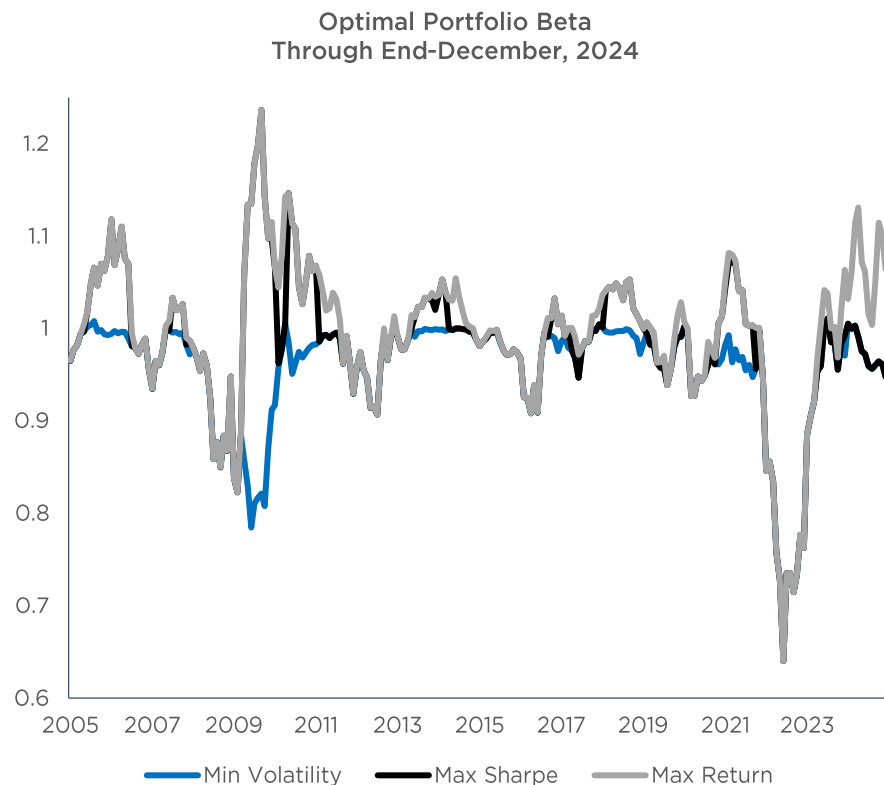
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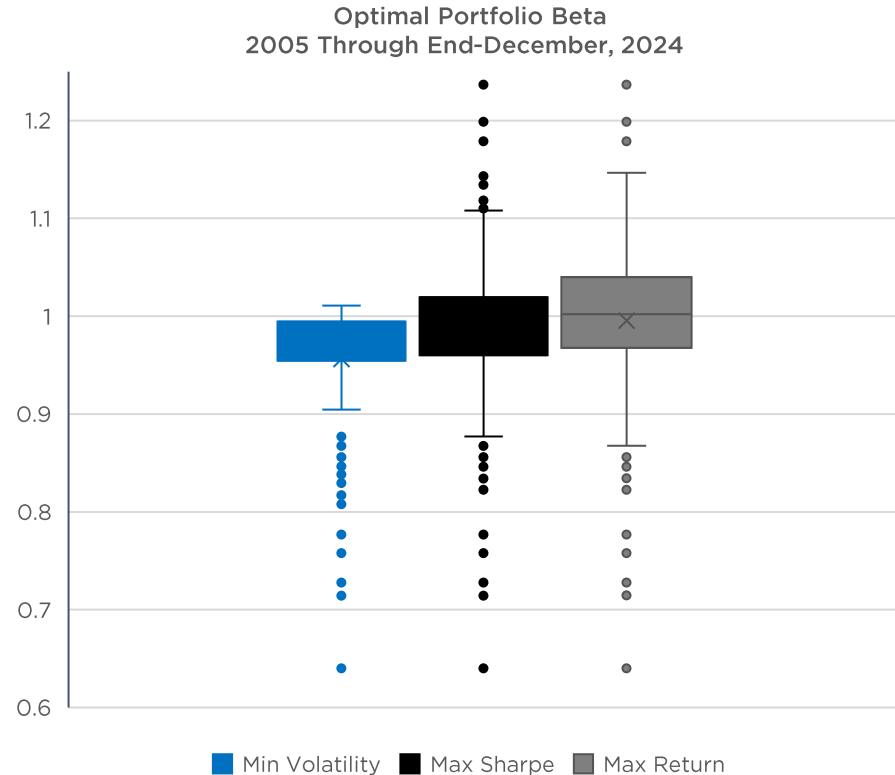
Source: Trivariate Research

OPTIMAL PORTFOLIO BETA IS BETWEEN 0.95 AND 1

We then used our own custom optimizer and selected an optimal portfolio each month since 2005. We chose to focus on three different portfolios to show a range of outcomes. Firstly, the lowest volatility portfolio (or Min Volatility) in blue on the left, secondly the maximum Sharpe ratio portfolio in black, and lastly the maximum return portfolio in gray. The optimal portfolio betas over the last 20 years have oscillated between 0.65 and 1.25, with lower volatility for the Min Vol. and Max Sharpe portfolios than the Max Return approach, where the current optimal beta is high vs. history. **On the right, we show the distribution of the betas for these three approaches with box and whiskers plots.** For a min-vol portfolio, the optimal portfolio beta appears to be 0.95. For a max-Sharpe portfolio, the optimal average beta is 0.98, and for the max return it is 0.995.



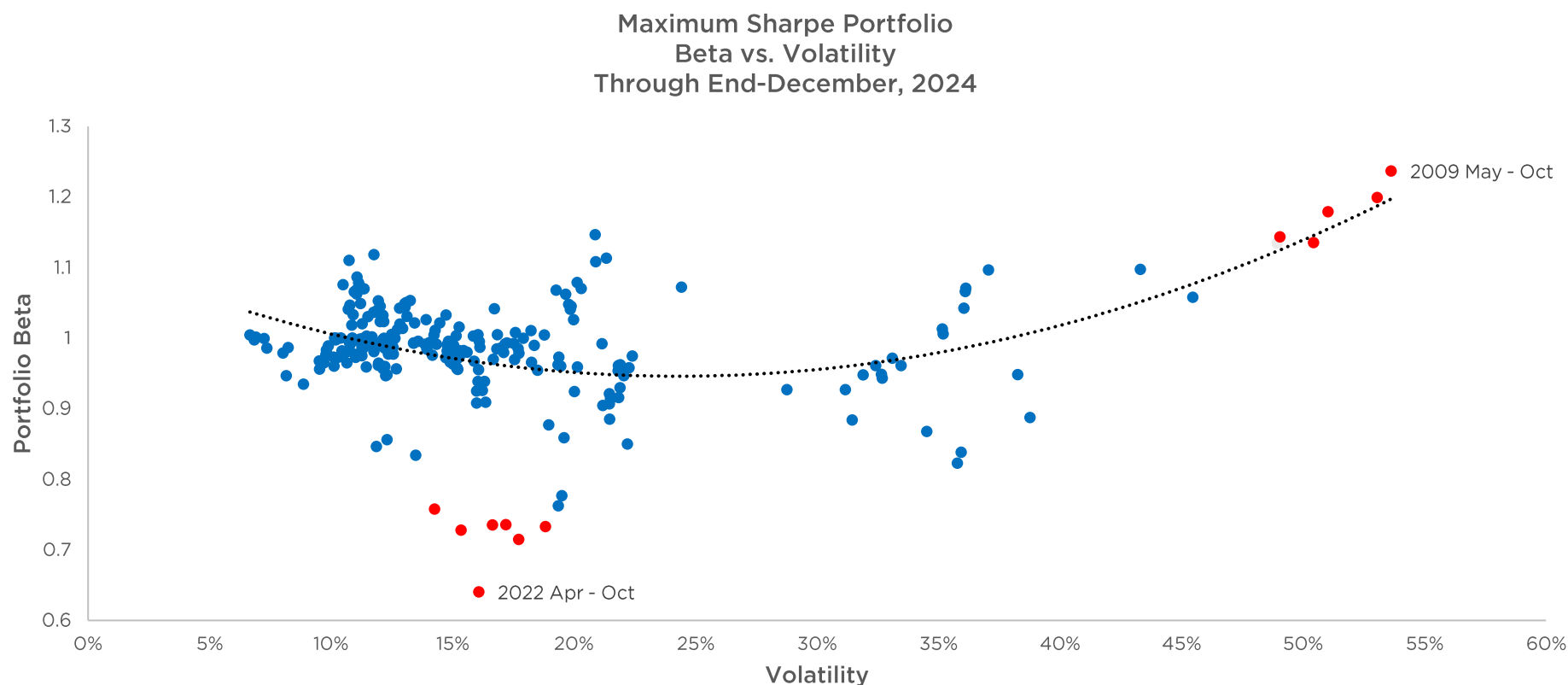
Source: Trivariate Research



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OPTIMAL PORTFOLIO BETAS ARE GENERALLY BELOW 1

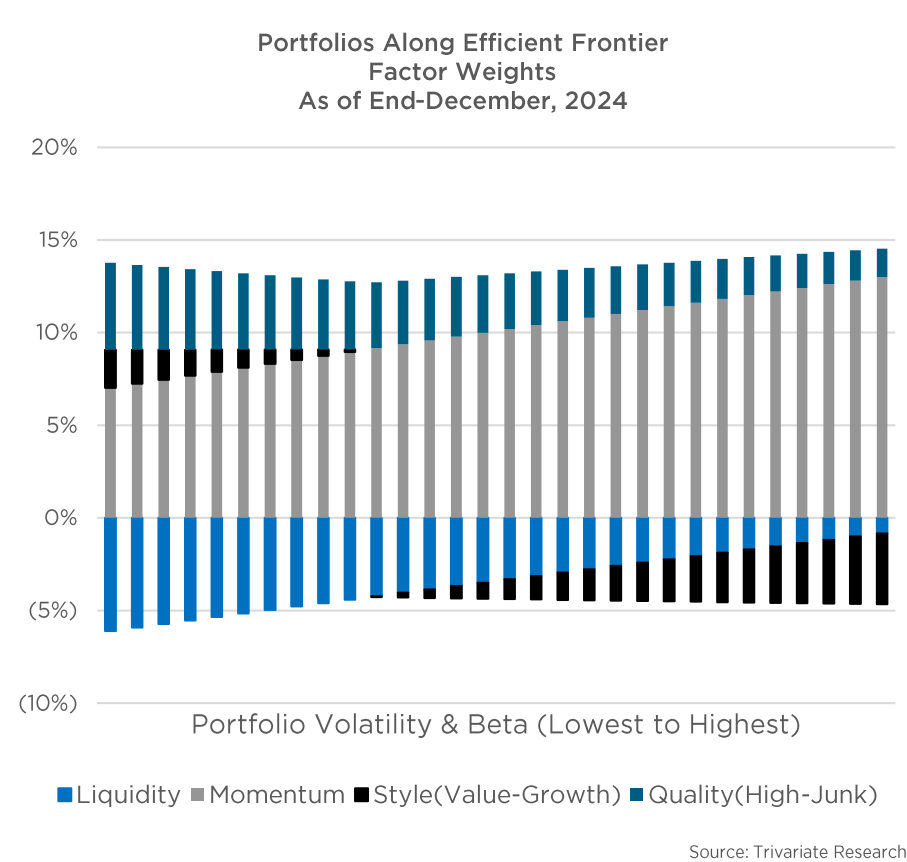
We also analyzed the maximum Sharpe portfolios across time, looking at their beta vs. volatility and observed a positive relationship. At an annualized volatility of 10% - 25%, a majority of the portfolios have beta well below 1. The interest rate meltdown in 2022 had the lowest optimal portfolio betas, near 0.7, and the Financial Crisis recovery in 2009, had the highest, around 1.2.



Source: Trivariate Research

TODAY THE MAX SHARPE PORTFOLIO IS LONG VALUE AND QUALITY

On the left, we show how different levels of volatility changes the optimal factor weights of liquidity, momentum, style and quality for optimal portfolios as of the end of December 2024. The more volatility, the more momentum, growth, and lower liquidity. The optimal way to lower your portfolio beta is to overweight value, high-quality, momentum, and low liquidity stocks. The maximum Sharpe portfolio (right) across the distribution shown on the left has a beta of 0.95 with an overweight in value and high-quality and an underweight in liquidity.



Maximum Sharpe Portfolio (Beta=0.95) Beta Contributed by Each Risk Factor As of End-December, 2024			
Factor	Factor Beta	Factor Weight	Beta Contribution
SP500	1.00	100.0%	1.00
Size	(0.04)	0.1%	(0.00)
Liquidity	0.69	(6.1%)	(0.04)
Momentum	0.35	7.0%	0.02
Style (Value-Growth)	(0.79)	2.1%	(0.02)
Quality (High-Junk)	(0.39)	4.7%	(0.02)

Source: Trivariate Research

LOW AND HIGH BETA OPTIMAL STOCK IDEAS

If you are looking to lower your portfolio beta efficiently, owning high-quality value stocks with relatively low liquidity makes sense (left). This list includes XOM, PM, LOW, and MDT, among others. If you want to take more risk, the optimal factor loadings would be to add to highly liquid growth stocks that are junk quality to optimize. This includes TSLA, APP, MU, and MRVL, among others (right). Overweighting the first group and underweighting the second, or vice-versa, would amplify the exposure.

Top 500 High Quality Value Stocks with Low Liquidity
As of January 27th, 2025

Ticker	Company	Market Cap. (\$Bn)	Beta
XOM	Exxon Mobil Corporation	484.21	0.20
PM	Philip Morris International	202.80	0.08
LOW	Lowe's Companies, Inc.	151.56	0.65
MDT	Medtronic plc	118.56	0.29
PLD	Prologis, Inc.	112.30	0.72
CB	Chubb Limited	111.45	0.24
SO	The Southern Company	94.78	(0.07)
MO	Altria Group, Inc.	90.59	(0.00)
DUK	Duke Energy Corporation	87.00	(0.01)
AFL	Aflac Incorporated	60.08	0.39
OTIS	Otis Worldwide Corp.	39.04	0.53
AVB	AvalonBay Communities	31.30	0.43
EQR	Equity Residential	26.61	0.47
MKL	Markel Group Inc.	23.57	0.63
CINF	Cincinnati Financial Corp.	22.02	0.60

Source: Trivariate Research

Top 500 Lower Quality Growth Stocks with High Liquidity
As of January 27th, 2025

Ticker	Company	Market Cap. (\$Bn)	Beta
TSLA	Tesla, Inc.	1274.88	2.58
APP	AppLovin Corporation	115.11	2.72
MU	Micron Technology, Inc.	101.51	2.31
MRVL	Marvell Technology, Inc.	86.82	2.85
VST	Vistra Corp.	46.64	2.33
VRT	Vertiv Holdings Co	38.51	2.86
LYV	Live Nation Entertainment	32.31	1.00
CVNA	Carvana Co.	31.12	1.60
GFS	GlobalFoundries Inc.	22.76	1.97
WDC	Western Digital Corp.	22.26	1.71
BURL	Burlington Stores, Inc.	17.94	1.06
SOFI	SoFi Technologies, Inc.	17.45	2.29

Source: Trivariate Research

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