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Fall 2011

Risk-Adjusted Momentum: A Superior Approach to Momentum Investing

Synopsis

This paper summarizes our methodology and findings on a risk-adjusted momentum strategy that dampens the volatility and reduces the risk of large drawdowns.

Momentum investing can suffer from long periods of negative returns with large drawdowns especially during market downturns (Hancock, 2010). In our research, we found that adjusting the momentum signal by a risk measure (i.e., penalizing recent winners based on their risk) helps to dampen the high volatility associated with momentum investing and reduces the risk of large drawdowns.

Momentum has been one of the most widely researched anomalies in empirical finance since the seminal paper by Jegadeesh and Titman (Jegadeesh and Titman, 1993). They discovered that buying winners and selling losers based on the past 6-12 months' returns provides systematic profit opportunities in the stock market. Momentum investing was discovered to be profitable in various asset classes and in every major market (Asness, Moskowitz, and Pedersen, 2007; Asness, 2011). Momentum is especially appealing from an asset allocation standpoint due to its negative correlation with the value anomaly (Berger, Israel, and Moskowitz, 2009).

There is no consensus on a risk-based explanation for momentum. However, several possible behavioral explanations for momentum exist such as slow diffusion of information through anchoring and adjustment. Another possible explanation for momentum is the *disposition effect* where investors sell their winning positions prematurely to lock in gains while hanging on to their losing positions with the hope of breaking even in the future (Grinblatt and Han, 2005).

Momentum Portfolio Construction

As benchmarks for our study, we used a widely accepted methodology for momentum indices.¹ We call them simple momentum indices to differentiate them from the risk-adjusted approach discussed below. To construct the large-cap momentum index, the top one-third of the stocks are chosen based on the past 12 months' total returns, excluding the last month, from the universe of largest 1000 US stocks by market capitalization (similar to Russell 1000 Index universe). Similarly, the top one-third of the stocks from a Russell 2000 Index-like universe are selected to construct the small-cap momentum index. The indices are market-cap weighted and rebalanced every three months.

For our study, risk-adjusted momentum indices were also constructed using a similar methodology. We used the past 12-month returns' volatility, i.e., standard deviation of past 12 months' returns, as the risk factor.² To construct risk-adjusted momentum indices, we divided the simple momentum measure (i.e., past 12-months' total returns excluding the last month) by their 12-month volatility and then selected the top one-third of the large-cap and small-cap universe respectively.³ We also market cap weighted and rebalanced the indices quarterly for comparison.

Momentum investing was discovered to be profitable in various asset classes and in every major market.

Results and Discussion

Exhibit 1 compares the performance of risk-adjusted momentum with simple momentum for large-caps. Risk-adjusted momentum has slightly higher historical annual returns (13.8% vs. 13.6%) as the simple momentum strategy with one-tenth less volatility (17.0% vs. 18.6%). It has the highest Sharpe Ratio (0.55) compared to simple momentum (0.51), core (0.45), growth (0.36) and value (0.50) strategies. It also has the lowest drawdowns (-47.0%) compared to other large-cap strategies (simple momentum: -51.0%, core: -51.1%, growth: -61.9%, value: -55.6%). This outperformance is remarkably consistent in each of the three decades of this study. Risk-adjusted

momentum did underperform simple momentum (19.6% vs. 20.2%) during the Internet bubble era from 1991 through 2000, but still outperformed on a risk-adjusted basis (Sharpe Ratio 0.86 vs. 0.81).

Another interesting aspect of risk-adjusted momentum's performance is its consistency during market downturns (Exhibit 2). The risk-adjusted momentum strategy outperformed the simple momentum strategy in four of the six years when the Russell 1000 Index had negative returns. It even outperformed the Russell 1000 Value Index, which historically tends to do well in downturns, in three out of the six down years.

Exhibit 1: Performance of Large-Cap Risk-Adjusted Momentum					
	Large-Cap Risk-Adjusted Momentum	Large-Cap Simple Momentum	Russell 1000 Index	Russell 1000 Growth Index	Russell 1000 Value Index
January 1980 - April 2011					
Annual Return ^a	13.8%	13.6%	11.5%	10.5%	12.1%
Annualized Volatility ^b	17.0%	18.6%	15.7%	17.9%	15.0%
Sharpe Ratio ^c	0.55	0.51	0.45	0.36	0.50
Maximum Drawdown ^d	-47.0%	-51.0%	-51.1%	-61.9%	-55.6%
January 1980 - December 1990					
Annual Return ^a	18.4%	17.2%	14.7%	13.9%	15.3%
Annualized Volatility ^b	18.4%	19.7%	16.8%	18.7%	15.6%
Sharpe Ratio ^c	0.56	0.48	0.40	0.34	0.46
January 1991 - December 2000					
Annual Return ^a	19.6%	20.2%	17.7%	17.3%	17.3%
Annualized Volatility ^b	17.5%	19.5%	13.4%	16.4%	12.8%
Sharpe Ratio ^c	0.86	0.81	0.94	0.78	0.96
January 2001 - April 2011					
Annual Return ^a	3.9%	4.0%	2.7%	0.9%	4.0%
Annualized Volatility ^b	14.7%	16.1%	16.4%	18.1%	16.1%
Sharpe Ratio ^c	0.19	0.19	0.12	0.03	0.20
<p><i>a Normal geometric average returns</i> <i>b Annualized standard deviation of monthly returns</i> <i>c Using arithmetic returns and one month Treasury bill as the risk-free rate</i> <i>d Maximum drawdowns using monthly returns data</i> Source: Bridgeway Capital Management. Simple Momentum returns are from aqrindex.com.</p>					

Exhibit 2: Performance in Down Markets (Russell 1000 Index is Negative)					
Year	Large-Cap Risk-Adjusted Momentum	Large-Cap Simple Momentum	Russell 1000 Index	Russell 1000 Growth Index	Russell 1000 Value Index
1981	-12.4%	-18.3%	-5.1%	-11.3%	1.3%
1990	-1.3%	-2.7%	-4.2%	-0.3%	-8.1%
2000	-19.1%	-26.3%	-7.8%	-22.4%	7.0%
2001	-12.8%	-11.8%	-12.4%	-20.4%	-5.6%
2002	-11.6%	-10.4%	-21.7%	-27.9%	-15.5%
2008	-34.7%	-37.0%	-37.6%	-38.4%	-36.8%
Average	-15.3%	-17.8%	-14.8%	-20.1%	-9.6%

Source: Bridgeway Capital Management. Simple Momentum returns are from aqrindex.com.

In the small-cap space (Russell 2000 Index universe), risk-adjusted momentum consistently outperformed in each of the three decades both on an absolute and risk-adjusted basis (Exhibit 3). It outperformed simple

momentum by 280 bps (17.6% vs. 14.8%) with one-tenth less volatility (20.3% vs. 22.2%). Risk-adjusted momentum outperformed simple momentum in seven of nine small-cap downturns (Exhibit 4).

Exhibit 3: Performance of Small-Cap Risk-Adjusted Momentum					
	Small-Cap Risk-Adjusted Momentum	Small-Cap Simple Momentum	Russell 2000 Index	Russell 2000 Growth Index	Russell 2000 Value Index
January 1980 - April 2011					
Annual Return ^a	17.6%	14.8%	11.1%	8.6%	13.2%
Annualized Volatility ^b	20.3%	22.2%	19.9%	23.4%	17.5%
Sharpe Ratio ^c	0.65	0.51	0.38	0.26	0.51
Maximum Drawdown ^d	-54.9%	-53.1%	-52.9%	-62.6%	-55.5%
January 1980 - December 1990					
Annual Return ^a	19.7%	17.1%	10.9%	8.5%	13.2%
Annualized Volatility ^b	20.4%	22.2%	20.9%	23.9%	18.4%
Sharpe Ratio ^c	0.58	0.45	0.20	0.11	0.31
January 1991 - December 2000					
Annual Return ^a	24.5%	20.3%	15.5%	12.8%	17.6%
Annualized Volatility ^b	21.4%	23.8%	17.7%	23.3%	13.3%
Sharpe Ratio ^c	0.92	0.70	0.65	0.44	0.95
January 2001 - April 2011					
Annual Return ^a	9.0%	7.5%	7.2%	4.9%	9.0%
Annualized Volatility ^b	19.2%	20.6%	20.9%	23.0%	20.0%
Sharpe Ratio ^c	0.44	0.36	0.34	0.23	0.43

^a Normal geometric average returns
^b Annualized standard deviation of monthly returns
^c Using arithmetic returns and one month Treasury bill as the risk-free rate
^d Maximum drawdowns using monthly returns data
 Source: Bridgeway Capital Management. Simple Momentum returns are from aqrindex.com.

Exhibit 4: Performance in Down Markets (Russell 2000 Index is Negative)					
Year	Small-Cap Risk-Adjusted Momentum	Small-Cap Simple Momentum	Russell 2000 Index	Russell 2000 Growth Index	Russell 2000 Value Index
1984	5.1%	1.7%	-7.3%	-15.8%	2.3%
1987	-5.6%	-10.8%	-8.8%	-10.5%	-7.1%
1990	-12.5%	-13.9%	-19.5%	-17.4%	-21.8%
1994	0.1%	-1.3%	-1.8%	-2.4%	-1.5%
1998	5.6%	1.0%	-2.5%	1.2%	-6.5%
2000	4.2%	-12.2%	-3.0%	-22.4%	22.8%
2002	-4.7%	-12.1%	-20.5%	-30.3%	-11.4%
2007	-0.6%	0.0%	-1.6%	7.0%	-9.8%
2008	-36.9%	-33.8%	-33.8%	-38.5%	-28.9%
Average	-5.0%	-9.0%	-11.0%	-14.3%	-6.9%

Source: Bridgeway Capital Management. Simple Momentum returns are from aqrindex.com.

Another important comparison is how these strategies perform in volatile market conditions. We divided all the months into high volatility and low volatility regimes based on their daily return volatility for a given month. All the months with daily return volatility above the median were considered high volatility periods and all months below the median as low volatility periods.

Exhibit 5 compares the annual returns and risk for large-cap strategies.^{4,5} We used Russell 1000 Index daily return volatility to identify high volatility and low volatility regimes. As expected, risk-adjusted momentum significantly outperformed simple momentum (1.6% vs. 0.2%) in high volatility periods with one-tenth less volatility (20.7% vs. 22.6%). Risk-adjusted momentum underperforms simple momentum (24.5% vs. 25.5%) in low volatility periods but with less volatility (11.5% vs. 12.6%).

The performance of the risk-adjusted momentum strategy could be just an outcome of combining simple momentum with the well-known low volatility anomaly (Blitz, D., Van Vliet, P., 2007). The stocks with the lowest historical volatility have had higher risk-adjusted returns than high volatility stocks. To consider this possibility, we created a portfolio that allocates between a low volatility strategy and simple momentum. The low volatility strategy was created by picking one-third of lowest volatility stocks (calculated based on past 12 month returns) and holding them for 12 months.

Exhibit 5: Performance in Volatile Markets						
January 1980 - April 2011		Large-Cap Risk-Adjusted Momentum	Large-Cap Simple Momentum	Russell 1000 Index	Russell 1000 Growth Index	Russell 1000 Value Index
High Volatility Periods	Annual Return	1.6%	0.2%	0.5%	-1.2%	1.8%
	Annualized Volatility	20.7%	22.6%	19.5%	22.1%	18.6%
Low Volatility Periods	Annual Return	24.5%	25.5%	21.4%	21.4%	21.2%
	Annualized Volatility	11.5%	12.6%	10.0%	11.6%	9.5%

Source: Bridgeway Capital Management. Simple Momentum returns are from aqrindex.com.

Exhibit 6 reports the portfolio returns of combining the low volatility strategy with simple momentum. The combined portfolio is rebalanced quarterly. We only report large-cap returns for brevity; the results are similar for small cap returns. None of the combinations of low volatility with

simple momentum have the returns characteristics of risk-adjusted momentum. However, combining low volatility and simple momentum strategies and then levering up the portfolio can generate the return and risk characteristics similar to that of risk-adjusted momentum.

Exhibit 6: Portfolio Allocation Between Low Volatility and Simple Momentum				
% Allocation		January 1980 - April 2011		
Large-Cap Low Volatility	Large-Cap Simple Momentum	Annual Returns	Annualized Volatility	Sharpe Ratio
0%	100%	13.5%	18.6%	0.51
20%	80%	13.5%	17.0%	0.53
40%	60%	13.3%	15.6%	0.56
60%	40%	13.1%	14.4%	0.57
80%	20%	12.8%	13.6%	0.58
100%	0%	12.5%	13.1%	0.58

Source: Bridgeway Capital Management. Simple Momentum returns are from aqrindex.com.

Conclusion

Simple momentum is a very powerful investment style well supported by empirical evidence across various asset classes and in every major security market. However, it does suffer from high volatility and large drawdowns, especially during market downturns. Combining simple momentum with a risk factor, such as the past 12-months' stock volatility, dampens this downside risk and significantly enhances the return and risk characteristics of the portfolio.

Notes

- ¹ Refer to aqrindex.com for construction methodology and returns data.
- ² Excluding the latest month to calculate 12-month returns volatility gives similar results.
- ³ Bridgeway uses proprietary definitions of momentum and risk in our momentum strategy, which are different from the ones described in this paper.
- ⁴ The results are similar for small-caps which have been omitted for brevity.
- ⁵ For comparison annualized arithmetic returns are converted into geometric returns using the approximate relationship: $\text{Geometric Returns} = \text{Arithmetic Returns} - (\text{Standard Deviation})^2/2$

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